Unified Regulations for Bachelor Programs with Credit Hours System (Part I)

Faculty of Engineering – Mansoura University

2020

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بسم الله الرحمن الرحيم

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It was approved by Ministerial Resolution No. (3967) dated 27/9/2020

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Chapter One:

Regulations

It was approved in the unified regulations for bachelor's programs with credit hour system in (2020) by Ministerial Resolution No. (3967) dated 27/9/2020

First: Introduction

Due to the great scientific development and the collaboration among many majors within one faculty or across many faculties in the university, the university's strategy has headed towards introducing many new programs based on a combination of different majors that adhere to technological changes, scientific development and meet labor market needs. Besides, these programs were designed based on the credit hour system in order to be compatible with National Authority of Quality Assurance and Education Accreditation Standards, the governing standards for an educational product in line with international educational standards, the Academic Standards *NARS2018* and the Engineering Sector Reference Framework 2020 which provides flexibility for learners, and facilitates adopting study plans that correspond to the above mentioned changing attributes.

Second: General Rules

Article [1]: Granting Academic Degrees

Based on Faculty of Engineering Council request, Mansoura University grants a bachelor's degree in one of the following majors:

1. Biomedical Engineering
2. Communication and Computer Engineering
3. Mechatronics Engineering
4. Building and Construction Engineering
5. Chemical and Environmental Engineering
6. Renewable and Sustainable energy Engineering
7. Infrastructure and Environmental Engineering
8. Sustainable Architecture Engineering
9. Sustainable Water Engineering
10. Structural Engineering Program
11. Materials Engineering for Advanced Technology
12. Artificial Intelligent Engineering

Students are stipulated to complete the academic requirements necessary for one of these programs to obtain a B.Sc. degree in the required major. Study in these programs should take place in English within each specialization scope based on the credit hour system. Further, students should be aware of the requirements and regulations of each program and should be responsible for achieving them.

Article [2]: The Program Study System

The study system used in these programs is the American system of credit hours within the context of one semester.

Article [3]: The Credit Hour Standard According to the Reference Framework 2020

1. With regard to theoretical lectures:

One credit hour is calculated for everyone hour per week lecture during one semester.

2. For practical lessons and practical exercises:

One credit hour is calculated for each 2-3-hour workshop or exercises per semester.

Article [4]: The Academic Council

The Program Management Academic Council shall be formed by a decision from the University President based upon the Faculty Council nomination for two-year-period headed by Faculty Dean and the membership of:

1. Vice Dean of Education and Student Affairs.
2. Heads of Scientific Departments concerned with the program.
3. Program Executive Director.
4. Professor or assistant professor from the specialized scientific departments nominated by the Dean after taking the opinion of the Head of the department and it is permissible in special cases to include two lecturers at most to the membership of the council.
5. Two experienced members either internal or external.

The academic council of the program will perform all the duties of the faculty scientific departments with respect to education and students' affairs. Further, the academic council shall observe the following criteria with regard to assigning teaching duties to staff members:

1. Scientific departments nominations based on their specialty.
2. Students' surveys on the previous times the course was taught.
3. The program management opinion according to performance evaluation and follow-up.

Article [5]: The Program Executive Director

For each program, an executive director shall be appointed by the University President, after a nomination by the Faculty Dean provided that he is one of the faculty members specialized in the field(s) of the program with associate / full professorship degree, for a minimum of two calendar years, renewable under the same conditions of the first appointment.

The executive director of the program shall perform the following tasks:

1. Implementing the program's internal regulation.
2. Coordination between the scientific departments in assigning teaching duties to faculty members.
3. Supervising students' academic registration.
4. Supervising the administrative work by the program staff.
5. Supervising the regularity of academic counseling in the program.
6. Following up the educational process regularity in accordance with the approved study schedules.
7. Supervising and regulating end-of-term and mid-term exams (if any).
8. Supervising field training and forming partnerships with distinguished training authorities.
9. Carrying out the secretariat of the council in the subcommittee of the academic council.
10. Organizing and supervising the program scientific conference.
11. Preparing the forms related to the financial duties in the program and submitting them to the higher management of the college.
12. Overseeing the development of the program's infrastructure, including runways, lecture halls, exercise halls, school laboratories and equipment.
13. Supervising the fulfillment of all quality assurance requirements in accordance with the standards of the National Authority for Accreditation and Quality Assurance of Education.
14. Preparing the annual self-study for the program to be presented to the Project Management Unit in the Ministry of Higher Education and Scientific Research.

Article [6]: Programs Coordinator for Digital Transformation

A programs coordinator for digital transformation is appointed by the Dean of the faculty after a nomination by the Faculty Vice Dean of student affairs (if three or more programs are available in the faculty) from the (associate) professors at the faculty having experience working with the credit hours' system and the programs for a period of two years' renewable with the same conditions of the first appointment.

The programs coordinator for digital transformation duties are:

1. Reviewing and auditing student registrations for all programs after approval of the relevant councils.
2. Reviewing the control works and fulfilling the final control stages after approval of the relevant councils.
3. Supervising the financial page follow-up for program students.
4. Reviewing the quality assurance work in the programs.

Article [7]: Registration Requirements and Entry Requirements

The student's registration for the bachelor's degree in these programs is required in addition to the general conditions stipulated in the executive regulations (Article 75) of the Universities Organizing Law as follows:

1. The student meets the admission requirements determined by the Supreme Council of Universities.
2. The student must have a high school completion certificate or its equivalent where major is in Mathematics.
3. The student fulfills the internal rules approved by the Faculty Board regarding the admission of students to these programs.

Article [8]: Transfer Conditions (change of course) and Re-enrollment

If the transfer is within the faculty, the transfer can occur before the start of the main semesters via approved rules by the faculty council and applied by the faculty representative for education and students affairs; while if the transfer is from another faculty within the university or from another university, the transfer is only through the central remittance office. At the beginning of the academic year, a student budget is made according to Table (1).

Table (1): The Symbol and Grade Corresponding to Assessment Obtained Degree by the Student when Converting from the Semester System to the Credit Hour System.

The percentage obtained by the student	Number of points	Estimate
Less than 50% (Failed)	00.0	F
40% to less than 50% (successful by clemency rules)	1.00	D
50% to less than 55%	1.00	D
55% to less than 60%	1.30	D+
60% to less than 65%	1.70	C-
65% to less than 68%	2.00	C
68% to less than 71%	2.30	C-
71% to less than 75%	2.70	B+

75% to less than 80%	3.00	B
80% to less than 85%	3.30	B+
85% to less than 90%	3.70	A-
90% to less than 95%	4.00	A
95% to 100%	4.00	A+

1. Transferring students who wish to enroll in one of the accredited programs specializations must have completed level (000) courses with an average grade of no less than 2,00 (maximum grade 4,00), and according to the rules determined by the faculty council and approved by the university council, based on the available capacity of the program.
2. Students who are transferred from the regular stream may be admitted to the same faculty, according to conditions determined by the Faculty Council and approved by the University Council based on the program's available capacity.
3. Students who have already spent two years in five years studying colleges outside of Faculty of Engineering, Mansoura University, and wish to join the program should submit a case statement from the faculty in which they were enrolled stating the degrees they have obtained and whether they have obtained credit hours or not.
4. It is permissible to accept international students who have obtained a high school diploma or its equivalent in every academic year according to the order of their degrees according to the nominations received by the Faculty from the General Administration of International Students. Then, the faculty council undertakes a proposal in exchange for the cost of educational services other than the university fees prescribed for these students.
5. Students, who have previously left studying in the program for a period of up to four semesters at a maximum and who have already received high estimates in the period they spent, may re-register for the program if they wish to do so, after the approval of the relevant academic council and in accordance with the rules for regular study [11].

Article [9]: Obtaining the Degree Requirements

In order for the student to obtain a bachelor's degree in the aforementioned programs, Article [1]:

1. The student must successfully pass at least (160 credit hours) in all programs, and 163 credit hours in the BCE program, and 162 credit hours in the MET program.
2. The student must pass the graduation project.

3. The student must pass courses where the evaluation is Pass / Fail and does not count towards the student GPA such as summer training.
4. The distribution of subjects that are included in the study program for graduation requirements should be as follows:

Table (2) Distribution of the program hours to graduation requirements

Specialized Groups	Min %	Max%
University Requirements	8%	-
Faculty Requirements	20%	-
General Major Requirements	35%	-
Accurate Specialization Requirements	-	28%

Taking into account that the academic plans for each program achieve the courses and the indicative proportions set by the National Authority for Quality Assurance of Education, which includes the following curricula:

1. Social and Human Sciences
2. Business Administration
3. Mathematics and Basic Sciences
4. Engineering culture
5. Basic Engineering Sciences
6. Engineering and design applications
7. Project and field training

Article [10] Participating Scientific Departments

The academic council supervises, for each program, teaching of all the courses of the subprograms that follow it, including humanities, Arabic language and technical reports. The scientific departments assign teaching duties of the various courses after being approved by the faculty council. Teaching should be conducted through the following scientific departments, each in the scope of its major:

1. Electronics and Communications Engineering Department.
2. Computer Engineering and Control Systems Department.
3. Production Engineering and Mechanical Design Department.
4. Electrical Engineering Department.
5. power mechanical engineering Department.
6. Mathematics and Engineering Physics Department.
7. Structural Engineering Department - Public Works Department - Irrigation and Hydraulics Department.
8. Architecture Department.

9. External departments in the field of anatomy, physiology and public health from the Faculty of Medicine.
10. External departments in the field of organic chemistry, biochemistry, Microbiology and Pharmaceutical procedures from Faculty of Pharmacy.
11. External departments in the field of languages - Faculty of Education or Faculty of Arts – English Major.
12. External departments of the Faculty of Commerce in the field of management and marketing.
13. External departments of the Faculty of Law in the field of legislation and administration laws.

The academic council of the program administration approves the faculty members nominated by the concerned departments, and these nominations are presented to the faculty council for approval such that the language of study for all courses is English.

Article [11]: Study Duration and its Dates

The duration of the study in the program is ten main semesters for all students, and the outstanding student may be allowed to graduate and obtain a Bachelor of Engineering degree by credit hour system in a period of 4 academic years or (eight major semesters) when he successfully completes all graduation requirements, including the minimum number of credit hours prescribed for the program. The academic year is divided into two main semesters, each ending with an exam, according to the content stated in the curriculum schedules appended to this regulation.

The academic year is divided into three semesters:

1. The first semester: Autumn semester (main semester): It starts at the beginning of the university academic year for a period of 14 teaching weeks.
2. The second semester: Spring semester (main semester): It starts after the mid-year vacation of the university for a period of 14 teaching weeks.
3. Summer semester: It starts in July for a period of 7 teaching weeks doubling the course contact hours.

Enrolment and Registration take place before the start of each semester.

Article [12]: Study Regulations

All students enrolled in the program must adhere to the following university rules:

1. Tuition Fees

Registration fees and educational services are paid at the start of registration, and the faculty council determines the fees required for registration and educational services after they have been approved by the university council.

2. Payment Rules

The student is not allowed to register at the next level or know his result unless all tuition fees are paid to the lower level. Upon graduation, the student does not receive his papers and certificates indicating that the degree was awarded unless all the late tuition fees have been paid in full.

3. Attendance

The course professor records the attendance of students at the start of each theoretical lecture, or an exercise / practical workshop in a record prepared for that by the Student Affairs of the program, taking into account the following:

A. The absence limit allowed for the students without an acceptable excuse is 25% of the total hours of the tutorials and labs of the course, and the course professor shall notify the Student Affairs Department to warn the student twice, the first warning is after the student exceeds the absence rate of 10% of the course hours, and the second warning is after exceeding the absence rate of 20%. Then, the student’s case is presented to the academic council to take measures needed to prevent him from entering the course exam.

B. If the student’s absence rate exceeds 25% and the student’s absence without an approved excuse is accredited from the academic council of the program, the student will score a deprived grade in the course and the result of a “deprived” grade will be included in the calculation of the student’s semester grade and the overall GPA.

4. Partial Discontinuation Condition

Students must notify the academic advisor assigned to them by the academic council when they have stopped their studies for more than a week, and if the discontinuation is a result of illness, a “being sick declaration” must be submitted from an accredited governmental hospital or medical center that is approved by the university's medical administration within the specified times. If the student does not take the exam as a result of the illness, a “being sick declaration” must be introduced within the stipulated timings. In addition, a “being sick declaration” approved by the medical administration of the university must be introduced by whom the student's affairs will be notified of the expected absence period for the student.

5. **Enrollment Stoppage**

In case that the student stops his enrollment in one of the new programs, the student shall pay the related administrative fees.

6. **Address Change**

The student must notify the faculty administration of any change in his postal address.

7. **Demurrage**

If the student is late in paying the fees, the decisions approved by the College Board and the University Council in this regard will be applied.

Article [13]: Academic Registration and Academic Load

1. **Registration**

The academic council of the program announces the dates of registration in the academic curricula through the approved academic agenda. Students should review their choices with the academic advisors assigned to them according to the instructions written in the program's guide announced on the program's website on the official university website. Registration will not be allowed after the specified date, and if the defaulters are allowed to register, this will be accompanied by a delay fine after being submitted to the academic council.

2. **Advertising**

Information on registration steps is announced in advance of each semester (Academic Agenda).

3. **Academic Load Per Semester**

The minimum and maximum number of credit hours a student is allowed to register in one semester is determined as follows:

Table (3): The Maximum Registration

No	Student's GPA	Maximum Registration
1	**GPA<2**	Up to 14 Credit hours
2	**2≤GPA<3**	Up to 18 Credit hours
3	**3≤GPA**	Up to 21 Credit hours

A. The minimum number of hours a student is allowed to register in **Fall** and **Spring** semesters is 12 credit hours, except for graduation or stumbling cases (under academic observation) based on the approval of the Academic Council.

B. Students may register some courses in the summer semester with a maximum of two courses and up to 3 courses in case of graduating in the summer semester. In all cases, graduation projects may not be registered during the summer semester.

Article [14]: The Academic Adviser

The academic council of the program appoints an academic advisor from the teaching staff, at the rate of an academic advisor per 25 students, to guide students in their study trajectory and help them choose the academic courses. Further, he or she determines the number of credit hours they can register according to their circumstances, abilities and academic readiness, and help them solve encountered problems during the study. Besides, he or she supervises the students' study programs, monitoring their progress and monitoring their performance as part of the educational process.

1. The academic advisor meets with his/her students periodically to avoid students being exposed to academic warning.
2. No administrative procedures are taken for any student except through the academic advisor and with his written approval.
3. Each academic advisor determines a time period in his study schedule every week, and a report of this meeting is prepared and submitted to the program management.
4. Students must obtain the approval of the academic advisor assigned to them in choosing a study trajectory before registering for courses in each semester and in the summer semester.

Article [15]: Addition, Deletion and Retraction

1. After registration, the student may add or delete one of the courses in ways and steps that are approved by the academic council of the program.
2. The student may, after the approval of the academic advisor, unregister one or more courses until the end of the fourth week of study only, without violating the academic load stipulated in Article [13].
3. After the approval of the academic advisor, the student may withdraw from studying any course until the end of the tenth week of the start of registration for the autumn or spring semester (third week of the summer semester). This course is recorded in the student’s academic record with a grade of W “withdrawn”, provided that the student has not exceeded the percentage of absence prescribed before withdrawal, provided that the withdrawal does not violate the academic load stipulated in Article [13].
4. Re-registration

   The student is allowed to re-register in the study course in which he previously obtained an estimate of **F**, and he is allowed to attend the course and repeat the exam in accordance with the financial regulations that specify that, where the maximum allowed estimate is **B +**.

5. Elective Courses

   In case that the student registers an elective course and fails and registers the same course again, the student gets the maximum grade of B +, while in the case of changing the elective course, the student gets the newly obtained degree.

Article [16]: Projects

1. Students prepare 2-3 projects in specific topics related to local industries and service to the surrounding community, to be determined by the Academic Council and during the last two academic years according to what is found in the special tables of the program curricula, and under the supervision of faculty members who to prepare, supervise and discuss projects.
2. The last project, called the Graduation Project, is prepared in the last semester, culminating in what the student has studied during the university years.
3. It is permissible that the Academic Council decide to allocate an additional period for the graduation project that begins after the completion of the last semester exam for a period of one month, and at the end of the period allocated to any of the projects the student submits a scientific report on the subject of the project and discusses it.
4. The student cannot obtain a bachelor's degree unless he successfully performs all the prescribed projects.

Article [17]: Practical and Field Training

The program includes a training system during the summer vacation for students transferred to levels 200, 300 and 400 and under the supervision of faculty members, as follows:

1. **Practical Training**: students transferred to level 200 will perform a practical training within the faculty or in specialized training centers and units within the faculty for a period of two weeks with a total number of hours of not less than 60 hours. The student should get a practical training completion certificate.
2. **Field Training**: students transferred to level 300 and those to level 400 perform field training within specialized sectors outside the faculty for a period of four weeks with a total number of hours of at least 120 hours. The

student must obtain a certificate from the training authority stating his attendance and obtained the required experience.

3. The faculty is responsible for obtaining training opportunities for students, and students may get training opportunities for themselves, but after faculty council approval is obtained.
4. It is permissible to train students abroad based upon the program academic council approval. The student does not obtain a bachelor's degree unless he has successfully completed both practical and field training.
5. In all training cases, the student is given a Pass/Fail estimate only and his grade is not added to the total grade, but a Pass grade is required to obtain the course degree. The student who reaches level 400 without successfully completing his training can repeat the training any number of times until he passes the training.

The college should provide training opportunities for students in each major through cooperation protocols with companies or through its industrial advisory board.

Article [18]: Optional Courses

The student is not allowed to register at any of the elective courses unless he is at the planned level and to achieve all the requirements of the pre-requisites, and in all cases the academic advisor must review the registration of the students and remove any wrong registration.

Article [19]: Courses Registration Synchronization

Fourth level students and students subject to dismissal can register a course in conjunction with the previous prerequisite for the course after obtaining the approval of the program academic council if the following conditions are met:

1. The student has previously studied this prerequisite and received an **F** grade.
2. This registration does not violate the registration rules according to the GPA.

Article [20]: The Evaluation System

1. Each course is evaluated from (100) one hundred marks.
2. The student is evaluated in theoretical and practical courses based upon the following elements:
   A. In the case of decisions that include only a theoretical study, the evaluation is as follows:

Table (4) Distribution of degrees for courses that include theoretical study only

Evaluation		Degree
Semester works	Mid-term exam	20%
	Short exams	30%
	Assignments (report)	
	Presentation and discussions	
Semester Exam (Written)		50%

B. In the case of study courses that include a theoretical and practical study, the evaluation is as follows:

Table (5) Distribution **of degrees for courses that include theoretical and practical study**

Evaluation		Degree
Semester works	Mid-term exam	20%
	Short exams	20%
	Assignments (report)	
	Presentation and discussions	
Practical Exam		10%
Semester Exam (Written)		50%

C. In the case of the Project Course, 50% of the degree is allocated to periodic follow-up, 50% for oral discussion.

D. For a student to succeed in any course, he or she must obtain at least 60% of the total score and must have obtained at least 40% of the final written examination score.

Article [21]: Degrees and Grades Digital and Symbolic Significance

A. The degrees obtained by the student in each course are estimated as shown in the following table:

Table (6) Table of numerical and symbolic implications of degrees and grades

The Student's Obtained %	Equivalent Degrees Range					Points No	Grade
From 97% or more	97	98	99	100	--	4,00	A+
93% to less than 97%	93	94	95	96	-	4.00	A
89% to less than 93%	89	90	91	92	-	3.70	A-
84% to less than 89%	84	85	86	87	88	3.30	B+
80% to less than 84%	80	81	82	83	-	3.00	B
76% to less than 80%	76	77	78	79	-	2.70	B-
73% to less than 76%	73	74	75	-	-	2.30	C+
70% to less than 73%	70	71	72	-	-	2.0	C
67% to less than 70%	67	68	69	-	-	1.7	C-
64% to less than 67%	64	65	66	-	-	1.3	D+
60% to less than 64%	60	61	62	63	-	1.0	D
Less than 60%						0.0	F

B. The course grade is calculated by multiplying the number of credit hours for the course by the number of assessment points (according to Table 6) that the student obtained in this course.

C. The following grades do not fall within the calculation of the average estimate, Table No. (7).

Table (7): Grades Completion

W	Formal Drop out
AU	listener
I	Incomplete
F	Unsuccessful
P	successful

a. Semester GPA:

For each course, the total score of the course is equal to the multiplication of both the number of credit hours of the course and the number of course points.

The semester average = the total points for the courses in which the student scored in the semester divided by the number of credit hours for these courses.

$$Semester\ GPA = \frac{Number of Points}{Number of Graded\ Hours} = \frac{\sum_{i=1}^{N} \quad Grade_i \times Hours_i}{\sum_{i=1}^{N} \quad Hours_i}$$

b. Cumulative GPA

The GPA is calculated as follows:

GPA = the sum of the points for the courses divided by the total number of hours for the courses

$$Comulative\ GPA = \frac{Number\ of\ Points}{Number\ of\ Graded\ Hours} = \frac{\sum_{i=1}^{N} \quad Grade_i \times Hours_i}{\sum_{i=1}^{N} \quad Hours_i}$$

c. Total Cumulative Calculation

The total cumulative is calculated as follows for the number of N courses:

For each course the total equivalent of the course scores is calculated equal to the number of credit hours for the course multiplied by the course score.

Cumulative total percentage is equal to the equivalent of the course grades divided by the total number of hours for the courses:

$$Cumulated\ Marks\ \% = \frac{Equivelent\ Accumulated\ Marks}{Number\ of\ Graded\ Hours}$$

$$= \frac{\sum_{i=1}^{N} \quad Mark_i \times Hours_i}{\sum_{i=1}^{N} \quad Hours_i} \times 100$$

d. <u>Requirements Condition are met</u>

For enrollment in courses requiring other courses as pre-requisites, the student's grade in the pre-requisites should not be less than D.

Article [22]: Graduation Students Grades

The grades obtained by the student upon graduation are granted according to the following schedule:

Table (8) Estimates Granted upon Graduation from the Program with Credit Hours System

The student's obtained percentage	Equivalent Degrees Range	Estimate	Equivalent grade
97% or more	**4.00**	**A+**	
93% to less than 97%	**4.00**	**A**	Excellent
89% to less than 93%	**3.70**	**A^{-}**	
84% to less than 89%	**3.30**	**B^{+}**	
80% to less than 84%	**3.00**	**B**	Very good
76% to less than 80%	**2.70**	**B^{-}**	
73% to less than 76%	**2.30**	**C^{+}**	
70% to less than 73%	**2.0**	**C**	Good

Article [23]: Honors Grade

1. Mansoura University grants a certificate of excellence to students who have obtained an average rating of 3.6 or more in previous semesters, provided that they have not failed any course during the study, and this distinction is recorded in the student's academic record.
2. Upon graduation, the student is awarded the honor degree if he obtains an average grade of 3.3 or more in all major semesters without failing any course.

Article [24]: Grades Statement

Students who obtain a degree or who drop out from the program have the right to obtain a statement of grades for their academic record, and this statement cannot be obtained during the period of exams, registration, or the date of graduation, and grades data are not given when tuition fees are not paid.

Article [25]: Academic Warning, Transferring and Dismissals

1. The student is warned academically if he obtains a GPA of less than 2 at the end of the second semester of his enrollment in the study or any other semester after that.
2. The student who is academically warned is placed under academic supervision and is not allowed to register more than 12 credit hours, and the monitoring is stopped if the GPA improves and exceeds the GPA 2.
3. A student who is academically dismissed shall be dismissed from credit hour programs if his cumulative GPA falls below 2.00 for six consecutive main semesters.
4. If the student does not meet the requirements for graduation during the maximum period of study, which is ten years, he will be dismissed.
5. The Faculty Council may consider the possibility of granting a student, subject to dismissal due to his inability to raise his cumulative GPA to at least 2.00 at least, one and last chance of two main semesters to raise his cumulative GPA to 2.00 and fulfil graduation requirements, if he has at least successfully completed 80% of the credit hours required for graduation.
6. A student who registers for 17 or more credit hours is considered a regular student, and the student's position in the study is defined according to Table No. (9).

Table (9): The Student's Position Based upon the Number of Credit Hours Passed

Academic level	Defining the student's Place in the study system	The number of credit hours the student has successfully passed	
		<	>=
1	**Freshman**	**32**	**0**
2	**Sophomore**	**64**	**32**
3	**Junior**	**112**	**64**
4	**Senior**	**160**	**112**

Article [26]: Graduation and Obtaining the Degree

For the student to obtain a bachelor's degree:

1. The student must have completed at least 160 credit hours in all programs and 163 credit hours in the Building and Construction Engineering Program and 162 credit hours in Materials Engineering for Advanced Technology Program in studying the courses with a grade of no less than **D**.
2. His average grade should not be less than C or more in the cumulative average, and this means that he will obtain at least a cumulative average of 2.00 / 4.00.
3. The student fulfills all program requirements.
4. Immediately after these conditions are fulfilled, the student’s condition will be transferred to a graduate and he may not register any other courses under any of the above items.

Article [27]: Transferring Students -to and from- the Program System

After approval of the academic council for the program and the Mansoura University Council, it is permissible to transfer students to and from the program with the accredited engineering faculties provided that a clearing is made between the courses studied by the student and the courses that he must study and succeed in, and to complete the clearing process the degrees equivalent to the grades specified in the credit hour system are used as shown in Table (1). Table (10) is used to calculate grades when converting from the credit hour system to faculties that do not use the credit hour system.

Table (10): Equivalence of Estimates when Converting from the Credit Hour System to the Two-Semester System

<table>
<tr><th colspan="2">Credit Hour System</th><th colspan="2">The Semester System</th></tr>
<tr><th>Number of points</th><th>Estimate</th><th>Equivalent Estimate</th><th>Equivalent Percentage</th></tr>
<tr><td>4.00</td><td>A +</td><td rowspan="3">Excellent</td><td>99%</td></tr>
<tr><td>4.00</td><td>A</td><td>95%</td></tr>
<tr><td>3.70</td><td>A-</td><td>91%</td></tr>
<tr><td>3.30</td><td>B+</td><td rowspan="2">Very Good</td><td>86%</td></tr>
<tr><td>3.00</td><td>B</td><td>82%</td></tr>
<tr><td>2.70</td><td>B-</td><td rowspan="3">Good</td><td>78%</td></tr>
<tr><td>2.30</td><td>C+</td><td>75%</td></tr>
<tr><td>2.0</td><td>C</td><td>72%</td></tr>
<tr><td>1.7</td><td>C-</td><td rowspan="3">Passed</td><td>69%</td></tr>
<tr><td>1.3</td><td>D+</td><td>66%</td></tr>
<tr><td>1.0</td><td>D</td><td>62%</td></tr>
<tr><td>0.0</td><td>F</td><td>Failed</td><td>Less than 60%</td></tr>
</table>

Article [28]: Appointing Graduates of the Program as a Demonstrators (Teaching Assistants)

1. Teaching assistants from the graduates of the program are appointed via a decision from the University President upon the request of the Faculty Council in accordance with Article (**133**) of Law No. **49** of **1972** regarding the organization of universities and without violating the application of Articles **135** and **136** of the same law.
2. The Faculty Council distributes teaching assistants newly graduated from the programs to the faculty scientific departments corresponding to their majors and based upon the previously presented annual plan of scientific departments

Article [29]: The Listening System

It is permissible to accept listening students in any of the courses if there are vacant places provided that the listening student cannot perform the exam, or obtain credit hours for joining this course, or can he obtain an attendance statement for the course from the faculty. They may register late after completing the registration for regular students.

Article [30]: The Improvement System

1. The student is allowed to improve in (5) subjects to raise the GPA during the study period, provided that the student gets the last grade, and it is not permissible to drop out from the course after the end of the official period in which withdrawal is permitted without an academic impact (the fourth week of the main semesters). As the expiration of this period entails the removal of the first estimate.
2. If the student has completed his studies in the program and his GPA is less than 2, he may improve any of the previously studied subjects until he reaches the required minimum of the GPA.
3. The student may not improve a failed course.

Article [31]: Disciplinary Rules

Students who are enrolled in the program are subject to the disciplinary system outlined in the University Regulatory Law and its executive regulations.

Article [32]: Electronic Administration

The university designs or contracts with an information administration system for the program to automate the work of the program with a credit hour system. The following conditions are required in this program:

1. Course registration.
2. Adding and removing courses.
3. Academic Advising.
4. program administration work in achieving the rules governing the program.
5. Grades control work.
6. Study work and exams.
7. Financial benefits.
8. Student affairs work.
9. Statement of the situation.
10. Student performance reports.
11. Record the absence of students.
12. E-exams.
13. Communication with students

Taking into account the preservation of confidentiality of data and its recall, ease of use for the student, faculty member and administrative team, and the availability of technical support.

Article [33]: Incomplete Courses

If a student request not to attend the final exam where he shows compulsive reasons why not to attend, is accepted by the academic council of the program and the faculty council, within two days at most from the final examination date, the course is considered incomplete with an estimate (I) in this course provided that he has obtained at least 60% of the coursework degree or he has been deprived of entering the final exam, in which case he will have the opportunity to take the final exam in the next semester and at the date determined by the faculty council, which is usually in the first week of the next academic semester directly. The degree of the semester work obtained by the student during the semester is added to the final theoretical exam degree which is conducted by the student.

Article [34]: Appeals for the Results of the Courses

The student can appeal to review the grades of the course within a week of announcing the result, after paying the fees determined in accordance with the overall regulations associated with this matter.

Article [35]: Implementing the Provisions of the Law Regulating Universities

The provisions of these regulations apply from the academic year following the date of their issuance to new students admitted to the faculty at the level (000) of those programs, and these regulations do not apply retroactively to any student in the faculty.

Article [36]: General Rules

1. The rules of the Universities Regulatory Law, its executive regulations, the internal regulations of the college, and other university regulations are applied in the absence of a text in these regulations.
2. The student is subject to the general system of the university and the college, and the rules of dismissal from the university, opportunities for re-enrollment, acceptable excuses for not taking the exam, stopping the academic registration, and all the rules, laws and regulations regarding student discipline as stipulated in the Universities Organization Law and its implementing regulations are applied to him/her.
3. The faculty is permitted to add to the list of elective courses with the approval of the Faculty Board and without the need to return to the Engineering Sector Committee.
4. The Faculty Council agrees to change the scientific content of the course in a manner that does not conflict with the course name and objectives.

Third: Transitional Rules

Article [37]: Transitional Rules

1. The provisions of these regulations shall be applied to new preparatory year students and those covered by the decisions of the University Council that regulate the enrollment of students in the credit hour programs, starting from the academic year following the issuance of the ministerial decision related to this regulation, and then applied sequentially to the remaining academic years.
2. When the provisions of these regulations are applied to any academic year, work shall apply to the remaining students for repetition, re-enrollment and applicants for the examination from abroad, and the College Board shall adjust the status of these students in the light of this regulation and the previous one.

Chapter Two:

A B. Sc. Program in Biomedical Engineering (BME) with Credit Hours System

1. Introducing the Program

There are many medical and biological applications in general for the various engineering disciplines. This includes in the medical field diagnostic devices (radiology and molecular biology laboratories ...) and treatment (radiology, prosthetic devices and tools ...), as it extends to vital activities and applications in general such as industries pharmacokinetics, sterile rooms, blood laboratories, serums and vaccines.

It is clear that these fields are applications to the study in a number of engineering departments such as electronics, systems, energy, design and control departments. Often, we need complex systems in which a number of the engineering disciplines mentioned above overlap, in order to achieve a specific medical or biological goal. The engineer who deals with these systems, must have a variety of basic engineering experiences covering the aforementioned engineering disciplines, in addition to basic biological information, in order to be able to study the medical and biological applications of engineering.

The program aims to give the student appropriate background information in the various engineering disciplines mentioned in addition to basic medical information. The program also gives the student the ability to self-learn, to complete the information he may need in any discipline, in order to deal with a specific application problem or to follow the development in it. The combination of the program’s coverage of the fundamentals of multiple disciplines and enabling the student to self-learn represents one of the elements of excellence in this program. The most important element of the distinction lies in giving the student the ability to deal with complex systems based on multiple engineering disciplines at the same time and visualize the appropriate system that combines the elements of this complex system. This cannot be achieved within the framework of a biased program for medical and biological applications for only one of the engineering departments.

Last but not least, the program focuses on learning through case studies and multiple projects aimed at solving specific problems in life, not satisfied with one graduation project as is the case in a number of other engineering disciplines, which represents another component of excellence.

This program hopes to prepare such an engineer, within the framework of a modern program, which takes the credit hours system and depends on the development of capabilities in the various disciplines that serve this interdisciplinary to be taken out in parallel with developing the skills of establishing and maintaining integrated systems.

2. Basic Information

2.1 Program Vision:

"Reaching the level of innovation and leadership locally and regionally in the field of biomedical engineering and its applications".

2.2 Program Mission:

"Preparing distinguished engineering cadres and competent pioneers in the field of biomedical engineering, to be able to compete locally and regionally in practical applications and scientific research, and to serve as a role model for community and resource development".

2.3 Program Aims:

A. Achieving complementarity between medical and engineering education in the research and applied fields.

B. Providing community service represented in the maintenance of medical devices in all hospitals by graduates of the department.

C. Creating a generation of engineers with a good medical background to work in the field of maintenance and marketing of medical devices from all countries and models.

D. Preparing engineering cadres with a high degree of scientific and administrative ability to lead the team of maintenance of medical devices in specialized companies or agents of manufacturers of medical devices in Egypt.

E. Bridging the gaps that currently exist in the labor market as a result of having engineers who graduate from other engineering departments take over the maintenance of complex medical devices and are not sufficiently familiar with the medical foundations upon which these devices work.

F. Creating a link between the medical team used for each medical device and the technicians who are entrusted with its maintenance in many simple cases, due to the technician's lack of the language that enables them to address the doctors.

G. Working on developing engineering research for amending and improving the technological foundations upon which medical devices work and intensifying the use of computers in all medical fields to support the physician in performing his personal and therapeutic task.

3. Graduate Attributes

A graduate of the Biomedical Engineering Program must be able to:

A. Apply general and specialized knowledge and theories in the field of biomedical engineering.

B. Use critical thinking to solve problems that can or cannot be predicted in the context of biomedical engineering specialization taking into account all variables.

C. Master an expanded set of specialized skills in the field of Biomedical Engineering.

D. Carry out critical evaluation of the results of completed tasks and building technical expertise.

E. Identify occupational risks and ways to reduce them.

F. Apply cost-effectiveness measures.

G. Manage the usual and unusual contexts in the field of medical engineering.

H. Use digital and media tools to tackle professional and academic challenges in an innovative way.

I. Study and work independently under the general rules and regulations.

J. Make correct decisions in the context of medical engineering.

K. Take responsibility for himself and the team.

L. Carry out optimal exploitation and development of workplace resources.

M. Apply work ethics.

N. Apply quality assurance standards in all procedures related to medical engineering.

4. Competencies of a Graduate According to NARS 2018

According to NARS 2018, a graduate must be able to:

A1: Being able to define, configure and solve complex engineering problems

A2: Develop, analyze and evaluate results of experiments and simulations and use statistical analysis to extract results

A3: Applying engineering design processes to produce innovative solutions at low cost to meet the needs of society

A4: Optimal utilization of contemporary technology, health and safety requirements and principles of crisis management

A5: Implementing research techniques as an integral part of learning

A6: Planning, supervising and following up the implementation of engineering projects

A7: Work efficiently as a member of a multicultural and multicultural team

A8: Communicate effectively with listeners through contemporary means

A9: Use innovative and critical thinking and gain leadership skills to confront new situations

A10: Acquire and apply new knowledge and other learning strategies

In addition to the competencies of most engineering programs, the engineering BME program has some special competencies, which are as follows:

B1: Optimal design and analysis of electrical, electronic and digital systems for specific applications

B2: Measuring the performance of electrical, electronic and digital systems and evaluating their suitability for a specific application

B3: Adopting national and international standards and codes for designing, building, operating, inspecting and maintaining electronic equipment, systems and services

D1: Design, analyze and measure the performance of medical systems in various fields

D2: The ability to use and calibrate medical devices to audit the results necessary for diagnosis

D3: Using digital technology and computer diagnostics to help the doctor in the early diagnosis of diseases

5. The Bachelor of Science in Biomedical Engineering Program Plan Description

The study plan of the BME Program at the Faculty of Engineering, Mansoura University involves different requirements for the university, the faculty, and the department, as well as courses which satisfy these requirements. Also, the study plan includes the credit units for all courses and the distribution of these credit units on the Five studying levels (Years).

5.1 BME Program Plan Requirements

To prepare the student for the previously-targeted educational objectives, a set of program outcomes, that describes what students are expected to know and is able to do by the time of graduation, have been adopted. The student must successfully pass a number of courses totaling 160 credit hours in order to obtain a bachelor's degree in biomedical engineering from the Faculty of Engineering, Mansoura University.

The following figure shows courses coding system according to reference framework NARS 2018, where the course code is composed of three letters and three digits. The letters indicate the course specialization department. The first digit indicates the year 0, 1, 2, 3, or 4. The second digit between 1 and 9 displays the discipline in the major. The third digit is the course sequence in each discipline.

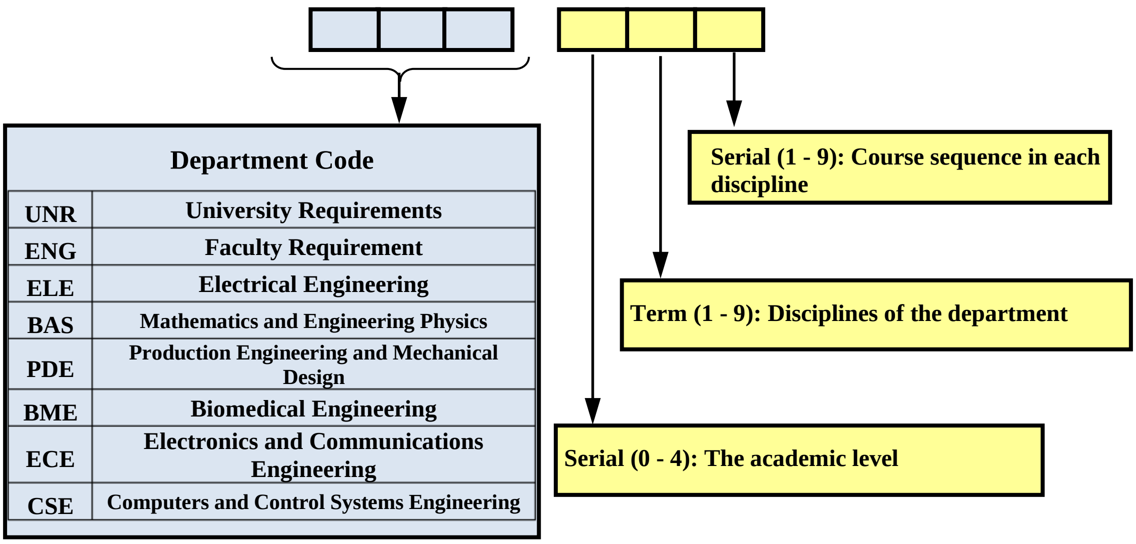


Figure (1): Courses coding system

5.2 BME Program Courses

Tables (1), illustrates the courses credit units for the university requirements. The following points must be considered:-

1. The letters indicate the majors in which the degree is given but some of these represent university requirements, college requirements, or specialized courses.
2. Course descriptions refer to the semester in which this course is usually given, but these dates are subject to change, as not all courses are taught every year,

and before the start of each semester, college affairs show the courses tables that will be taught in this semester, their teaching times and those in charge of teaching.

5.2.1 The University Requirements

Table (1): The Mandatory University Requirements (13 Credits)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	semester Works	Lab	Final Term
UNR061	English (1)	2	5	20	30	--	50
UNR062	English (2)	2	5	20	30	--	50
UNR171	History of Engineering and Technology	1	2	20	30	--	50
UNR281	Law and Human Rights	2	4	20	30	--	50
UNR241	Communication and Presentation Skills	2	5	20	30	--	50
UNR461	Ethics and Morals of The Profession	2	4	20	30	--	50
UNR471	Marketing	2	4	20	30	--	50
Total		13	29				

5.2.2 The Faculty Requirements

Table (2) indicates the college requirements which contain basic science courses and basic engineering science courses.

Table (2): The Faculty Requirements (45 Credit)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	semester Works	Lab	Final Term
BAS011	Mathematics (1)	3	8	20	30	--	50
BAS021	Mechanics (1)	3	8	20	30	--	50
BAS012	Mathematics (2)	3	8	20	30	--	50
BAS022	Mechanics (2)	3	8	20	30	--	50
BAS031	Physics (1)	3	9	20	20	10	50
BAS032	Physics (2)	3	9	20	20	10	50
BAS041	Engineering Chemistry	3	9	20	20	10	50
PDE051	Production Engineering	3	8	20	20	10	50
PDE052	Engineering Drawing	3	10	20	30	--	50
ENG111	Technical Reports Writing	2	6	20	30	--	50
BAS113	Mathematics (3)	3	8	20	30	--	50
BAS114	Mathematics (4)	3	8	20	30	--	50
BAS115	Statistics and Probability Theory	2	6	20	30	--	50
ELE151	Electrical Power and Machines	3	8	20	30	--	50

BAS215	Mathematics (5)	3	8	20	30	--	50
ENG412	Project Management	2	6	20	30	--	50
Total		45	127				

5.2.3 The Program Requirements (Core courses)

Table (3) shows the courses distribution according to the specializations in BME

Table (3): BME Requirements (79 credits + 12 credits elective courses)

Code	Course Name	Credit	Mandatory (M)	SWL	Marks Distribution			
					Mid-term	Lab.	Semester work	Final
CSE042	Introduction to Computer Systems	3	M	9	20	10	20	50
PDE161	Strength of Materials	3	M	8	20	0	30	50
ELE163	Electrical Circuits	3	M	8	20	0	30	50
ECE173	Electronics (1)	3	M	8	20	0	30	50
CSE143	Digital Design	3	M	9	20	10	20	50
CSE144	Algorithms and Data Structure	3	M	9	20	10	20	50
BME128	Organic Chemistry	3	M	9	20	10	20	50
CSE221	Automatic Control	3	M	8	20	0	30	50
CSE222	Sensors and Actuators	2	M	6	20	10	20	50
ECE262	Measurements and Instrumentation	3	M	9	20	10	20	50
ECE273	Electronics (2)	3	M	9	20	10	20	50
ECE284	Electromagnetic Fields	3	M	8	20	0	30	50
ECE295	Signal Analysis	3	M	8	20	0	30	50
BME228	Biochemistry	3	M	9	20	10	20	50
BME238	Introduction to Anatomy	3	M	9	20	10	20	50
BME239	Introduction to Physiology	3	M	9	20	10	20	50
CSE323	Embedded Systems	2	M	6	20	10	20	50
ECE395	Digital Signal Processing	3	M	8	20	0	30	50
ECE396	Digital Image Processing	3	M	9	20	10	20	50
BME339	Microbiology	3	M	9	20	10	20	50
BME345	Biomedical Instrumentations	3	M	8	20	10	20	50
BME358	Biomaterial Properties	3	M	9	20	10	20	50
BME346	Bioinformatics	3	M	8	20	0	30	50
CSE444	Database Systems	3	M	9	20	10	20	50
BME445	Biomedical Imaging	3	M	9	20	10	20	50
BME447	Medical Devices (1)	3	M	8	20	10	20	50
BME448	Medical Devices (2)	3	M	8	20	10	20	50

Table (3) Continued: List of Elective Courses

Code	Course Name	Credit	Elective (E)	SWL	Mark Distribution			
					Mid-term	Lab.	Semester work	Final
CSE362	Medical Decision Support Systems	3	E	9	20	0	30	50
CSE363	Healthcare Information Systems	3	E	9	20	0	30	50
CSE364	Internet of Medical Things (IoMT)	3	E	9	20	0	30	50
BME365	Public Health	3	E	9	20	0	30	50
ECE366	Opto-electronics	3	E	9	20	0	30	50
ECE367	Pattern Recognition	3	E	9	20	0	30	50
ECE421	Introduction to Deep Learning	3	E	9	20	0	30	50
ECE422	Introduction to Nanotechnology	3	E	9	20	0	30	50
BME431	**Medical and Pharmaceutical Procedures**	3	E	9	20	0	30	50
BME432	Fluid Flow in Bio-systems	3	E	9	20	0	30	50
BME433	Clinical Pathology	3	E	9	20	0	30	50
BME434	Industrial Pharmacy	3	E	9	20	0	30	50

Table (4) Projects and Training (11 credit hours)

Code	Course Name	Credit	Mandatory (M)	SWL	Mark Distribution			
					Mid-term	Lab.	Semester work	Final
BME191	Practical Training on BME	--	M*	3	--	--	--	--
BME291	Training (1) on BME	--	M*	3	--	--	--	--
BME391	Training (2) on BME	--	M*	3	--	--	--	--
BME392	Clinical Engineering	2	M	6	20	10	20	50
BME393	Project 1 on BME	3	M	10	--	--	50	50
BME494	Project 2 on BME	3	M	14	--	--	50	50
BME495	Project 3 on BME	3	M	14	--	--	50	50

(*) Graduation requirement

6. BME Program Curriculum

The curriculum presents the credit units, weekly contact hours either for lectures, tutorial and practical work for all courses. The curriculum also presents SWL and Marks distribution in addition to the projects and training according to **NARS 2018**. Figure (2) shows the program tree. Moreover, the matrix that relates courses to competencies is shown.

Level 000

First Semester

Course Code	Course Title	Hours/Week						Marks Distribution					Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BAS011	Mathematics (1)	3	2	2	--	4	8	20	30	--	50	100	----
BAS021	Mechanics (1)	3	2	2	--	4	8	20	30	--	50	100	----
BAS031	Physics (1)	3	2	1	1.5	4.5	9	20	20	10	50	100	----
BAS041	Engineering Chemistry	3	2	1	1.5	4.5	9	20	20	10	50	100	----
PDE052	Engineering Drawing	3	2	2	--	6	10	20	30	--	50	100	----
UNR061	English (1)	2	1	2	--	2	5	20	30	--	50	100	----
Total		17	11	10	3	25	49					600	
Total Contact hours = 24 hrs/week Total SWL = 49 hrs/week													

Second Semester

Course Code	Course Title	Hours/Week						Marks Distribution					Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BAS012	Mathematics (2)	3	2	2	--	4	8	20	30	--	50	100	BAS011
BAS022	Mechanics (2)	3	2	2	--	4	8	20	30	--	50	100	BAS021
BAS032	Physics (2)	3	2	1	1.5	4.5	9	20	20	10	50	100	----
CSE042	Introduction to Computer Systems	3	2	1	1.5	4.5	9	20	20	10	50	100	----
PDE051	Production Engineering	3	2	--	3	3	8	20	20	10	50	100	----
UNR062	English (2)	2	1	2	--	2	5	20	30	--	50	100	UNR061
Total		17	11	8	6	22	47					600	
Total Contact hours = 25 hrs/week Total SWL = 47 hrs/week													

Level 100

Third Semester

Course Code	Course Title	Hours/Week					Marks Distribution						Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BAS113	Mathematics (3)	3	2	2	--	4	8	20	30	--	50	100	BAS012
BAS115	Statistics & Probability Theory	2	1	2	--	3	6	20	30	--	50	100	BAS012
CSE143	Digital Design	3	2	1	1.5	4.5	9	20	20	10	50	100	CSE042
PDE161	Strength of Materials	3	2	2	--	4	8	20	30	--	50	100	BAS021 & BAS031
ELE163	Electrical Circuits	3	2	2	--	4	8	20	30	--	50	100	BAS032
ENG111	Technical Reports Writing	2	1	2	--	3	6	20	30	--	50	100	UNR061
Total		16	10	11	1.5	22.5	45					600	
Total Contact hours = 22.5 hrs/week Total SWL = 45 hrs/week													

Fourth Semester

Course Code	Course Title	Hours/Week					Marks Distribution						Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BAS114	Mathematics (4)	3	2	2	---	4	8	20	30	--	50	100	BAS113
ECE173	Electronics (1)	3	2	2	---	4	8	20	30	--	50	100	ELE163
BME128	Organic Chemistry	3	2	1	1.5	4.5	9	20	20	10	50	100	------
CSE144	Algorithms and Data Structures	3	2	1	1.5	4.5	9	20	20	10	50	100	CSE042
ELE151	Power and Electrical Machines	3	2	2	---	4	8	20	30	--	50	100	ELE163
UNR171	History of Engineering and Technology	1	1	-	-	1	2	20	30	--	50	100	------
BME191	Practical Training	0	0	0	0	3	3	0	0	0	0	0	------
Total		16	11	8	3	25	47					600	
Total Contact hours = 22 hrs/week Total SWL = 47 hrs/week													

Level 200

Fifth Semester

Course Code	Course Title	Hours/Week						Marks Distribution					Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BAS215	Mathematics (5)	3	2	2	--	4	8	20	30	--	50	100	BAS012
ECE284	Electromagnetic Fields	3	2	2	--	4	8	20	30	--	50	100	BAS012
UNR241	Presentation and Communications Skills	2	1	2	--	2	5	20	30	--	50	100	CSE042
BME228	Biochemistry	3	2	1	1.5	4.5	9	20	20	10	50	100	BAS021 & BAS031
BME238	Introduction to Anatomy	3	2	1	1.5	4.5	9	20	20	10	50	100	BAS032
CSE221	Automatic Control	3	2	2	--	4	8	20	30	--	50	100	UNR061
	Total	17	11	10	3	23	47					600	
Total Contact hours = 24 hrs/week Total SWL = 47 hrs/week													

Sixth Semester

Course Code	Course Title	Hours/Week						Marks Distribution					Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BME239	Introduction to Physiology	3	2	1	1.5	4.5	9	20	20	10	50	100	BME238
ECE262	Measurements and Instrumentations	3	2	1	1.5	4.5	9	20	20	10	50	100	ELE163
CSE222	Sensors and Actuators	2	1	--	3	2	6	20	20	10	50	100	CSE221
UNR281	Law and Human Rights	2	2	0	0	2	4	20	30	-	50	100	----------
ECE273	Electronics (2)	3	2	1	1.5	4.5	9	20	20	10	50	100	ECE173
ECE295	Signal Analysis	3	2	2	--	4	8	20	30	--	50	100	BAS113
BME291	Training (1)	0	0	0	0	3	3	0	0	0	0	0	----------
	Total	16	11	5	7.5	24.5	47					600	
Total Contact hours = 23.5 hrs/week Total SWL = 48 hrs/week													

Level 300

Seventh Semester

Course Code	Course Title	Hours/Week					Marks Distribution						Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
Elective	Elective Course (1)	3	2	2	--	5	9	20	30	-	50	100	According to Course Specs
BME339	Microbiology	3	2	1	1.5	4.5	9	20	20	10	50	100	BME228
BME345	Biomedical Instrumentations	3	2	1	1.5	4.5	9	20	20	10	50	100	BME239 & ECE262
ECE395	Digital Signal Processing	3	2	2	--	4	8	20	30	-	50	100	ECE295
BME358	Biomaterial Properties	3	2	1	1.5	4.5	9	20	20	10	50	100	PDE161
	Total	15	10	7	4.5	22.5	44					500	
Total Contact hours = 21.5 hrs/week Total SWL = 44 hrs/week													

Eighth Semester

Course Code	Course Title	Hours/Week					Marks Distribution						Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BME392	Clinical Engineering	2	1	--	3	2	6	20	20	10	50	100	BME239 & BME345
ECE396	Digital Image Processing	3	2	--	3	4	9	20	20	10	50	100	ECE395
CSE323	Embedded Systems	2	1	1	1.5	2	5.5	20	20	10	50	100	CSE221
Elective	Elective Course (2)	3	2	2	--	5	9	20	30	--	50	100	According to Course Specs
BME346	Bioinformatics	3	2	2	--	4	8	20	30	--	50	100	ECE395
BME393	Project (1) in BME	3	2	1	1.5	4	8.5	--	50	--	50	100	Reaching level 300
BME391	Training (2)	0	0	0	0	3	3	0	0	0	0	0	----------
	Total	16	10	6	9	24	49					600	
Total Contact hours = 25 hrs/week Total SWL = 49 hrs/week													

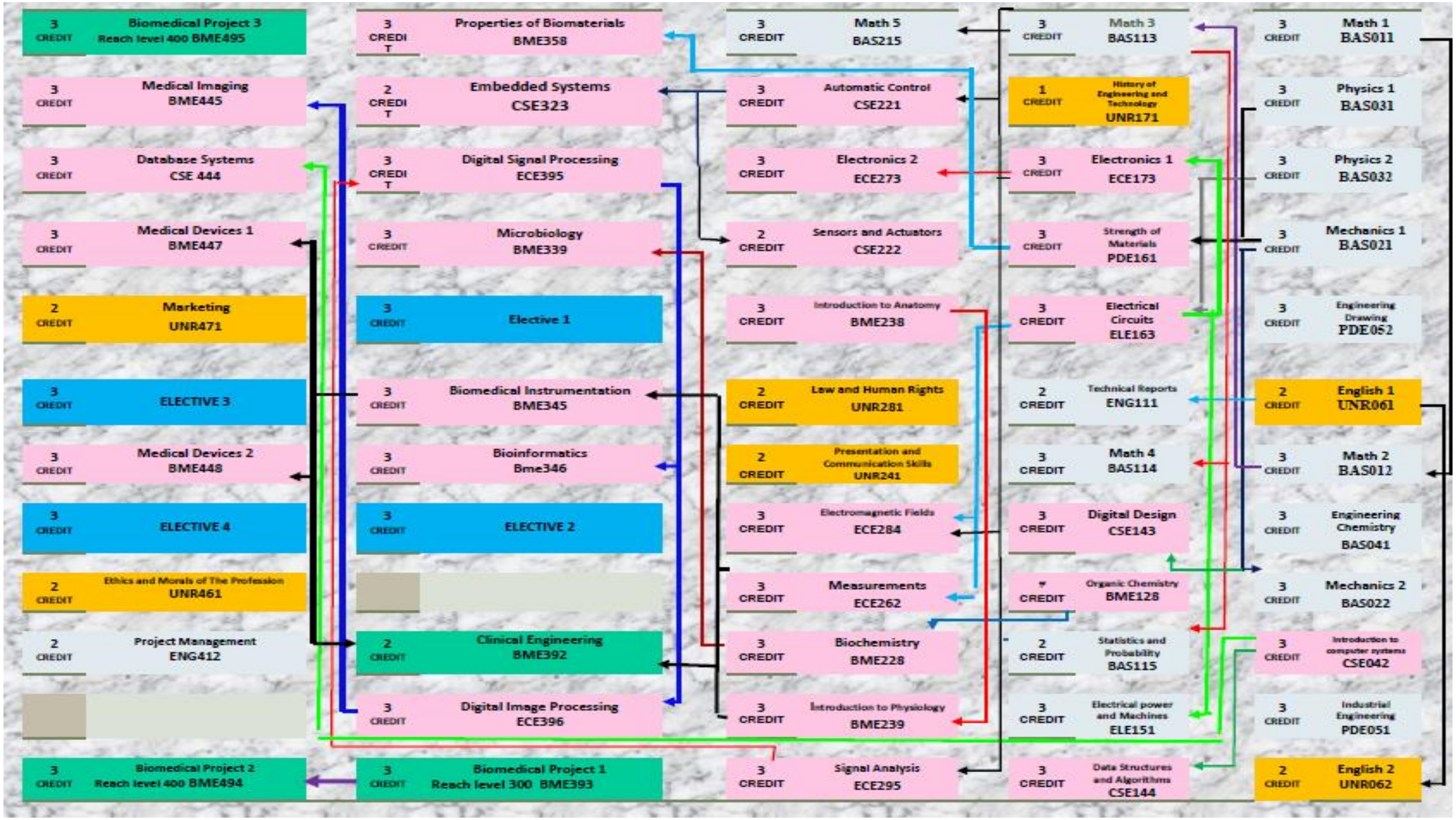
Level 400

Ninth Semester

Course Code	Course Title	Hours/Week					Marks Distribution						Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
Elective	Elective Course (3)	3	2	2	--	5	9	20	30	--	50	100	According to Course Specs
BME445	Biomedical Imaging	3	2	1	1.5	4.5	9	20	20	10	50	100	ECE396
BME447	Medical Equipment (1)	3	2	--	3	3	8	20	20	10	50	100	BME345
ENG412	Project Management	2	1	2	--	3	6	20	30	--	50	100	--------
UNR471	Marketing	2	2	--	--	2	4	20	30	--	50	100	--------
BME494	Project (2) in BME	3	1	2	3	8	14	--	50	--	50	100	Reaching Level 400
	Total	16	10	7	7.5	25.5	50					600	
Total Contact hours = 24.5 hrs/week Total SWL = 50 hrs/week													

Tenth Semester

Course Code	Course Title	Hours/Week					Marks Distribution						Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BME448	Medical Equipment (2)	3	2	--	3	3	8	20	20	10	50	100	BME345
UNR461	Ethics and Morals of the Profession	2	2	--	--	2	4	20	30	--	50	100	------------
CSE444	Database Systems	3	2	1	1.5	4.5	9	20	20	10	50	100	CSE042
Elective	Elective Course (4)	3	2	2	--	5	9	20	30	--	50	100	According to Course Specs
BME495	Project (3) in BME	3	1	2	3	8	14	--	50	--	50	100	Reaching Level 400
	Total	14	9	5	7.5	22.5	44					500	
Total Contact hours = 21.5 hrs/week Total SWL = 44 hrs/week													



	مقررات اختيارية		تدريب عملي ومشاريع		تخصص عام ودقيق		متطلبات كلية		متطلبات جامعة

Matrix of Competencies and Courses for Biomedical Engineering Program

Level	Course Code	Course Title	Graduate Competencies According to NARS 2018															
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	D1	D2	D3
000	BAS011	Mathematics (1)	√															
	BAS021	Mechanics (1)	√															
	BAS031	Physics (1)	√	√														
	BAS041	Engineering Chemistry	√	√														
	PDE052	Engineering Drawing	√		√													
	UNR061	English Language (1)								√								
	BAS012	Mathematics (2)	√															
	BAS022	Mechanics (2)	√															
	BAS032	Physics (2)	√	√														
	CSE042	Introduction to Computer Systems	√				√											
	PDE051	Production Engineering	√	√		√												
	UNR062	English Language (2)								√								
100	BAS113	Mathematics (3)	√															
	BAS115	Probability Theory and Statics	√	√				√										
	CSE143	Digital Design	√	√									√	√				
	PDE161	Strength of Materials	√	√	√													
	ELE163	Electric Circuits	√											√				
	ENG111	Technical Report Writing					√			√								
	BAS114	Mathematics (4)	√															
	ECE173	Electronics (1)	√	√									√	√				
	BME128	Organic Chemistry	√									√				√	√	
	CSE144	Algorithms and Data Structures	√	√			√					√						
	ELE151	Electric Power and Machines	√	√									√	√	√			
	UNR171	History of Engineering and Technology				√	√			√		√						
	BME191	Training		√	√	√		√	√	√	√	√	√	√	√			
200	BAS215	Mathematics (5)	√	√														
	ECE284	Electromagnetic Fields	√	√									√		√			
	UNR241	Communication and						√	√	√	√	√						

		Presentation Skills																
	BME228	Biochemistry	√									√				√	√	
	BME238	Introduction to Anatomy	√									√				√	√	
	CSE221	Automatic Control	√	√									√	√	√			
	BME239	Introduction to physiology	√									√				√	√	
	ECE262	Instrumentation and Measurements	√	√	√	√							√	√	√			
	CSE222	Sensors and Actuators	√	√	√								√	√	√		√	
	UNR281	Law and Human Rights	√				√		√	√		√						
	ECE273	Electronics (2)	√	√									√	√	√			
	ECE295	Signal Analysis	√	√									√					
	BME291	Training (1)		√	√	√		√	√	√	√	√				√	√	√
300	Elective	Elective (1)	√	√		√	√					√				√	√	√
	BME339	Microbiology																
	BME345	Biomedical Instrumentation	√	√	√	√										√	√	√
	ECE395	Digital Signal Processing	√	√	√								√	√	√			√
	BME358	Biomaterial Properties	√	√	√	√	√									√		
	BME392	Clinical Engineering	√	√	√	√	√	√	√	√	√	√			√	√	√	√
	ECE396	Digital Image Processing	√	√	√								√	√	√			√
	CSE323	Embedded Systems	√	√	√	√							√	√	√			
	Elective	Elective (2)	√	√		√	√					√				√	√	√
	BME346	Bioinformatics	√	√		√	√					√						√
	BME393	Project (1) in Biomedical Engineering	√	√	√	√	√	√	√	√	√	√			√	√	√	√
	BME391	Training (2)		√	√	√		√	√	√	√	√				√	√	√
400	Elective	Elective (3)	√	√		√	√					√				√	√	√
	BME445	Medical Imaging	√	√	√		√							√				√
	BME447	Medical Equipment (1)	√	√	√	√										√	√	√
	ENG412	Project Management	√	√	√	√	√	√	√	√	√							
	UNR471	Marketing	√	√		√	√	√	√	√	√	√						
	BME494	Project (2) in Biomedical Engineering	√	√	√	√	√	√	√	√	√	√			√	√	√	√
	BME448	Medical Equipment (2)	√	√	√	√										√	√	√
	UNR461	Ethics and Morals of the	√			√	√		√	√	√	√						

		Profession																
	CSE444	Database Systems	√	√	√	√	√	√				√				√		
	Elective	Elective (4)	√	√		√	√					√				√	√	√
	BME495	Project (3) in Biomedical Engineering	√	√	√	√	√	√	√	√	√	√			√	√	√	√

7. CEE Program Courses Syllabi

7.1. University Requirements:

UNR061	English (1)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---
Main skills of the English language - listening to short and long conversations - reading scientific passages - writing reports, summaries, and scientific articles - speaking and presenting new ideas									
References: ▪ *Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011*									

UNR062	English (2)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	UNR061
Analysis and interpretation of engineering issues - summarizing engineering issues - preparation for language tests.									
References: ▪ *Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011*									

UNR171	History of Engineering and Technology								Prerequisites
1 Cr	Lecture	1	Tutorial	--	Lab.	--	Semester	2nd	---
Engineering history: Art, Science, Engineering and technology - Role of engineering and technology in development and establishment of civilizations -Technology and environment - Examples on development of engineering activity.									
References: ▪ *Roger S. Kirby, Engineering in History, Dover Publications Inc. New York, United States, 1990, ISBN10 0486264122*									

UNR281	Law and Human Rights								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	2ed	---
Systems and laws of institutions - Introduction to Accounting - Labor legislation and laws governing engineering professions - Industrial security legislation and environment - Historical philosophical origins of human rights - international sources of human rights - national sources of human rights - global bodies based on the protection of human rights.									

UNR241	Communication and Presentation Skills								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---
Communication skills - Presentation planning and preparation - Delivery skills such as eye contact, voice control, gestures, body language and appearance - Presenter's characteristics - Using visuals - Presentation structure - Elevator Pitch									
References: ▪ *Joan van Emden, Lucinda Becker, Presentation Skills for Students, 3rd Edition, Red Globe Press, 2016* ▪ *M. Wa Mutua, S. Mwaniki, P. Kyalo, B. Sugut, Communication Skills: A University Book, Succex Publishers, 2016*									

- *Ian Tuhovsky, Wendell Wadsworth, Communication Skills Training, Ian Tuhovsky, 2015*
- *Tabitha Wambui, Alice W. Hibui, Elizaeth Gathuthi, "Communication skills " Vol.1, Students' coursebook, LAP LAMBERT Academic Publishing, 2012*

UNR461	Ethics and Morals of The Profession								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	1st	---

General principles of professional ethics - Commitments to society - Responsibilities of the engineer - Detection of violations - Behavior - Case studies and general issues.

References:

- *Lizabeth A. Stephan, David R. Bowman, William J. Park, Benjamin L. Sill, Matthew W. Ohland, "Thinking like an engineer", Published by Pearson 2018.*
- *Harris, C. E., Jr., Pritchard, M. S., & Rabins, M. J. Engineering Ethics. Second edition. Belmont, CA: Wadsworth, 2000*

UNR471	Marketing								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	1st	---

Principles of products marketing - Marketing research - Customers buying behavior - Marketing mix - Plotting marketing strategy - Building marketing plan - Pinpointing the target market - Marketing on the world wide web - Branding strategy - Developing new products - Advertising and promotions - Costing and pricing strategies - Case studies on products marketing

References:

- *Principles of Marketing, University of Minnesota Libraries Publishing, 2015, ISBN 13: 9781946135193*

7.2 Faculty Requirements:

BAS011	Mathematics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Calculus: Function (definition - theorems) - Basic functions - limits - Continuity - Derivation - definition - theorems - types - higher orders - Applications on derivatives - partial derivatives - indefinite integral - theories and properties of integration.

Algebra: Binomial theorem (with any exponent and applications) - Partial Fractions - Theory of Equations - Matrices - System of linear equations - Gauss elimination method.

References:

- *Akhtar & Ahsan, Textbook of Differential Calculus, second edition, 2009, PHI Learning Private Limited.*
- *Alan Jeffrey, Matrix operations for Engineers and Scientists, 2010, Springer Science & Business Media.*

BAS021	Mechanics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Newton's laws - Types of forces، coplanar forces، Rectangular components of vector (1D, 2D, Space), Forces in space - Equilibrium of a particle - Conditions, Free-body diagram - Moment - Couple moment - Resultant of a system of forces and couples as a force and couple system - General procedure for reducing force and couple systems - Equilibrium of a rigid body - Conditions of equilibrium of a rigid-body، free body diagrams – friction

References:

- *R.C. Hibbeler, "Engineering Mechanics: Statics and Dynamics, 14th Edition", Pearson Prentice Hall, New Jersey, 2016.*
- *J. L. Meriam, L. G. Kriage, and J. N. Botton, "Engineering Mechanics: Statics, 8th Edition", John Wiley & Sons, New York, 2016.*

BAS012	Mathematics (2)							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	**BAS011**

Integral Calculus: Definite integral - Methods of integration – Applications on definite integral (plane area - volume of revaluation - length of a plane curve - area of surfaces of revolution) - improper integral.
Analytic Geometry: Equations of second degree - Equation of pair of straight lines - Translation of axes - Conic sections - parabola - ellipse - hyperbola) Equation of plane - Equation of sphere.

References:

- *Jumarie, G., Fractional Differential Calculus for Non-Differentiable Functions: Mechanics, Geometry, Stochastics, Information Theory. 2013: LAP Lambert Academic Publishing.*
- *Hestenes, D. and G. Sobczyk, Clifford algebra to geometric calculus: a unified language for mathematics and physics. Vol. 5. 2012: Springer Science & Business Media.*
- *Grossman, S.I., Multivariable calculus, linear algebra, and differential equations. 2014: Academic Press.*

BAS022	Mechanics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	**BAS021**

Kinematics of a particle: curvilinear motion - Normal and tangential components. - Newton's laws - motion of projectiles - Work and energy of a particle - applications of friction.

References:

- *R.C. Hibbeler, "Engineering Mechanics: Statics, 11th Edition", Pearson Prentice Hall, 2006.*
- *F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg, "Vector Mechanics for Engineering, Statics and Dynamics, 9th Edition", McGraw-Hill, New York, 2010.*

BAS031	Physics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Material properties: Physical quantities - Standard units and dimensions - Mechanical properties for materials - Fluid properties - Periodic motion - Mechanical waves - Sound waves - Waves in elastic media.
Heat and thermodynamics: Temperature measurements and thermometers - Thermal expansion - Specific and latent heat - Heat transfer - Gas motion theory - First law of thermodynamics - Entropy and second law of thermodynamics.

References:

- *Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 6th Edition, Thomson Brooks/Cole 2014.*
- *Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.*

BAS032	Physics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2nd	---

Electricity and Magnetism: Electric charge - Electric force - Electric field- Column's law- Electric flux- Gauss law- Electric potential- Electric capacitance and Dielectrics - Ohm's law and simple circuits- Magnetic field - Baiot and Savart laws.
Optics and Modern physics: Nature of light and laws of geometric optics - Interference - Diffraction - polarization - optical fiber - laser - photoelectric effects - principle of quantum theory - special theory of relativity.

References:

- *Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 9th Edition, Thomson Brooks/Cole 2014.,*
- *Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.*

BAS041	Engineering Chemistry								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Equations of state-chemical thermodynamics - Material and energy balance in chemical processes- properties of solutions - Basic principles in electrochemistry and it's applications- selected topics in chemical industry.

References:

- *Brown, L. T, LeMay H. E. Jr; Bursten, B. E.; Murphy, C.J., and Woodward, P.; " Chemistry The Central Science", Pearson International Edition (11th edn), Pearson Printice Hall, (2009).*

PDE051	Production Engineering								Prerequisites
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	2ed	---

Introduction to the following processes (Casting- Forging- Metal filing - Machining- Forming- Woodworking)

References:

- *Hitomi, Katsundo. Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics. Routledge, 2017.*

PDE052	Engineering Drawing								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Two-dimensional drawings - Free-hand sketching - Sectional views - Auxiliary views and conventions - Computer-aided drawing (CAD) of 2D and 3D figures.

References:

- *Mcgraw-hill Mint, "Mechanical Drawing Board & CAD Techniques", Student Edition,2011*

ENG111	Technical Reports Writing								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	2nd	UNR062

Technical writing definition - audience analysis - technical writing styles - technical document characteristics - automated document organization - official and unofficial document types - structure of different types of technical documents.

References:

- *G. J. Alred, W. E. Oliu, The Handbook of Technical Writing, 12th Edition, Bedford/St. Martin's; 2018*
- *K. Hyland, Teaching and researching writing. 3rd edition Routledge academic publisher, 2016*
- *M. Markel, Technical Communication, 11th edition, MacMillan, 2015.*

BAS113	**Mathematics (3)**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	**BAS012**

Applications of partial differentiation - Maximum values of functions in more than one variable and applications - First order differential equations - Second order differential equations - Laplace transform and its applications - Analytical geometry in space.

References:

- *D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.*
- *S. A. Wirkus, and R. J. Swifi, "A Course of Ordinary Differential Equations", Taylor & Francis Group, LLC, 2015.*

BAS114	**Mathematics (4)**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	**BAS113**

Fourier series - Fourier transform - Complex numbers - Functions of a complex variable - Complex integration - Residue theorem - Direction derivatives - Double integrals - Triple integrals - Line integrals - Surface integrals.

References:

- *J. Brown, and R. Churchill, "Complex Variables and Applications", 9th Edition, McGraw-Hill, 2013.*
- *D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.*

BAS115	**Statistics and Probability Theory**								**Prerequisites**
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	**BAS012**

Measures of tendency and dispersion - Probability distributions - Sampling theorem - tests of hypothesis - non-parametric tests - regression and correlation - time series.

References:

- *Mary C. Meyer, Probability and Mathematical Statistics: Theory, Applications, and Practice in RSBN-10: 1611975778, SIAM (June 24, 2019)*

ELE151	**Electrical Power and Machines**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	---

Power: Electrical power systems - three phase systems - Theory and models of transformers - Transmission line models - Voltage and frequency control - effective and ineffective power - Optimal work of power systems.

Machines: The theory of operation - The construction of the Direct Current motors. The speed، torque، and current characteristics - applications of the DC motors. The theory of operation and construction of stepper motors - Permanent-magnet DC motor and Low-inertia DC Motors. The theory of operation، construction of three phase induction motors.

References:

- *Nilsson, J.W. and S.A. Riedel, Electric circuits. 2015: Pearson Upper Saddle River, NJ.*
- *Slade, P.G., Electrical contacts: principles and applications. 2017: CRC press.*

BAS215	Mathematics (5)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	**BAS113**

Numerical solution of linear and non-linear systems of equations - Iterative methods - Curve fitting: Least square of (Straight lines, Polynomials), Linearization of nonlinear relationship. Interpolation and polynomial approximation -finite difference operators - Numerical integration and differentiation.

References:

- *Mazumder, Numerical Methods for Partial Differential Equations, Finite Difference and Finite Volume Methods, science direct ,2016.*
- *Sheldon Rose, A First course in probability, Eighth edition, 2010, Pearson Prentice Hall.*

ENG412	Project Management								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---

Fundamentals of biomedical project management - Integration management - Scope management - Time management - Cost management - Quality management - Human resources management - Communication management - Risk management - Procurement management - Biomedical projects case studies

References:

- *Kerzner, H. and H.R. Kerzner, Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons, 2017.*
- *Kalpakjian, S., K. Vijai Sekar, and S.R. Schmid, Manufacturing Engineering and technology. Pearson, 2014.*
- *Nigel J. Smith, "Engineering Project Management", 3rd Edition, Wiley-Blackwell, 2008.*

7.3 BME Requirements:

3 Cr	Introduction to Computer Systems								CSE042
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	2	

Pre-requisites: UNR032

Introduction to the design and operation of digital computers: types of data and its representation and number systems - the basic components of the computer and the organization of the computer and the ways of transfer of information- programming with Visual Basic - Introduction to information networks

Introduction to Programming: Program Structure and Command Types - Presentation of key commands - simple software development

Training Fundamentals: Dealing with Common Operating Systems (Windows – Linux) - Software Development and Desktop Software

Reference:

3 *H. Rogler, " Introduction to Computer Systems", Kendall Hunt Publishing; 3 edition, 2018*

3 Cr	Strength of Materials							PDE161
M	Lectures	2	Tutorial	2	Lab	0	Semester	1
Pre-requisites: BAS031 &BAS021								
Types of loads acting on mechanical components - Force analysis of simple mechanical elements - Axial forces، shear forces، bending and twisting moments - Stress، strain and Hook's law - Design stresses and factor of safety - Stress concentrations - Thermal stresses - Bearing stresses - Direct and torsional shear stresses - Bending stress and eccentric loading - Bending stresses and shear stresses in beams - Stress and strain analysis - Stresses in two dimensions - principal stresses and maximum shear stresses.								
Reference: • *R. K. Bansal, "A Text Book of Strength of Materials", Laxmi Publications, 4th edition , 2010*								

3 Cr	Electric Circuits							ELE163
M	Lectures	2	Tutorial	2	Lab	0	Semester	1
Pre-requisites: BAS032								
Elements of electrical circuits - Simple resistive circuits - Analysis of DC circuits - Theories of electrical circuits - First-order circuits –steady AC sinusoidal circuits - Power and power factor - Resonance circuits - Three-phase circuits.								
Reference: • *J. W. Nilsson, "Electric Circuits", Pearson; 11th edition, 2018*								

3 Cr	Electronics (1)							ECE173
M	Lectures	2	Tutorial	2	Lab	0	Semester	2
Pre-requisites: ELE163								
Semiconductors – pn junction – biasing of pn junction –types of pn junction diodes – bipolar junction transistors and their properties and applications in DC circuits – Field-effect transistors (JFET& MOSFET) and their properties and applications in DC circuits.								
Reference: • *T. Floyd, "Electronic Devices", 10th edition, Pearson, 2018*								

3 Cr	Digital Design							CSE143
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	1
Pre-requisites: CSE042								
Binary algebra and logic gates – Binary function simplification –Analysis and design of synthetic logic circuits – components of programmable logic devices – Introduction to synchronous logic – Analysis of time-controlled serial circuits – Programmable logic arrays – Introduction to logic design laboratory – Design and connection of digital circuits using traditional or high level design programs using VHDL – Basic design using program – Basic design using structural graph editor – Functional simulation – Design verification – Flow design of digital circuits using new computational programs.								

Reference:

- *M. Mano, "Digital Design" , Pearson; 6th edition, 2017*

3 Cr	Algorithms and Data Structure							CSE144
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	2

Pre-requisites: CSE042

Introduction to data structures - Different Data representations- Study the structure، properties، and implementation issues of different data structures (Array – Stack – queue،..) -Data Structure Storing ، ordering and sorting algorithms. - Study Different search algorithms - Evaluation and analysis of studied algorithms using a recent programming language.

Reference:

- *A. Khot, " Learning Functional Data Structures and Algorithms", Packt Publishing, 2017*

3 Cr	Organic Chemistry							BME128
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	2

Pre-requisites: ---

Functional groups - Aliphatic compounds - Aromatic compounds - Cyclic compounds - Polymers - Biomolecules - Fullerenes and small molecules

Reference:

- *L. Wade, " Organic Chemistry" , Pearson; 9th edition, 2016*

3 Cr	Automatic Control							CSE221
M	Lectures	2	Tutorial	2	Lab	0	Semester	1

Pre-requisites: BAS113

Fundamentals of control – Mathematical model for linear systems and Laplace transform – Systems representation (Block diagram – Transfer Functions – Signal Flow Graph) – Modeling of electrical and mechanical systems – State variables – System analysis in time and frequency domains – Root Locus – Systems Stability – Introduction to proportional-differential-integral controller – System analysis using suitable software – Static performance – Response analysis – Introduction to control systems – Types of optimal control – Optimal linear follow-up system – Multi-variable systems

Reference:

- *F. Golnaraghi, " Automatic Control Systems", McGraw-Hill Education; 10th edition, 2017*

2 Cr	Sensors and Actuators							CSE222
M	Lectures	1	Tutorial	0	Lab	3	Semester	2

Pre-requisites: CSE221

Sensor performance criteria and selection - Thermocouples - Resistive sensors - Inductive sensors - Capacitive sensors - Piezoelectric sensors - Encoders and tachometers - Actuator performance criteria and selection - Fluidic actuators - Solenoids and voice coil motors - Stepper motors - DC motors - Piezoelectric actuators - Shape memory alloy actuators - MEMS sensors and actuators

Reference:

- *C. de Silva," Sensors and Actuators: Engineering System Instrumentation" , CRC Press; 2nd edition, 2015*

3 Cr	Measurements and Instrumentation							ECE262
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	2

Pre-requisites: ELE163

Statistical analysis of data – DC measurement devices - DC measurement devices – Oscillososcope – DC bridges – AC bridges – Transducers – Digital voltmeters

Reference:

- *A. Morris, "Measurement and Instrumentation Theory and Application", Academic Press; 2nd edition, 2015*

3 Cr	Electronics (2)							ECE273
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	2

Pre-requisites:ECE173

Small signal analysis of different transistor types – Amplifiers (operational amplifier – power amplifier – feed-back amplifier – differential amplifier) – multi-stage amplifiers – analog and digital integrated circuits – filters – oscillators – signal generators – wave shaping

Reference:

- *T. Floyd, "Electronic Devices", 10th edition, Pearson, 2018*

3 Cr	Electromagnetic Fields							ECE284
M	Lectures	2	Tutorial	2	Lab	0	Semester	2

Pre-requisites: BAS113 &ELE163

Coordinate systems – charges in space – Coulomb's law – electric field - electric flux –Gauss's law and its applications – electric potential – work and energy – capacitance – conductors and dielectrics – boundary conditions – Poisson and Laplace equations and their applications – magnetic field – magnetic flux – varying magnetic field – Faraday's law – Maxwell equations

Reference:

- *W. Hayt, "Engineering Electromagnetics", 8th edition, McGraw Hill, 2010*

3 Cr	Signal Analysis							ECE295
M	Lectures	2	Tutorial	2	Lab	0	Semester	2

Pre-requisites: BAS113

Classification signals and systems - linear time-invariant analog systems - linear time-invariant digital systems - Laplace transform and its applications on analog signals - analog system properties - Z-transform and its applications on discrete-time signals - digital system properties - analog Fourier transform and its applications - digital Fourier transform and its applications.

Reference:

- *B. Boashash , "Time-Frequency Signal Analysis and Processing", Academic Press; 2nd edition, 2015*

3 Cr	Biochemistry							BME228
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	1

Pre-requisites: BME128

Structures، functions and interaction between cell components including proteins، carbohydrates، fats، nucleic acids and other biological cells - nucleic acids - proteins formation

Reference:

- *D. Nelson , "Principles of Biochemistry", W. H. Freeman, 7th edition, 2017*

3 Cr	Introduction to Anatomy							BME238
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	1

Pre-requisites: ---

Introduction - different organs and parts that form the human body system including gastrointestinal system، respiratory system، cardiovascular system، lymphatic system, genitourinary system and endocrinal system- skeletal parts of the human body and the control of various muscles and joints.

Reference:

- *E. Solomon, "Introduction to Human Anatomy and Physiology", Saunders; 4th edition, 2015*

3 Cr	Introduction to Physiology							BME239
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	2

Pre-requisites: BME238

Cell Transport - Excitable Membranes and Synapses - Smooth and Cardiac Muscle - Cardiac Electrophysiology and ECGs - Cardiac Mechanics and Systemic Circulation - Control of the Cardiovascular System - Repiratory Mechanics، Gas Transport، and Control of Breathing - Autonomic Nervous System - Brain and Spinal Cord - Somatic Nerves and Control of Movement - Auditory System - Visual System - Renal System - Endocrine System

Reference:
- *S. Fox ," Human Physiology", McGraw-Hill Education; 15th edition, 2018*

2 Cr	Embedded Systems							CSE323
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	2

Pre-requisites: CSE221

Specifications of microcontrollers - common hardware/ software، peripherals and interfacing - memory، performance analysis and optimization - CAD tools - FPGA design flows - Low- power computing، and circuit architectures - research، design and development، of electronic devices - Applications: medical devices، pacemakers، cochlear implants، insulin pumps

Reference: J. Valvano, "Introduction to Embedded Systems", Create Space Independent Publishing Platform; 1st edition, 2016

3 Cr	Digital Signal Processing							ECE395
M	Lectures	2	Tutorial	2	Lab	0	Semester	1

Pre-requisites: ECE295

Converting analog signals to digital signals - IIR digital filter design - FIR digital filter design - implementation of digital filters - Wiener filter - adaptive filters - data compression and encryption - applications on biomedical signals.

Reference:
- *Lizhe Tan, "Digital Signal Processing: Fundamentals and Applications", Academic Press; 3rd edition, 2018*

3 Cr	Digital Image Processing							ECE396
M	Lectures	2	Tutorial	0	Lab	3	Semester	2

Pre-requisites: ECE395

Image acquisition and sampling - types of digital images - point processing - image histograms - neighborhood processing - edge sharpening - 2D-Fourier transform - transform processing - image restoration in spatial and frequency domains - image segmentation - edge detection - Hough transform - morphological operations - processing of color images.

Reference:
- *Rafael C. Gonzalez, " Digital Image Processing" , Pearson; 4th edition, 2017*

3 Cr	Microbiology							BME339
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	1

Pre-requisites: BME228

Prokaryoticand Eukaryotic cells، Nomenclature and structure of microorganisms، Spores، Fungi، Viruses، Bacterial genetics، Growth curve and growth requirements of microorganisms، Types of Microscopes، Medically important microorganisms، Parts of the immune system

Reference:
- *G. Tortora, " Microbiology: An Introduction" , Pearson; 13th edition, 2018*

3 Cr	Biomedical Instrumentation							BME345
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	1
Pre-requisites: BME239 & ECE262								
Fluorescent microscopy، Florescence process، bioelectronics and biomechanical instruments، Applications of statistics، probabilities، signal analysis، noise suppression، and Fourier techniques in bioinstrumentation, biomedical embedded systems، biomedical mini-project.								
Reference: • *A. Webb, "Principles of Biomedical Instrumentation", Cambridge University Press; 1st edition, 2017*								

3 Cr	Biomaterial Properties							BME358
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	1
Pre-requisites: PDE161								
Physical and chemical surface properties of selected materials، – Surface measuring instruments – Modification of surface properties of materials – Acute and chronic response to implanted biomaterials – Design of biomaterial implants and artificial organs								
Reference: • *W. Murphy, "Handbook of Biomaterial Properties", Springer; 2nd edition, 2016*								

3 Cr	Bioinformatics							BME346
M	Lectures	2	Tutorial	2	Lab	0	Semester	2
Pre-requisites: ECE395								
Review of DNA replication، transcription، and translation، Genome organization - Review of molecular biology methods - DNA and protein databases، data storage، file formats، information retrieval - Database queries، sequence retrieval، Creation of restriction endonuclease maps - Dot plots، Sequence alignment، Local alignment، Global alignment، Multiple alignments - Alignment scores، Statistical significance of database searches - Genetic distances، Distance based phylogenies، Phylogenetic tree construction - Consensus sequences، Finding genes and open reading frames in DNA sequences - Microarrays and the transcriptome - Microarray analysis and applications of microarrays - Introduction to proteomics - Prediction of protein structure and function - Comparative genomics - Future directions of bioinformatics.								
Reference: • *J. Momand, "Concepts in Bioinformatics and Genomics" , Oxford University Press; 1st edition, 2016*								

3 Cr	Database Systems								CSE444
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	2	

Pre-requisites: CSE042

Introduction to database Concepts -Data Structure handling and File Systems - Database Management systems operation and Components - Data Modeling ANSI/SPARC – Client Server - Relational Databases (indexing- keys – sorting) - Structured Query Languages (SQL) - Schema Design and normalization - E/R Model and database Programming -Practical implementation using recent DBMS- implementing a database using MYSQL DBMS.

Reference:

- *C. Coronel, "Database Systems: Design, Implementation, & Management", Cengage Learning, 13th edition, 2018*

3 Cr	Medical Imaging								BME445
M	Lectures	2	Tutorial	1	Lab	1.5	Semester	1	

Pre-requisites: ECE396

Medical image modalities (Magnetic resonance imaging، X-ray- Computed tomography- ultrasonic)- different formats of medical images and medical files- image reconstruction- principles of computer- aided medical image analysis- statistical analysis of medical images- medical image processing- medical image understanding (spatial- temporal- spectral)- Medical image modeling- programming techniques for medical image analysis- classical and recent computer aided technologies for medical image analysis (e.g.- deep learning)- relevant mini-project

Reference:

- *A. Maier, "Medical Imaging Systems", Springer Open, 2018*

3 Cr	Medical Equipment (1)								BME447
M	Lectures	2	Tutorial	0	Lab	3	Semester	1	

Pre-requisites: BME345

Electrocardiographs - EEG - EMG - Ventilators - Patient Monitor - Diathermy - Anesthesia - Dialysis - robotic surgeon - dental devices

Reference:

- *E. Tobin, "The Medical Device Engineers Handbook" , Create Space Independent Publishing Platform, 2016*

3 Cr	Medical Equipment (2)								BME448
M	Lectures	2	Tutorial	0	Lab	3	Semester	2	

Pre-requisites: BME345

MRI Equipment - CT Scanner - X-Ray Equipment - PET Equipment - Ultrasound Equipment - Gamma Camera - Medical Endoscopy - Prosthetic Devices

Reference:

- *E. Tobin, "The Medical Device Engineers Handbook" , Create Space Independent Publishing Platform, 2016*

3 Cr	Medical Decision Support Systems (MDSS)								CSE362
E	Lectures	2	Tutorial	2	Lab	0	Semester	--	

Pre-requisites: ----

Introduction to Decision making process - Decision Making under Certainty and Uncertainty - Linear Programming - Graphical LP solution - Simplex method - Representation of clinical knowledge، guidelines and recommendations; Interfaces for decision support; Search and ranking recommendations; - Methods for authoring and validation of clinical guidelines; Evaluation، efficacy and consistency - Precision medicine.

Reference:

- *E. Berner, "Clinical Decision Support Systems: Theory and Practice", Springer; 3rd edition, 2016*

3 Cr	Healthcare Information Systems (HCIS)								CSE363
E	Lectures	2	Tutorial	2	Lab	0	Semester	--	

Pre-requisites: CSE144

Introduction to Healthcare Informatics - Process Fundamentals: Motivation and modeling constructs - Metrics and methods -Process Enabled Information Technology (PEIT)Framework - Electronic Health Records (EHR): Definitions، content، and technology - Electronic Health Records (EHR): Adoption and use issues - Computerized Physician Order Entry (CPOE) - Healthcare Data and Standards - Data Analytics - Data Management and Data Warehousing - HIPAA and Health IT; Evaluation of Healthcare IT Applications - e-health technologies and applications – m-health technologies and applications - Health Information Exchanges

Reference:

- *K. Wager, "Health Care Information Systems: A Practical Approach for Health Care Management", Jossey-Bass; 4th edition, 2017*

3 Cr	Internet of Medical Things (IoMT)								CSE364
E	Lectures	2	Tutorial	2	Lab	0	Semester	--	

Pre-requisites:CSE144

Demystifying the Internet of Things - Setting up IoT work flow - An Overview of IoT Technologies - Aligning IoT and Strategy - Creating an IoT Roadmap for the Future – Programming with Python — IoT Cloud Infrastructure - Performance and Security in IoT - Building IoT medical applications

Reference:

- *A. Hassanien, "Medical Big Data and Internet of Medical Things: Advances, Challenges and Applications", CRC Press; 1st edition, 2018*

3 Cr	Public Health								BME365
E	Lectures	2	Tutorial	2	Lab	0	Semester	--	

Pre-requisites: BAS115 & BME228

Biostatistics - effect of human exposure to chemicals and their effect on metabolism and related health effects - quantitative and qualitative assessment of health hazards as basis for regulatory policies establishment - Case study

Reference:

- *M. Schneider, "Introduction to Public Health", Jones & Bartlett Learning; 5th edition, 2016*

3 Cr	Opto-electronics								ECE366
E	Lectures	2	Tutorial	2	Lab	0	Semester	--	

Pre-requisites: ECE273

Displays and LASER devices- Luminous intensity - Cathode Luminous - electrical Luminous- Luminous injection - Light emitting diode - Plasma display screens - Liquid crystal displays LCDs- Digital displays- Absorption، emission and radiation of LASER- Feedback optics- Threshold and active mediums of LASER - LASER classes - steady state regime and LASER applications - Photodetector devices (photodetector- thermal detector- photonic devices- optical connectors- photodiodes PN junctions- detector performance- photoemission rate- optical switch)- electro-optic integrated circuits (integrated optics).

Reference:

- *S. Kasap," Optoelectronics & Photonics: Principles & Practices ", Pearson; 2nd edition, 2012*

3 Cr	Pattern Recognition								ECE367
E	Lectures	2	Tutorial	2	Lab	0	Semester	--	

Pre-requisites :ECE396

Introduction - Features - training and learning - Classification - decision tree classifier - rule-based classifier - statistical pattern recognition - supervised learning - non-parametric learning - feature extraction and selection - unsupervised learning

Reference:

- *G. Dougherty, "Pattern Recognition and Classification", Springer, 2013*

3 Cr	Introduction to Deep Learning								ECE421
E	Lectures	2	Tutorial	2	Lab	0	Semester	--	

Pre-requisites: BME345, ECE395

Introduction to Deep Learning - Deep Computer Vision -Deep Reinforcement Learning - Data Visualization for Machine Learning - Learning and Perception - Deep Sequence Modeling - Deep Generative Models - Limitations and New Frontiers - Biologically Inspired Learning

Reference:

- *S. Skansi, "Introduction to Deep Learning", Springer; 1st edition, 2018*

3 Cr	Introduction to Nanotechnology								ECE422
E	Lectures	2	Tutorial	2	Lab	0	Semester	--	
Pre-requisites: ECE273									
Introduction to nano technology science - Wave Nature of Light - Dielectric Waveguides and Optical Fibers - Polarization and Modulation of Light – nano plasmonic waveguide – plasmonic sensors – medical applications of nano technology									
Reference: • *J. Ramsden, "Nanotechnology: An Introduction", Elsevier, 2nd edition, 2016*									

3 Cr	Medical and Pharmaceutical Procedures								BME431
E	Lectures	2	Tutorial	2	Lab	0	Semester	--	
Pre-requisites: BME228									
Sterilization regarding: Methods of sterilization، Basis for selection of method of sterilization، Devices used in each method and its technical principle، Evaluation of the success of the sterilization process - Most commonly used instruments and consumables in laboratories – Blood components and medical applications related to it.									
Reference: • *S. Haider, "Quality Operations Procedures for Pharmaceutical, API, and Biotechnology", CRC Press, 1st edition, 2012*									

3 Cr	Fluid Flow in Bio-Systems								BME432
E	Lectures	2	Tutorial	2	Lab	0	Semester	--	
Pre-requisites: BME239									
Introduction to biofluid mechanics - The circulation of blood as a fluid - blood vessels - Pressure and flow in the cardiovascular system-Equation of motion - Newtonian flow in blood vessels - Non-Newtonian flow in blood - Wave phenomena in blood vessels - the effect of curvature، branching and changes in shape/area - Flow in the microcirculation.									
Reference: • *S. Becker, "Heat Transfer and Fluid Flow in Biological Process", Elsevier, 2015*									

3 Cr	Clinical Pathology								BME433
E	Lectures	2	Tutorial	2	Lab	0	Semester	--	
Pre-requisites: BME239									
CBC/chemistry: Various causes of anemia - Factitious results - Endocrine diseases-Inflammatory disease - Renal disease - Coagulopathies - Hepatic disease Methodologies - Toxic insults - Acid-Base/Electrolyte disturbances, Cytology: Inflammatory/infectious - Benign tumors - Carcinomas - Sarcomas - Round cell tumors									
Reference: • *S. Kawthalkar, "Essentials of Clinical Pathology", Jaypee Brothers Medical Publishers (P) Ltd., 1st edition, 2010*									

3 Cr	Industrial Pharmacy								BME434
E	Lectures	2	Tutorial	2	Lab	0	Semester	--	
Pre-requisites: BME228									

Basic techniques used in Pharmaceutical industries: Sterilization، Instrumentation in pharmaceutical industry - Instrumental methods of analysis - .Preformulation studies - Optimization techniques in pharmaceutical formulation and processing - Compaction and compression - Effect of design of agitator system(shape factors) on the manufacturing of liquid products - Bio process - Materials of construction and prevention of corrosion - Production planning & control - Selection and evaluation of packaging materials for Solid /semisolid and liquid products - Finished product release، Quality review – Design، Construction، maintenance and sanitation for materials and products - industrial hazards.

Reference:

- *B. Chandakavathe, "Textbook of Industrial Pharmacy", Studium Press, 1st ed. 2019*

7.4 Projects and Training

3 Cr	Training (1) on BME								BME391
M	Lectures	0	Tutorial	0	Lab	0	Semester	--	
Pre-requisites: Pass level 200									

Training conducted by the student، whether in the university hospitals or in any external institution for a period of at least two weeks and a total number of not less than 75 hours. The training must end with a technical report and a discussion.

3 Cr	Training (2) on BME								BME491
M	Lectures	0	Tutorial	0	Lab	0	Semester	--	
Pre-requisites: Pass level 300									

Training conducted by the student، whether in the university hospitals or in any external institution for a period of at least two weeks and a total number of not less than 75 hours. The training must end with a technical report and a discussion.

2 Cr	Clinical Engineering								BME392
M	Lectures	1	Tutorial	0	Lab	3	Semester	2	
Pre-requisites: BME239 & BME345									

Introduction to clinical engineering - Product development – testing - usability Clinical trials and research - FDA definitions and approval process - Acute care، anesthesia، hemodialysis - Imaging، radiation therapy، lasers Cardiology، infusion and general medical، laboratory Telehealth، RTLS، special purpose systems - Healthcare facility design & special environments - Radiation safety، MRI safety - EMI/RFI، laser safety Laboratory، electrical، and construction safety، hazardous materials - Sanitation and infection prevention Disaster planning/emergency preparedness codes، standards، regulations، and accreditation

Reference:

- *A. Taktak, "Clinical Engineering", Elsevier Ltd., 2nd edition, 2020*

3 Cr	Project in Biomedical Engineering (1)								BME393
M	Lectures	1	Tutorial	2	Lab	3	Semester	2	
Pre-requisites: Pass level 200									
Completion of a project using all previously learned sciences from different fields in order to solve a realistic problem in a team. The project ends with a technical report and a discussion.									

3 Cr	Project in Biomedical Engineering (2)								BME494
M	Lectures	1	Tutorial	2	Lab	3	Semester	1	
Pre-requisites: Pass level 300									
Completion of a project using all previously learned sciences from different fields in order to solve a realistic problem in a team. The project ends with a technical report and a discussion.									

3 Cr	Project in Biomedical Engineering (3)								BME495
M	Lectures	1	Tutorial	2	Lab	3	Semester	2	
Pre-requisites: Pass level 300									
Completion of a project using all previously learned sciences from different fields in order to solve a realistic problem in a team. The project ends with a technical report and a discussion.									

Chapter Three:

A B. Sc. Program in Communications and Computers Engineering (CCE) with Credit Hours System

1. INTRODUCTION

The Communications and Computers Engineering program offers a sophisticated specialization for those who want to combine the specialty of Electronics, Communications Engineering, Computer Engineering and Control Systems as it provides a balanced mix of communications and computers and this mix has become necessary for the presence of computers as essential components in many areas of electronics and for the needs of computer industries and for engineers to be able to deal with Hardware and software design. This is also in line with the knowledge economy and the dynamic nature of specialization. Each branch has become a stand-alone industry such as the software industry, electronics industry,telecommunications technology industry, computer network technology industry, and control systems industry.This specialization is considered one of the modern specializations on the international level, where the department grants a bachelor's degree to graduates in communications and computers engineering after preparing them with a comprehensive curriculum according to NARS 2018 standards. It also explores new areas in communications and computers engineering where the program integrates knowledge in different areas of design, the computer parts' applications, computer programs, communication networks' connections, the optical communication basics, satellites and microwave communications, as well as areas of computer visions.

2. The Bachelor of Science in Communications and Computers Engineering Program

2.1 CCE Program Vision

Achieve leadership in the field of communications and computers engineering and gain the confidence of the local and regional community in the program graduates.

2.2 CCE Program Mission

The Computer and Communications Engineering program at Mansoura University aims to prepare scientifically qualified and professional engineers in the fields of communications and computer engineering, able to compete in the local and regional labor market and conduct scientific research to serve the community and develop the environment.

2.3 CCE Program Objectives

A. In-depth knowledge: Acquire in-depth knowledge of the requirements of mathematics and natural sciences
B. Broad specialized science: Acquisition of specialized science for communications engineering, including knowledge of various contemporary engineering issues related to disciplines.
C. Professional: Use practical and managerial skills to design systems, conduct experiments, analyze data, manage projects, identify and solve engineering problems necessary for productive occupations in the public and private sectors, or to pursue higher education.
D. Professionalism: Identify communication, presentation and language skills to ensure effective communication, demonstrate professional and ethical responsibilities, and engage in lifelong self-learning so that graduates are prepared for a modern and complex work environment
E. Creativity: Providing an environment that enables students to pursue their goals in an innovative,
F. rigorous, developed and supportive program.

2.4. The following are the aimed graduate attributes.

A. Apply knowledge of mathematics, science and engineering.
B. Design and conduct experiments as well as analyze and interpret data.
C. Design a system, component or process to meet desired needs.
D. Communicate and work effectively within multi-disciplinary teams.
E. Identify, formulate and solve engineering problems.
F. Acquire professional and ethical responsibility.
G. Use Broad education necessary to investigate the impact of engineering solutions in a global-societal context.
H. Recognize the ability to engage in life-long learning.
I. Acquire knowledge of contemporary issues.
J. Use the techniques, skills and modern engineering tools necessary for engineering practice.
K. Acquire Leadership qualities and business adminstartion
L. Design, operate, analyze and maintain different communication systems
M. Designing and simulating different applications using computers and mobile phones

2.5 Graduate Competencies in Accordance with the National Academic Standards

According to NARS 2018, a graduate must be able to:

A1. Be able to define, configure and solve complex engineering problems

A2. Develop, analyze and evaluate results of experiments, simulations and use statistical analysis to extract results

A3. Applying engineering design processes to produce innovative solutions at low cost to meet the needs of society

A4. Optimal utilization of contemporary technology, health and safety requirements and principles of crisis management

A5. Implementing research techniques as an integral part of learning

A6. Planning, supervising and following up the implementation of engineering projects

A7. Work efficiently as a member of a multicultural team

A8. Communicate effectively with listeners through contemporary means

A9. Use innovative and critical thinking and gain leadership skills to confront new situations

A10. Acquire and apply new knowledge and other learning strategies

In addition to the competencies of most engineering programs, the engineering CCE program has some special competencies, which are as follows:

B1. Optimal design and analysis of electrical, electronic and digital systems for specific applications

B2. Measuring the performance of electrical, electronic and digital systems and evaluating their suitability for a specific application

B3. Adopting national, international standards and codes for designing, building, operating, inspecting and maintaining electronic equipment, systems and services

C1. Design, analyze and measure the performance of communication and control systems in various applications

C2. Designing and simulating different applications using computers and mobile phones

3. CCE Program Plan Requirements

To prepare the student for the above targeted educational objectives, a set of program outcomes, that describes what students are expected to know and able to do by the time of graduation, has been adopted. The student must successfully pass a number of courses totaling 160 credit hours in order to obtain a bachelor's degree in Communications and Computers Engineering Based on credit hours systems (CHS) from the Faculty of Engineering, MansouraUniversity.

The following figure shows courses coding system according to reference framework NARS 2018, where the course code is composed of three letters and three digits. The letters indicate the course specialization department. The first digit indicates the year 0, 1, 2, 3, or 4. The second digit between 1 and 9 displays the discipline in the major. The third digit is the course sequence in each discipline.

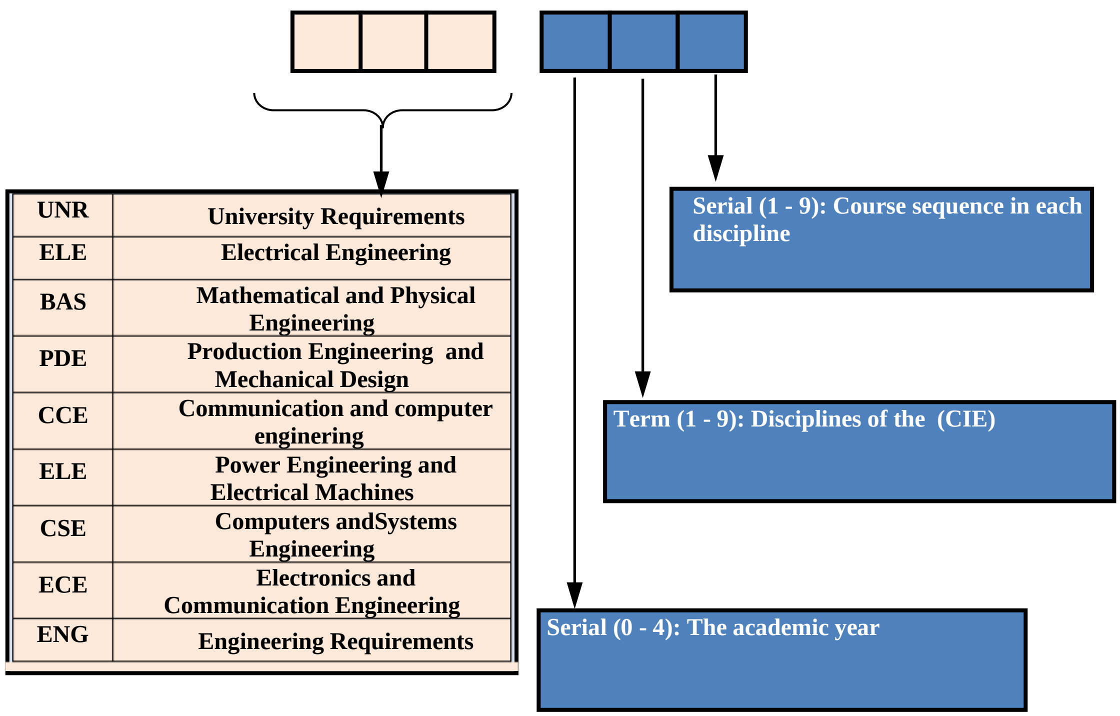


Figure (1): Courses coding system

3.1 CCE Program Courses

Table (1), illustrates the courses credit units, Total SWL and marks distribution for the university. The following points must be considered :.

1. The letters indicate the majors in which the degree is given but some of these represent university requirements, college requirements, or specialized courses.
2. Course descriptions refer to the semester in which this course is usually given, but these dates are subject to change, as not all courses are taught every year, and before the start of each

semester, college affairs show the tables of courses that will be taught in this semester, their teaching times and those in charge of teaching.

Table (1): The University Requirements (13 Credit hours)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	semester Works	Lab	Final Term
UNR 061	English (1)	2	5	20	30	--	50
UNR 062	English (2)	2	5	20	30	--	50
UNR 171	History of Engineering and Technology	1	2	20	30	--	50
UNR 241	Communication and Presentation Skills	2	5	20	30	--	50
UNR 281	Law and Human Rights	2	4	20	30	--	50
UNR 461	Ethics and Morals of The Profession	2	4	20	30	--	50
UNR 471	Marketing	2	4	20	30	--	50
Total		13	29				

3.2 The College Requirements

Table (2) indicates the college requirements which contain basic science courses and basic engineering science courses.

Table (2): The College Requirements (45 Credit hours)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	semester Works	Lab	Final Term
BAS011	Mathematics (1)	3	8	20	30	--	50
BAS021	Mechanics (1)	3	8	20	30	--	50
BAS012	Mathematics (2)	3	8	20	30	--	50
BAS022	Mechanics (2)	3	8	20	30	--	50
BAS031	Physics (1)	3	9	20	20	10	50
BAS032	Physics (2)	3	9	20	20	10	50
BAS041	Engineering Chemistry	3	9	20	20	10	50
PDE051	Production Engineering	3	8	20	20	10	50
PDE052	Engineering Drawing	3	10	20	30	--	50
ENG111	Technical Reports Writing	2	6	20	30	--	50
BAS113	Mathematics (3)	3	8	20	30	--	50
BAS114	Mathematics (4)	3	8	20	30	--	50
BAS115	Statistics and Probabilty Theory	2	6	20	30	--	50
ELE151	Electrical Power and Machines	3	8	20	30	--	50

BAS215	Mathematics (5)	3	8	20	30	--	50
ENG412	Project Management	2	6	20	30	--	50
Total		45	127				

3.3 The Program Requirements (Core Courses)

Tables (3), (4) and (5) show the courses distribution according to the specializations in CCE which include:

- Compulsory Courses
- Elective Courses
- Training and Graduation Projects

Table 3: Compulsory Courses for Specialization Requirements

(77 credit hours, 48.125% of the total 160)

Code	Course Name	Credit	Total SWL	Marks Distribution				Groups Name
				Mid Term	semester Works	Lab	Final Term	
CSE 042	Introduction to Computer Systems	3	9	20	20	10	50	
CSE 141	Digital Design (1)	3	8	20	20	10	50	
CSE 112	Algorithms and Data Structure	3	9	20	20	10	50	
CSE 221	Control (1)	3	8	20	30	--	50	
CSE 212	Data Base systems	3	9	20	20	10	50	
CSE 211	Digital Design (2)	3	8	20	30	--	50	
CSE 213	Computer Architecture	3	9	20	20	10	50	
CSE 311	Operating Systems	3	9	20	20	10	50	
CSE 312	Computer Networks (1)	3	9	20	20	10	50	
CSE 313	Microprocessors	3	8	20	30	--	50	
ECE 123	Electronic Basics	3	9	20	20	10	50	
ECE 121	Electrical Circuits	3	8	20	30	--	50	
ECE 221	Electronic circuits	3	9	20	20	10	50	
ECE 131	Signals and Systems	2	6	20	30	--	50	
ECE 232	Analog Communication Systems	3	8	20	30	--	50	
ECE 331	Digital Communication Systems	3	8	20	30	--	50	
ECE 231	Digital Signal Processing	3	8	20	30	--	50	
ECE 122	Solid State Electronics	3	8	20	30	--	50	
CSE 314	Computer Drawings	3	9	20	20	10	50	
CSE 315	Embedded Systems	3	9	20	20	10	50	
ECE 341	Electromagnetic Fields	3	8	20	30	--	50	
ECE 342	Waveguides and Antennas	3	9	20	20	10	50	
CSE 411	Advanced Programming Techniques	3	9	20	20	10	50	
CSE 421	Programmable Logic Control	3	9	20	20	10	50	

CSE 422	Artificial Intelligence	3	9	20	20	10	50	
ECE 431	Mobile Communications	3	8	20	30	--	50	
Total		77	220					

Table 4: Elective Courses for Specialization Requirements

In communications and computer engineering

(18credit hours 11.25% of the total 160 credit hours)

Code	Course Name	Credit	Total SWL	Marks Distribution				Groups Name
				Mid Term	semester Works	Lab	Final Term	
CCE 311	Integrated Circuits	3	8	20	30	--	50	
CCE 331	Optical Fiber	3	8	20	30	--	50	
CCE 332	Microwave Engineering	3	8	20	30	--	50	
CCE 341	Distributed systems	3	8	20	30	--	50	
CCE 342	Multimedia	3	8	20	30	--	50	
CCE 343	Computer System Programming	3	8	20	30	--	50	
CCE 344	Software Engineering	3	8	20	30	--	50	
CCE 345	Control (2)	3	8	20	30	--	50	
Level 400								
CCE 411	Industrial Electronics	3	8	20	30	--	50	
CCE 412	Introduction to Nanotechnology	3	8	20	30	--	50	
CCE 421	Information Theory	3	8	20	30	--	50	
CCE 422	Selected Topics in Communications Engineering	3	8	20	30	--	50	
CCE 423	Satellite Communications	3	8	20	30	--	50	
CCE 424	Communication Security	3	8	20	30	--	50	
CCE 425	Adapative Filters	3	8	20	30	--	50	
CCE 426	Phonics	3	8	20	30	--	50	
CCE 427	Wireless Communications	3	8	20	30	--	50	
CCE 441	Computer Networks (2)	3	8	20	30	--	50	
CCE 442	Design and Programming of Web server	3	8	20	30	--	50	
CCE 443	Big Data Analytics	3	8	20	30	--	50	
CCE 444	Selected Topics in ComputersEngineering	3	8	20	30	--	50	
CCE 445	Game Theory and Decision	3	8	20	30	--	50	
CCE 446	Internet Engineering	3	8	20	30	--	50	
CCE 447	Languages Compilers	3	8	20	30	--	50	
CCE 461	Digital Image Processing	3	8	20	30	--	50	
CCE 462	Biomedical Engineering	3	8	20	30	--	50	
CCE 463	Communication Engineering for Genetics and Bioinformatics	3	8	20	30	--	50	
CCE 464	Neural Engineering	3	8	20	30	--	50	

Table 5: Graduation projects and field training
(7 credit hours, 4.375% of the total 160)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	semester Works	Lab	Final Term
CCE 271	Training (1)	1	3	--	--	--	--
CCE 371	Training (2)	1	3	--	--	--	--
CCE 481	Graduation Project (1)	2	6		50	--	50
CCE 482	Graduation Project (2)	3	9	--	50	--	50
Total		7	21				

4. CCE Program Curriculum

The curriculum presents the credit units, weekly contact hours either for lectures, tutorial and practical work for all courses. The curriculum also presents SWL and Marks distribution in addition to the senior project and the summer training according to **NARS 2018**. It is clear from the table that the total contact hours (lectures + tutorial+ practical) in addition to the hours of self-learning range from 44 to 49 hours per week for all levels with an average of 46 hours per week.

LEVEL 000

First Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
BAS 011	Mathematics (1)	3	2	2	-	4	8	20	30	-	50	100	-
BAS 021	Mechanics (1)	3	2	2	-	4	8	20	30	-	50	100	-
BAS 031	Physics (1)	3	2	1	1.5	4.5	9	20	20	10	50	100	-
BAS 041	Engineering Chemistry	3	2	1	1.5	4.5	9	20	20	10	50	100	-
PDE 052	Engineering Drawing	3	2	2	-	6	10	20	30	-	50	100	-
UNR 061	English (1)	2	1	2	-	2	5	20	30	-	50	100	-
Total		17	11	10	3	25	49	120	160	20	300	600	-
Total Contact hours = 24 hrs/week, Total SWL = 49 hrs/week													

Second Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
BAS 012	Mathematics (2)	3	2	2	-	4	8	20	30	-	50	100	BAS011
BAS 022	Mechanics (2)	3	2	2	-	4	8	20	30	-	50	100	BAS021
BAS 032	Physics (2)	3	2	1	1.5	4.5	9	20	20	10	50	100	-
CSE 042	Intduction to Computer Systems	3	2	1	1.5	4.5	9	20	20	10	50	100	-
PDE 051	Production Engineering	3	2	-	3	3	8	20	20	10	50	100	-
UNR062	English (2)	2	1	2	-	2	5	20	30	-	50	100	UNR061
Total		17	11	8	6	22	47	120	160	30	300	600	
Total Contact hours = 25 hrs/week, Total SWL = 47 hrs/week													

LEVEL 100

Third Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
BAS 113	Mathematics (3)	3	2	2	-	4	8	20	30	-	50	100	BAS 012
UNR 171	History of Engineering and Technology	1	1	-	-	1	2	20	30	-	50	100	-
ECE 121	Electrical Circuits	3	2	2	-	4	8	20	30	-	50	100	BAS 032
CSE 141	Digital Design (1)	3	2	1	1	4	8	20	20	-	50	100	CSE 042
ENG 111	Technical Reports Writing	2	1	2	-	3	6	20	30	10	50	100	UNR 061
ECE 122	Solid State Electronics	3	2	2	-	4	8	20	30	-	50	100	BAS 031 BAS 032
	Total	15	10	9	1	20	40	120	170	10	300	600	
Total Contact hours = 20 hrs/week, Total SWL = 40 hrs/week													

Fourth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
BAS 114	Mathematics (4)	3	2	2	-	4	8	20	30	-	50	100	BAS 113
CSE 112	Algorithms and Data Structure	3	2	1	1.5	4.5	9	20	20	10	50	100	CSE 042
BAS 115	Statistics and Probabilty Theory	2	1	2	0	2	5	20	30	-	50	100	BAS 012
ECE 131	Signals and Systems	2	2	0	0	4	6	20	30	-	50	100	BAS 113
ECE 123	Electronic Basics	3	2	1	1.5	4.5	9	20	20	10	50	100	ECE 121 ECE 122
ELE 151	Electrical Power and Machines	3	2	2	-	4	8	20	30	-	50	100	ECE 121
	Total	16	11	8	3	23	45	120	160	20	300	600	
Total Contact hours = 22 hrs/week, Total SWL = 45 hrs/week													

LEVEL 200

Fifth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
BAS 215	Mathematics (5)	3	2	2	-	5	8	20	30	-	50	100	BAS 113
CSE 211	Digital Design (2)	3	2	2	-	5	9	20	30	-	50	100	CSE 141
CSE 212	Data Base Systems	3	2	-	3	4	9	20	20	10	50	100	CSE 112
ECE 231	Digital Signal Processing	3	2	2	-	5	9	20	30	-	50	100	ECE 131
UNR 241	Communication and Presentation Skills	2	2	-	-	3	5	20	30	-	50	100	-
Total		14	10	6	3	22	41	100	140	10	250	500	
Total Contact hours = 19 hrs/week, Total SWL = 41 hrs/week													

Sixth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
CSE 221	Control (1)	3	2	2	-	4	8	20	30	-	50	100	BAS 113 ECE 121
CSE 213	Computer Architecture	3	2	-	2	5	9	20	20	10	50	100	CSE 211
ECE 232	Analog Communication Systems	3	2	2	-	4	8	20	30	-	50	100	BAS 114 ECE 131
ECE 221	Electronic Circuits	3	2	-	2	5	9	20	30	10	50	100	ECE 123
UNR 281	Law and Human Rights	2	2	-	-	2	4	20	30	-	50	100	-
CCE 271	Training (1)	1	-	-	-	-	3	-	-	-	-	-	-
Total		15	10	4	4	20	41	100	140	20	250	500	
Total Contact hours = 18 hrs/week, Total SWL = 41 hrs/week													

LEVEL 300

Seventh Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
CSE 311	Operating Systems	3	2	-	2	5	9	20	20	10	50	100	CSE 213
ECE 331	Digital Communication Systems	3	2	2	-	4	8	20	30	-	50	100	ECE 232
CSE 313	Microprocessors	3	2	2	-	5	9	20	30	-	50	100	CSE 213
ECE 341	Electromagnetic Fields	3	2	2	-	4	8	20	30	-	50	100	BAS 113 ECE 121
CSE 312	Computer Networks (1)	3	2	-	2	4	8	20	20	10	50	100	CSE 042
Total		15	10	6	4	22	42	100	130	20	250	500	
Total Contact hours = 20 hrs/week, Total SWL = 42 hrs/week													

Eighth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
ECE 342	Waveguides and Antennas	3	2	1	1.5	4.5	9	20	20	10	50	100	ECE 341
Elective Table 13	Elective course (1)	3	2	2	-	4	8	20	30	-	50	100	Course Specs.
	Elective course (2)	3	2	2	-	4	8	20	30	-	50	100	
CSE 315	Embedded Systems	3	2	1	1.5	4.5	9	20	20	10	50	100	CSE 213
CSE 314	Computer Drawing	3	2	-	2	5	9	20	20	10	50	100	CSE 042
CCE 371	Training (2)	1	-	-	-	-	3	-	-	-	-	-	CCE 271
Total		16	10	6	5	22	46	100	120	30	250	500	
Total Contact hours = 21 hrs/week, Total SWL = 46 hrs/week													

LEVEL 400

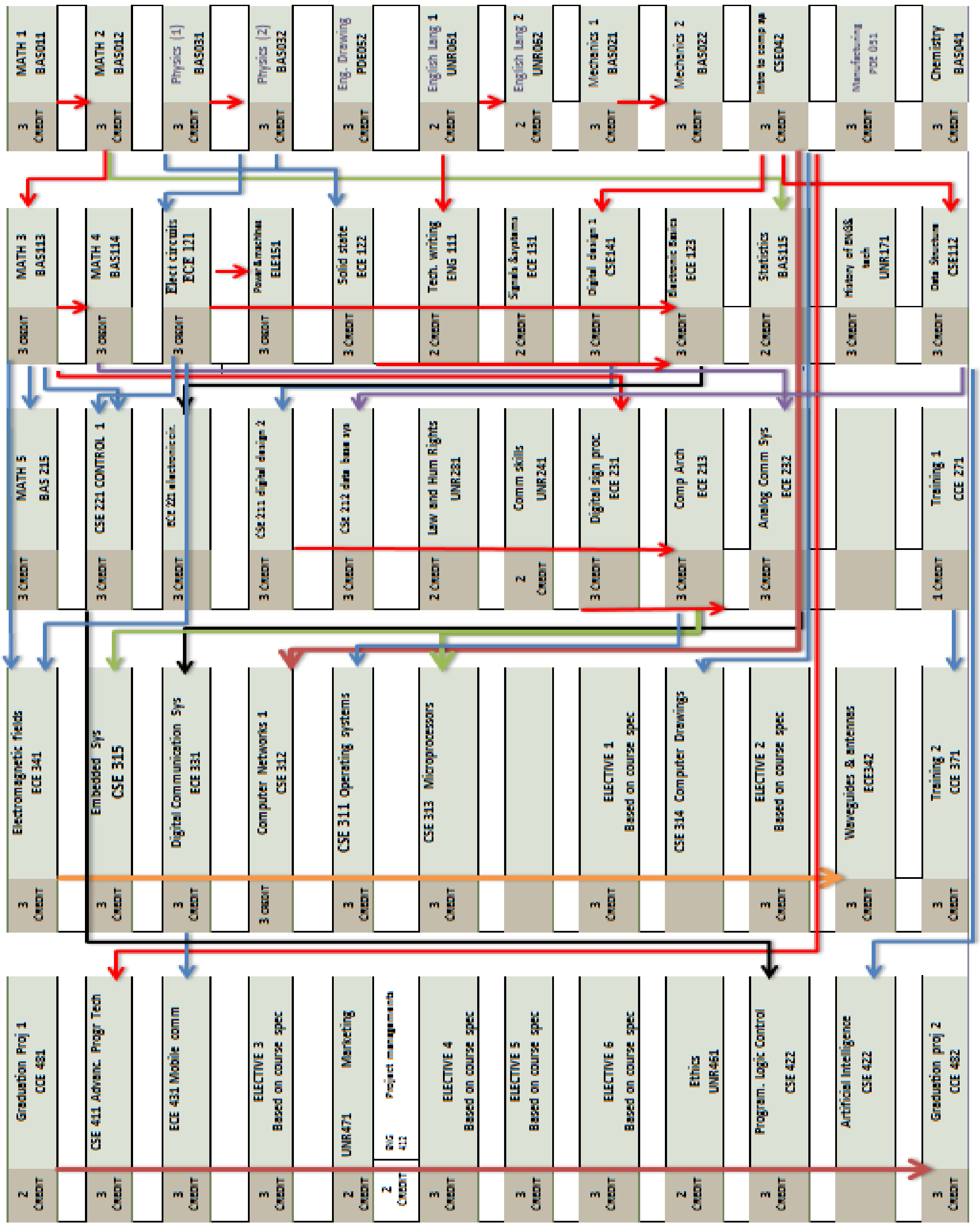
Ninth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
CCE 481	Graduation Project (1)	2	1	-	3	2	6	-	50	-	50	100	Level 400
ECE 431	Mobile Communications	3	2	2	-	4	8	20	30	-	50	100	ECE 331
Elective Table 13	Elective course (3)	3	2	2	-	4	8	20	30	-	50	100	Course Specs.
	Elective course (4)	3	2	2	-	4	8	20	30	-	50	100	
CSE 411	Advanced Programming Techniques	3	2	-	2	5	9	20	20	10	50	100	CSE 042
UNR 461	Ethics and Morals of The Profession	2	2	-	-	4	6	20	30	-	50	100	-
ENG 412	Project Management	2	1	2	-	2	5	20	30	-	50	100	-
Total		18	12	8	5	25	50	120	220	10	350	700	
Total Contact hours = 25 hrs/week, Total SWL = 50 hrs/week													

Tenth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
CCE 482	Graduation Project (2)	3	1	-	6	2	9	-	50	-	50	100	CCE 481
Elective Table 13	Elective course (5)	3	2	2	-	4	8	20	30	-	50	100	Course Specs.
	Elective course (6)	3	2	2	-	4	8	20	30	-	50	100	
CSE 421	Programmable Logic Control	3	2	1	1.5	4.5	9	20	20	10	50	100	CSE 221
CSE 422	Artificial Intelligence	3	2	1	1.5	4.5	9	20	20	10	50	100	CSE 112
UNR 471	Marketing	2	2	-	-	4	6	20	30	-	50	100	-
Total		17	11	6	9	23	49	100	180	20	300	600	
Total Contact hours = 26 hrs/week, Total SWL = 49 hrs/week													

Figure (2) Courses Dependency for CCE Program



Level	Course Code	Course Name	CCE Graduate Competencies According to NARS 2018														
			A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**B1**	**B2**	**B3**	**C1**	**C2**
000	BAS011	Mathematics (1)	√														
	BAS021	Mechanics (1)	√														
	BAS031	Physics (1)	√	√													
	BAS041	Engineering Chemistry	√	√													
	PDE052	Engineering Drawing	√		√												
	UNR061	English Language (1)								√							
	BAS012	Mathematics (2)	√														
	BAS022	Mechanics (2)	√														
	BAS032	Physics (2)	√	√													
	CSE042	Introduction to Computer Systems	√				√										
	PDE051	Production Engineering	√	√		√											
	UNR062	English Language (2)								√							
100	BAS 113	Mathematics (3)	√														
	ENG 111	Technical Report Writing					√			√							
	UNR 171	History of Engineering and Technology				√	√			√		√					
	ECE 121	Electric Circuits	√	√			√					√					
	CSE 141	Digital Logical Design 1	√	√									√	√			
	ECE 122	Solid state electronics	√	√									√	√			
	BAS 114	Mathematics (4)	√														
	BAS 115	Probability Theory and Statics	√	√				√									
	CSE 112	Algorithms and Data Structures	√	√			√					√					
	ECE 131	Signals and Systems	√	√			√					√					
	ECE 123	Electronic Basics	√	√									√	√			
	ELE 151	Electric Power and Machines	√	√									√	√	√		
200	BAS 215	Mathematics (5)	√	√													
	CSE 211	Digital Design 2	√		√	√					√				√		
	CSE 212	Data base Systems	√		√	√					√				√		√
	ECE 231	Digital signal processing	√		√	√					√				√	√	√
	UNR 241	Communication and Presentation Skills						√	√	√	√	√					
	CSE 221	Control 1	√		√	√					√				√		
	CSE 213	Computer Architecture	√		√	√					√				√	√	√

	ECE 232	Analog communication systems	√		√	√					√				√	√	√
	ECE 221	Electronic circuits	√									√	√	√		√	
	UNR 281	Law and Human Rights	√				√		√	√		√					
	CCE 271	Training (1)	√	√	√		√	√	√	√	√				√	√	√
300	CSE 311	Operating systems	√		√	√					√				√	√	√
	ECE 331	Digital communication systems	√		√	√					√				√	√	√
	CSE 313	Microprocessors	√		√	√					√				√	√	√
	ECE 341	Electromagnetic Fields	√									√		√			
	CCE 311	Integrated Circuits	√		√	√					√				√	√	
	CCE 331	Optical Fiber	√		√	√					√				√	√	
	CCE 332	Microwave Engineering	√		√	√					√				√	√	
	CCE 341	Distributed systems	√		√	√					√				√		√
	CCE 342	Multimedia	√		√	√					√				√		√
	CCE 343	Computer System Programming	√		√	√					√				√		√
	CCE 344	Software Engineering	√		√	√					√				√		√
	CCE 345	Control (2)	√		√	√					√				√	√	√
	CSE 312	Computer Networks (1)	√	√		√	√					√				√	√
	ECE 342	Waveguides and Antennas	√	√		√	√					√				√	
	CSE 315	Embedded Systems	√	√		√	√					√				√	√
	CSE 314	Computer Drawing	√	√		√	√					√					√
	CCE 371	Training 2		√	√	√		√	√	√	√	√	√	√	√	√	√
400	CCE 481	Graduation Project (1)	√	√	√	√	√	√	√	√	√	√			√	√	√
	ECE 431	Mobile Communications	√	√		√	√					√				√	
	CSE 411	Advanced Programming Techniques	√	√		√	√					√					√
	UNR 461	Ethics and Morals of the Profession	√			√	√		√	√	√	√					
	ENG 412	Project Management	√	√	√	√	√	√	√	√	√						
	CCE 482	Graduation Project (2)	√	√	√	√	√	√	√	√	√	√			√	√	√
	CSE 421	Programmable Logic Control	√	√		√	√					√				√	√
	CSE 422	Artificial Intelligence	√	√		√	√					√				√	√
	UNR 471	Marketing	√	√		√	√	√	√	√	√	√					
	CCE 411	Industrial Electronics	√	√		√	√					√				√	
	CCE 412	Introduction to Nanotechnology	√	√		√	√					√				√	
	CCE 421	Information Theory	√	√		√	√					√				√	√

	CCE 422	Selected Topics in Communications Engineering	√	√		√	√					√				√	
	CCE 423	Satellite Communications	√	√		√	√					√				√	
	CCE 424	Communication Security	√	√		√	√					√				√	√
	CCE 425	Adaptive Filters	√	√		√	√					√				√	√
	CCE 426	Phonics	√	√		√	√					√				√	
	CCE 427	Wireless Communications	√	√		√	√					√				√	
	CCE 441	Computer Networks (2)	√	√		√	√					√				√	√
	CCE 442	Design and Programming of Web server	√	√		√	√					√					√
	CCE 443	Big Data Analytics	√	√		√	√					√					√
	CCE 444	Selected Topics in Computers Engineering	√	√		√	√					√					√
	CCE 445	Game Theory and Decision making	√	√		√	√					√					√
	CCE 446	Internet Engineering	√	√		√	√					√					√
	CCE 447	Languages Compilers	√	√		√	√					√					√
	CCE 461	Digital Image Processing	√	√		√	√					√					√
	CCE 462	Biomedical Engineering	√	√		√	√					√				√	
	CCE 463	Communication Engineering for Genetics and Bioinformatics	√	√		√	√					√				√	√
	CCE 464	Neural Engineering	√	√		√	√					√				√	√

5. CCE Program Courses Syllabi

5.1. University Requirements:

UNR061	English (1)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---
Main skills of the English language - listening to short and long conversations - reading scientific passages - writing reports, summaries, and scientific articles - speaking and presenting new ideas									
References: • *Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011*									

UNR062	English (2)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	2nd	UNR061
Analysis and interpretation of engineering issues - summarizing engineering issues - preparation for language tests.									
References: • *Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011*									

UNR 171	History of Engineering and Technology								Prerequisites
1 Cr	Lecture	1	Tutorial	--	Lab.	--	Semester	3rd	---
Engineering history: Art, Science, Engineering and technology - Role of engineering and technology in development and establishment of civilizations -Technology and environment - Examples on development of engineering activity.									
References: • *Roger S. Kirby, Engineering in History, Dover Publications Inc. New York, United States, 1990, ISBN10 0486264122*									

UNR281	Law and Human Rights								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	6th	---
Systems and laws of institutions - Introduction to Accounting - Labor legislation and laws governing engineering professions - Industrial security legislation and environment - Historical philosophical origins of human rights - international sources of human rights - national sources of human rights - global bodies based on the protection of human rights.									

UNR241	Communication and Presentation Skills								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	5th	---
Communication skills - Presentation planning and preparation - Delivery skills such as eye contact, voice control, gestures, body language and appearance - Presenter's characteristics - Using visuals - Presentation structure - Elevator Pitch									
References: • *Joan van Emden, Lucinda Becker, Presentation Skills for Students, 3rd Edition, Red Globe Press, 2016* • *M. Wa Mutua, S. Mwaniki, P. Kyalo, B. Sugut, Communication Skills: A University Book, Succex Publishers, 2016* • *Ian Tuhovsky, Wendell Wadsworth, Communication Skills Training, Ian Tuhovsky, 2015* • *Tabitha Wambui, Alice W. Hibui, Elizaeth Gathuthi, "Communication skills " Vol.1, Students' coursebook, LAP LAMBERT Academic Publishing, 2012*									

UNR461	Ethics and Morals of The Profession								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	9th	---
General principles of professional ethics - Commitments to society - Responsibilities of the engineer - Detection of violations - Behavior - Case studies and general issues.									
References: ▪ *Lizabeth A. Stephan, David R. Bowman, William J. Park, Benjamin L. Sill, Matthew W. Ohland, "Thinking like an engineer", Published by Pearson 2018.* ▪ *Harris, C. E., Jr., Pritchard, M. S., & Rabins, M. J. Engineering Ethics. Second edition. Belmont, CA: Wadsworth, 2000*									

UNR471	Marketing								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	10th	---
Principles of products marketing - Marketing research - Customers buying behavior - Marketing mix - Plotting marketing strategy - Building marketing plan - Pinpointing the target market - Marketing on the world wide web - Branding strategy - Developing new products - Advertising and promotions - Costing and pricing strategies - Case studies on products marketing									
References: ▪ *Principles of Marketing, University of Minnesota Libraries Publishing, 2015, ISBN 13: 9781946135193*									

4.2. Faculty Requirements:

BAS011	Mathematics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---
Calculus: Function (definition - theorems) - Basic functions - limits - Continuity - Derivation - definition - theorems - types - higher orders - Applications on derivatives - partial derivatives - indefinite integral - theories and properties of integration. Algebra: Binomial theorem (with any exponent and applications) - Partial Fractions - Theory of Equations - Matrices - System of linear equations - Gauss elimination method.									
References: ▪ *Akhtar & Ahsan, Textbook of Differential Calculus, second edition, 2009, PHI Learning Private Limited.* ▪ *Alan Jeffrey, Matrix operations for Engineers and Scientists, 2010, Springer Science & Business Media.*									

BAS021	Mechanics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---
Newton's laws - Types of forces، coplanar forces، Rectangular components of vector (1D, 2D, Space), Forces in space - Equilibrium of a particle - Conditions, Free-body diagram - Moment - Couple moment - Resultant of a system of forces and couples as a force and couple system - General procedure for reducing force and couple systems - Equilibrium of a rigid body - Conditions of equilibrium of a rigid-body، free body diagrams – friction									
References: ▪ *R.C. Hibbeler, "Engineering Mechanics: Statics and Dynamics, 14th Edition", Pearson Prentice Hall, New Jersey, 2016.* ▪ *J. L. Meriam, L. G. Kriage, and J. N. Botton, "Engineering Mechanics: Statics, 8th Edition", John Wiley & Sons, New York, 2016.*									

BAS012	Mathematics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	3rd	**BAS011**

Integral Calculus: Definite integral - Methods of integration - Applicationson definite integral (plane area - volume of revaluation - length of a plane curve - area of surfaces of revolution) - improper integral.
Analytic Geometry: Equations of second degree - Equation of pair of straight lines - Translation of axes - Conic sections - parabola - ellipse - hyperbola) Equation of plane - Equation of sphere.

References:

- *Jumarie, G., Fractional Differential Calculus for Non-Differentiable Functions: Mechanics, Geometry, Stochastics, Information Theory. 2013: LAP Lambert Academic Publishing.*
- *Hestenes, D. and G. Sobczyk, Clifford algebra to geometric calculus: a unified language for mathematics and physics. Vol. 5. 2012: Springer Science & Business Media.*

Grossman, S.I., Multivariable calculus, linear algebra, and differential equations. 2014: Academic Press.

BAS022	Mechanics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	**BAS021**

Kinematics of a particle: curvilinear motion - Normal and tangential components. - Newton's laws - motion of projectiles - Work and energy of a particle - applications of friction.

References:

- *R.C. Hibbeler, "Engineering Mechanics: Statics, 11th Edition", Pearson Prentice Hall, 2006.*
- *F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg, "Vector Mechanics for Engineering, Statics and Dynamics, 9th Edition", McGraw-Hill, New York, 2010.*

BAS031	Physics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Material properties: Physical quantities - Standard units and dimensions - Mechanical properties for materials - Fluid properties - Periodic motion - Mechanical waves - Sound waves - Waves in elastic media.
Heat and thermodynamics: Temperature measurements and thermometers - Thermal expansion - Specific and latent heat - Heat transfer - Gas motion theory - First law of thermodynamics - Entropy and second law of thermodynamics.

References:

- *Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 6th Edition, Thomson Brooks/Cole 2014.*
- *Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.*

BAS032	Physics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2nd	---

Electricity and Magnetism: Electric charge - Electric force - Electric field- Column's law- Electric flux- Gauss law- Electric potential- Electric capacitance and Dielectrics - Ohm's law and simple circuits- Magnetic field - Baiot and Savart laws.
Optics and Modern physics: Nature of light and laws of geometric optics - Interference - Diffraction - polarization - optical fiber - laser - photoelectric effects - principle of quantum theory - special theory of relativity.

References:
- *Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 9th Edition, Thomson Brooks/Cole 2014.,*
- *Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.*

BAS041	Engineering Chemistry								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Equations of state-chemical thermodynamics - Material and energy balance in chemical processes- properties of solutions - Basic principles in electrochemistry and it’s applications- selected topics in chemical industry.

References:
- *Brown, L. T, LeMay H. E. Jr; Bursten, B. E.; Murphy, C.J., and Woodward, P.; " Chemistry The Central Science", Pearson International Edition (11th edn), Pearson Printice Hall, (2009).*

PDE051	Production Engineering								Prerequisites
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	2ed	---

Introduction to the following processes (Casting- Forging- Metal filing - Machining- Forming- Woodworking)

References:
- *Hitomi, Katsundo. Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics. Routledge, 2017.*

PDE052	Engineering Drawing								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Two-dimensional drawings - Free-hand sketching - Sectional views - Auxiliary views and conventions - Computer-aided drawing (CAD) of 2D and 3D figures.

References:
- *Mcgraw-hill Mint, "Mechanical Drawing Board & CAD Techniques", Student Edition,2011*

ENG111	Technical Reports Writing								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	3rd	UNR062

Technical writing definition - audience analysis - technical writing styles - technical document characteristics - automated document organization - official and unofficial document types - structure of different types of technical documents.

References:
- *G. J. Alred, W. E. Oliu, The Handbook of Technical Writing, 12th Edition, Bedford/St. Martin's; 2018*
- *K. Hyland, Teaching and researching writing. 3rd edition Routledge academic publisher, 2016*
- *M. Markel, Technical Communication, 11th edition, MacMillan, 2015.*

BAS113	Mathematics (3)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	3rd	**BAS012**

Applications of partial differentiation - Maximum values of functions in more than one variable and applications - First order differential equations - Second order differential equations - Laplace transform and its applications - Analytical geometry in space.

References:
- *D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.*
- *S. A. Wirkus, and R. J. Swifi, "A Course of Ordinary Differential Equations", Taylor & Francis Group, LLC, 2015.*

BAS114	Mathematics (4)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	4th	**BAS113**

Fourier series - Fourier transform - Complex numbers - Functions of a complex variable - Complex integration - Residue theorem - Direction derivatives - Double integrals - Triple integrals - Line integrals - Surface integrals.

References:
- *J. Brown, and R. Churchill, "Complex Variables and Applications", 9th Edition, McGraw-Hill, 2013.*
- *D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.*

BAS 115	Statistics and Probabilty Theory								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	4th	**BAS012**

Measures of tendency and dispersion - Probability distributions - Sampling theorem - tests of hypothesis - non-parametric tests - regression and correlation - time series.

References:
- *Mary C. Meyer, Probability and Mathematical Statistics: Theory, Applications, and Practice in RSBN-10: 1611975778, SIAM (June 24, 2019)*

ELE151	Electrical Power and Machines								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	4th	---

Power: Electrical power systems - three phase systems - Theory and models of transformers - Transmission line models - Voltage and frequency control - effective and ineffective power - Optimal work of power systems.

Machines: The theory of operation - The construction of the Direct Current motors. The speed، torque، and current characteristics - applications of the DC motors. The theory of operation and construction of stepper motors - Permanent-magnet DC motor and Low-inertia DC Motors. The theory of operation، construction of three phase induction motors.

References:
- *Nilsson, J.W. and S.A. Riedel, Electric circuits. 2015: Pearson Upper Saddle River, NJ.*
- *Slade, P.G., Electrical contacts: principles and applications. 2017: CRC press.*

BAS215	Mathematics (5)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	5th	**BAS113**

Numerical solution of linear and non-linear systems of equations - Iterative methods - Curve fitting: Least square of (Straight lines, Polynomials), Linearization of nonlinear relationship. Interpolation and polynomial approximation -finite difference operators - Numerical integration and differentiation.

References:
- *Mazumder, Numerical Methods for Partial Differential Equations, Finite Difference and Finite Volume Methods, science direct ,2016.*
- *Sheldon Rose, A First course in probability, Eighth edition, 2010, Pearson Prentice Hall.*

ENG 412	Project Management							Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	9th	---

Basics of project management - basic administrative functions - planning, preparatory for different engineering applications. Elements of human resources management: recruitment, mentoring, and control. Total quality management, continuous improvement. - Integration management - Domain management - Time management - Cost management - Communication management - Risk management - Procurement management

References:

- *Kerzner, H. and H.R. Kerzner, Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons, 2017.*
- *Kalpakjian, S., K. Vijai Sekar, and S.R. Schmid, Manufacturing Engineering and technology. Pearson, 2014.*
- *Nigel J. Smith, "Engineering Project Management", 3rd Edition, Wiley-Blackwell, 2008.*

5.3. CCE Program Requirements

5.3.1. CCE Program Compulsory courses

CSE042	Introduction to Computer Systems								Prerequisites
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	2ed	---

Introduction to the design and operation of digital computers: types of data and its representation and number systems - the basic components of the computer and the organization of the computer and the ways of transfer of information- programming with Visual Basic - Introduction to information networks

Introduction to Programming: Program Structure and Command Types - Presentation of key commands - simple software development

Training Fundamentals: Dealing with Common Operating Systems (Windows – Linux) - Software Development and Desktop Software

References:

- Peter Van Roy, Seif Haridi, "Concepts, Techniques, and Models of Computer Programming" The MIT Press (February 20, 2012)

ECE 121	Electrical Circuits								Prerequisites
3Cr	3rd	Semester	-	Lab.	2	Tutorial	2	Lecture	BAS 032

Elements of electrical circuits - Simple resistive circuits - Analysis of DC circuits - Theories of electrical circuits - First-order circuits –steady AC sinusoidal circuits - Power and power factor - Resonance circuits - Three-phase circuits.

References

- *William Hayt, Jack Kemmerly, Steven Durbin,Engineering Circuit Analysis, 8th ed. 2011*

ECE122	Solid State Electronics								Prerequisites
3Cr	3rd	Semester	-	Lab.	2	Tutorial	2	Lecture	BAS 032 BAS 031

Introduction to quantum physics; Quantum mechanics; Atomic Physics; Molecules and solids; energy states and spectra of molecules, bonding in solids, introduction to crystalline properties of semiconductors, free electron theory of metals, band theory of solids, electrical conduction in metals, insulators and semiconductors, superconductivity. PN junction diode, Zener diode and tunnel diode

References

- *Donald Neamen, Semiconductor physics and Devices, McGraw-Hill 2003*

ECE 141	Digital Design (1)								Prerequisites
3Cr	3rd	Semester	1	Lab.	1	Tutorial	2	Lecture	CSE 042

Numeric Systems - Converting between binary, decimal, octal and hexadecimal numbers – Booleanalgebra - Logic gates –simplification of logic functions – Karnaugh map (Sum of product) minimization - Karnaugh map (Product of sum) minimization - Combinational logic analysis - Combinational logic using NAND and NOR gates – Functions of combinational logic : (Adders, Comparators, Decoders/Encoders, Code converters, Multiplexers, Parity generators) – Applications using FPGA – Experimental : Implementation of digital combinational circuit using TTL ICs.

References

- *Mano, M. Morris, and Charles R. Kime. Logic and computer design fundamentals. Pearson Higher Education, 2015.,*
- *Thomas L. Floyed, Digital fundamentals, Pearson international edition, 11th edition, 2019*

CSE 112	Algorithms and Data Structure								Prerequisites
3Cr	4th	Semester	1.5	Lab.	1	Tutorial	2	Lecture	CSE 042

Introduction to data structures - Different Data representations- Study the Introduction to data structures - Different Data representations- Study the structure، properties، and implementation issues of different data structures (Array – Stack – queue،..) -Data Structure Storing ، ordering and sorting algorithms. - Study Different search algorithms - Evaluation and analysis of studied algorithms using a recent programming language.

References

- *Allen Weiss Mark. Data structures and algorithm analysis in C++. Pearson Education India, 2007.*
- *Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles, Fifth Edition 5thEdition, 2017.*

ECE 123	Electronic Basics								Prerequisites
3Cr	4th	Semester	1.5	Lab.	1	Tutorial	2	Lecture	ECE122 ECE 121

Diode Circuit Analysis and Applications, Rectifier Circuits, Peak-Inverse-Voltage (PIV), Diode Power Dissipation, Clipping and Clamping Circuits, Power Generation from Solar Cells, Bipolar Transistors and Their Properties and Applications in DC Circuits - Field Impact Transistors (JFET / MOSFET) and their Properties and Applications in DC Cases.

References

- *Thomas L.* Floyd. ELECTRONIC. DEVICES. *Prentice Hall, 9th ed., 2012.*
- *Ulrich Tietze, Christoph Schenk, Eberhard Gamm "Electronic Circuits: Handbook for Design and Application", Springer; 2nd edition (March 11, 2008).*

ECE 131	Signals and Systems								Prerequisites
2Cr	4th	Semester	0	Lab.	0	Tutorial	2	Lecture	BAS 113

Continuous time and discrete time signals and systems - basic system properties - Linear Time Invariant Systems – The C.T and D.T. convolution –Properties of LTI systems - Fourier Series Representation of C.T. and D.T. Periodic Signals - Parseval's relation - The C.T. Fourier Transform for periodic and aperiodic signals - Properties of continuous time F.T. – The D.T. Fourier Transform – Properties of D.T. Fourier Transform - Complex exponential and sinusoidal Amplitude Modulation-Demodulation for Sinusoidal AM - Frequency Division Multiplexing - Representation of continuous time signal by its samples - The sampling Theorem - The effect of under-sampling or aliasing - sampling with zero order hold - The Z Transform

References

- *Lizhe Tan Jean Jiang, "Digital Signal Processing Fundamentals and Applications", cademic Press, 9thNovember 2018.*

CSE 221	Control (1)								Prerequisites
3 Cr	6th	Semester	0	Lab.	2	Tutorial	2	Lecture	BAS 113 ECE 121

Introduction to control systems - Open and closed loop control systems – Laplace transformation and transfer function - Block diagram reduction – Signal flow graph - Modeling of systems: (Electrical circuits , Mechanical systems, DC motors, AC servo motors, Synchro, Potentiometers, stepper motors – Hydraulicservo motor – Thermal systems – liquid level systems) – Linearization of nonlinear mathematical model – Time response analysis: (First order systems – second order systems – steady state error) – Stability ofcontrol systems: (Routh stability analysis – Determining relative stability using Routh and root locusmethod) – Applications of the previous topics using MATLAB/Simulink toolboxes

References

-Ogata, Katsuhiko. Modern control engineering. Upper Saddle River, NJ: Prentice Hall, 2015
-Farid Golnaraghi, Benjamin Kuo, "Automatic Control Systems", McGraw-Hill Education, 10 edition, 2017

CSE 212	Data Base Systems								Prerequisites
3Cr	5th	Semester	2	Lab.	0	Tutorial	2	Lecture	CSE 112

Basic database concepts - data structures and operations - data modeling –database system architecture - data definition and data manipulation languages - query languages including Algebra and SQL - software package training

References

Jukic, Nenad, Susan Vrbsky, and Svetlozar Nestorov. Database systems: Introduction to databases and data warehouses. Prospect Press, 2016

CSE 211	Digital Design (2)								Prerequisites
3Cr	5th	Semester	0	Lab.	02	Tutorial	2	Lecture	CSE 141

Latches – SR Flip flops – D Flip flops – JK flip flops – T Flip flops– Edge triggered flip flops – Sequential circuit analysis – Analysis of clocked sequential circuits – state reduction – flip flop excitation tables – design procedure – registers – shift registers – ripple counters – synchronous counters – random access memory (RAM) – memory decoding – Algorithmic state machine (ASM): (timing consideration – control implementation – design with multiplexers) – Applications using FPGA - Practical experiments using TTL logic chips with the aid of 555 timer IC.

References

-*Mano, M. Morris, and Charles R. Kime. Logic and computer design fundamentals. Pearson Higher Education, 2015.*
-*Thomas L. Floyed, Digital fundamentals, Pearson international edition, 11th edition, 2019*.

CSE 213	Computer Architecture								Prerequisites
3Cr	6th	Semester	02	Lab.	0	Tutorial	2	Lecture	CSE 211

Computer arithmetic - design of ALU - pipelined ALU and processor – multiprocessors - multicomputers control unit - instruction repertoires (RISC, CISC) - interrupt circuits - bus synchronization - I/O devices - channels - memory architectures - connection of computer peripherals - Distributed Systems- parallel processors architecture - scalable computer platforms - vector processors - vectorizing compilers - systolic arrays - loosely and tightly coupled processors - symmetric and CC-NUMA multiprocessors- data flow machines - interconnecting networks - clustering - parallel programming - performance evaluation - case studies

References

- *Andrew S. Tanenbaum, Structured Computer Organization (5th Edition) 5th Edition, Pearson; 5 ed. 2005*
- *M. Morris Mano, Computer System Architecture, Prentice Hall, 1992*

CSE 311	Operating Systems								Prerequisites
3Cr	7th	Semester	2	Lab.	0	Tutorial	2	Lecture	CSE 213

Types of operating systems - functions of operating systems - process states - memory management - virtual memory - processor management - process scheduling - case study (Unix)- Real Time Operating systems-Multithreading. Multiprocessor systems - device management - deadlock prevention - file systems - system resilience - network and distributed operating systems - programming project.

References

- *Silberschatz, Abraham, Greg Gagne, and Peter B. Galvin. Operating system concepts. Wiley, 2018*.

CSE 312	Computer Networks (1)								Prerequisites
3Cr	7th	Semester	2	Lab.	0	Tutorial	2	Lecture	CSE 042

Seven layer communication model - network architecture and protocols routing techniques and algorithms - network planning and design - Network layers, TCP / IP Network protocol, Routing protocols, Network Design, Network Management, Congestion, Examples of LAN's and WAN's, High Speed Networks, Other Network Protocols.

References

- *Mosharraf, Firouz. Computer Networks: A Top-down Approach. McGraw-Hill, 2016.*

CSE 313	Microprocessors								Prerequisites
3Cr	7th	Semester	0	Lab.	2	Tutorial	2	Lecture	CSE 213

Computer architecture - CPU architecture - fetch-decode-execute cycle - addressing modes - instruction set - memories (RAM-ROM-Cache-Flash) - memory interfacing - timing diagrams - assembly language - instruction formats - data representation - arithmetic operations, Program controlled and interrupt driven I/O - I/O interfacing - connection of terminals, discs and I/O ports - assembly language - macros and kernels - introduction to embedded systems

References

- *Ahmet Bindal, "Fundamentals of Computer Architecture and Design", Springer; 2nd ed. 2019 edition (January 31, 2019).*

ECE 231	Digital Signal Processing								Prerequisites
3Cr	5th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 131

General Introduction - Speech Characteristics - Short time Processing - Pitch & Formants Estimation - Vector Quantization - Linear Predictive Coding - speech Coding Techniques - Speech Synthesis - Speech Recognition - Speaker Recognition - Image Coding - Video Coding - ReviewProjects.

References

- *Lizhe Tan Jean Jiang, "Digital Signal Processing Fundamentals and Applications", cademic Press, 9th November 2018.*

ECE 232	Analog Communication Systems								Prerequisites
3Cr	6th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 131 BAS 114

All Types of AM (DSB-LC, DSB-SC, SSB, VSB, QAM) – AM modulators, and demodulators, advantages and disadvantages-Synchronization circuits - AM applications: Telephone channel multiplexing and super heterodyne receiver -Angle Modulation - Narrow band angle modulated signals - Spectrum of sinusoidal signal (N.B and W.B) - Generation of wide band FM (Indirect and Direct methods)-Demodulation (slope detector, PLL) - De-emphasis and pre-emphasis filtering -compatible stereo - Intersystem comparison – Sampling process – PAM – Quantization (uniform and non-uniform) – PCM – Time division multiplexing – Delta, and adaptive delta modulation – Differential PCM – random process – Stationary and ergodic processes – Mean, correlation, and covariance functions – Power spectral density – Narrow band noise.

References

- *K.C. Raveendranathan, " Analog Communications Systems: Principles and Practices", Orient Blackswan (September 23, 2008).*

ECE221	**Electronic circuits**								**Prerequisites**
3Cr	**6^{th}**	**Semester**	**1.5**	**Lab.**	**1**	**Tutorial**	**2**	**Lecture**	**ECE 123**

AMPLIFICATION, Circuit MODELS FOR AMPLIFIERS-Impedance level transformation; VOLTAGE, current, Power gain; Frequency Response of Amplifiers, SINGLE-TRANSISTOR AMPLIFIERS; SMALL-SIGNAL MODELING AND LINEAR AMPLIFICATION; The BJT Amplifier. The MOSFET Amplifier Coupling and Bypass Capacitors Circuit Analysis Using dc and ac Equivalent circuits, Multistage amplifiers and composite circuits - Current mirrors – High frequency analysis and frequency response – Differential amplifiers - Feedback amplifiers - Digital logic gates – Sequential circuits (flip-flops, shift registers, counters) – Power amplifiers, Active filters based Operational amplifiers.

References

- *Thomas L.* Floyd. ELECTRONIC. DEVICES. *Prentice Hall, 9^{th} ed., 2012.*
- *Ulrich Tietze, Christoph Schenk, Eberhard Gamm "Electronic Circuits: Handbook for Design and Application", Springer; 2nd edition (March 11, 2008).*

ECE 331	**Digital Communication Systems**								**Prerequisites**
3Cr	**7^{th}**	**Semester**	**0**	**Lab.**	**2**	**Tutorial**	**2**	**Lecture**	**ECE 232**

Baseband Pulse transmission: Matched filters, Intersymbol Interference, Nyquist Criterion for distorionless baseband binary transmission - Signal- Space Analysis: Geometric representation of signals, likelihood functions, coherent detection of signals in noise: ML and MAP decoding rules, the correlation receiver. Probability of error calculation – Pass-band Digital Transmission: Description of ASK, FSK, PSK, DPSK, QAM, MSK modulation schemes - their implementation PSD c/cs - B.W efficiency (spectral efficiency) - performance in AWGN channels.

References

- *DR. J. S. CHITODE, "DIGITAL COMMUNICATION", Technical Publications; 1st edition, 2011*

ECE 341	**Electromagnetic Fields**								**Prerequisites**
3Cr	7^{th}	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 121 BAS 113

Vector analysis, static electric field, steady currents, electromagnetic fields. static magnetic fields, time varying and time harmonic Maxwell's equations, wave equation and its solutions, boundary conditions, introduction to electromagnetic wave propagation

References

- *Salam, Md. Abdus, "Electromagnetic Field Theories for Engineering", Springer Singapore, 2014.*
- *Sadiku, Matthew N. O.* Elements of Electromagnetics. *New York: Oxford University Press, 2001.*

ECE 342	Waveguides and Antennas								Prerequisites
3Cr	8th	Semester	1.5	Lab.	1	Tutorial	2	Lecture	ECE 341

Time varying fields and Maxwell's equations, boundary conditions at different media interface, retarded potentials, plane wave propagation in free space, TEM transmission lines, transmission line equivalent circuit, transmission line circuit theory, Smith chart, lossy transmission lines, matching techniques. Antenna fundamentals, basic antenna parameters, radiation fromwire antennas, aperture antennas, radiation from microstrip antennas, antenna arrays, array polynomial, phased arrays and nullsteering, receiving antennas, polarization mismatch, antennadesign techniques, introduction toterrestrial and extra terrestrial radio wave propagation, surface wave propagation, iono spheric propagation, microwave and millimeter wave

References

- *Bansal, Rajeev. Fundamentals of engineering electromagnetics. CRC press, 2018.*
- *Carlo G. Someda, "Electromagnetic Waves ", CRC Press; 2 edition (January 13, 2006).*
- *U. A. BAKSHI, "ANTENNA & WAVE PROPAGATION", Technical Publications; 1st edition, 2011.*

CSE 315	Embedded Systems								Prerequisites
3Cr	8th	Semester	1.5	Lab.	1	Tutorial	2	Lecture	CSE 213

Embedded system design process - embedded computing platform- program design and analysis- Hardware accelerators - distributed embedded architectures- system analysis and architecture design- Design example – Programming project.

References

- *Ibrahim, Dogan. Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC 18F Series. Newnes, 2016.*

CSE 314	Computer Drawings								Prerequisites
3Cr	8th	Semester	2	Lab.	0	Tutorial	2	Lecture	CSE 042

Fundamentals of computer graphics - display devices - fundamentals of graphic algorithms - two dimensional graphics - polygon representation - polygon filling - polygon clipping - three dimensional graphics - back face removal - scan line and ray tracing - illumination and shading models - programming projects

References

- *Computer Graphics: Principles and Practice in C, by J. D. Foley, A. Van Dam, S. K. Feiner, J. F. Hughes. Addison-Wesley, 2nd ed..*

CSE 411	Advanced Programming Techniques								Prerequisites
3Cr	9th	Semester	2	Lab.	0	Tutorial	2	Lecture	CSE 042

Programming Techniques in Network and various Media Types – New Programming Techniques (e.g. Internet programming-Web based applications – workflow automation – multithreaded programming –

introto embedded programming–Languages for Internetworking programming and Data Transfer

References

- *Rick Bitter, Advanced Programming Techniques, 2nd ed., CRC Press 2017*

CSE422	Artificial Intelligence								Prerequisites
3Cr	10th	Semester	1.5	Lab.	1	Tutorial	2	Lecture	CSE 112

Introduction to artificial intelligence concepts and definitions -state-space and search - knowledge representation - logic- production systems - semantic networks - frames - knowledge issues - inference - inheritance - nonmonotonic reasoning- uncertainty - fuzziness- game playing - AI-programming languages - Introduction to expert systems and knowledge engineering.- application fields that need intelligence (natural languages- learning-planning-robotics- decision support systems- intelligent agents – Semantic web
Russell, Stuart J., and Peter Norvig. Artificial intelligence: a modern approach.

References

- *Malaysia; Pearson Education Limited, 2016.*
- *Devangini Patel, Hands on Artificial Intelligence for search, 2018*

CSE 421	Programmable Logic Control								Prerequisites
3Cr	10th	Semester	1.5	Lab.	1	Tutorial	2	Lecture	CSE 221

Modular structure of Programmable Logic Controllers (PLCs) – Advantages of using PLCs in Industrial Automation – PLC Programming – Ladder Logic – Handling of Inputs and Outputs in PLCs – Markers – Timers –Counters – PLC Program Development for Control Applications – Interlocking Logic – Sequential Logic - Micro processor control systems – Interfacing controllers with sensors and actuators – Programming of Control Algorithms -Three-term control using micro processors – Controller Fault Tolerance.

References

- *Bolton, William. Programmable logic controllers. Newnes, 2015*

ECE 431	Mobile Communications								Prerequisites
3Cr	9th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 331

Conventional telephone systems – Traffic theory – Conventional mobile system – Frequency spectral efficiency – Methods of increasing system capacity – System architecture – Multiple access schemes – Interference in cellular systems – Hand off – Fading and Doppler in cellular system – GSM system architecture – GSM channel coding- Ciphering and modulation – System management.

References

- *Alexander Kukushkin, "Introduction to Mobile Network Engineering: GSM, 3G-WCDMA, LTE and the Road to 5G", 1st Edition, Wiley; 2018.*

Elective Courses Level 300

CCE 311	Integrated Circuits								Prerequisites
3Cr	8th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 221

IC technology – Tuned amplifiers – Noise analysis – Operational amplifiers and applications – Waveform generation – Analog IC applications (analysis and design) – Evaluation of circuit performance by computer-aided circuit simulations – Phase locked loops - Electronic circuits in radio and television –Video recording

References

- *D. Widmann, H. Mader, H. Friedrich, "Technology of Integrated Circuits", Springer-Verlag Berlin Heidelberg, 1 edition, 2000.*

CCE 331	Optical Fiber								Prerequisites
3Cr	8th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 341

Optical versus radio frequency communications – Optical fibers – Ray representation in optical fibers – Model analysis in step and graded index optical fibers – Signal degradation – Optical receivers – Optical properties of III – V semiconductors – Emitters: SC laser diodes, light emitting diodes –Photo detectors PIN and avalanche photo diode (APD).

References

- *Rongqing Hui, "Introduction to Fiber-Optic Communications 1st Edition", Academic Press Elsevier, 2019.*
- *John P. Dakin, Robert Brown, "Handbook of Optoelectronics: Concepts, Devices, and Techniques", CRC Press Published October 11, 2017.*

CCE 332	Microwave Engineering								Prerequisites
3Cr	8th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 341

Rectangular and circular wave guides, cavity resonators, excitation of waveguides, surface guiding and dielectric optical waveguides, analysis of microstrip and strip lines, scattering parameters, wave propagation inferrite media, passive microwave components.

References

- *Nguyen, Cam. Radio-frequency integrated-circuit engineering. John Wiley & Sons, 2015.*
- *Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", 2nd Edition, 2003.*
- *Christopher Bowick, "RF Circuit Design", 2nd Edition, Newnes, Elsevier, 19th October 2007.*

CCE 341	Distributed Systems								Prerequisites
3Cr	8th	Semester	0	Lab.	2	Tutorial	2	Lecture	CSE 042

The course deals with the distributed systems technology. It explains the principles of distributed systems such as communication, naming, synchronization, replication, fault tolerance, and security using examples and case studies. It covers architectures in distributed systems, reflecting the progress that has been made on organizing distributed systems, and new topics such as peer-to-peer computing, sensor networks, web services, grid computing, virtualization, cloud computing and its roots in distributed systems mechanisms, and self-management of distributed systems. The course illustrates design concepts for each topic with concept-oriented assignments and a small high-level programming assignment. Students complete a term project on the design and implementation of a realdistributed system.

References

- *Van Steen, Maarten, and Andrew S. Tanenbaum. "A brief introduction to distributed systems." Computing 98.10 (2016): 967-1009*

CCE 342	Multimedia								Prerequisites
3Cr	8th	Semester	0	Lab.	2	Tutorial	2	Lecture	CSE 042

Multimedia - design and implementation of GUI- hardware interfacing- programming project.

References

- *Iain E G Richardson, H.264 and MPEG–4 Video Compression: Video Coding for Next–generation Multimedia Hardcover – Import, 17 Oct 2003*

CCE 343	Computer System Programming								Prerequisites
3Cr	8th	Semester	0	Lab.	2	Tutorial	2	Lecture	CSE 042

Functions of system software components - design of hardware drivers, loaders and linkers, compilers, assemblers, interpreters and utilities - case study of real system programming

References

- *Randal E. Bryant and David R. O'Hallaron, Computer Systems: A Programmer's Perspective, 3/E (CS:APP3e)*

CCE 344	Software Engineering								Prerequisites
3Cr	8th	Semester	0	Lab.	2	Tutorial	2	Lecture	CSE 042

Software Development processes: Waterfall models, Agile methods, Rapid application development – System modeling using UML: Context models, Interaction models, Structural models, Behavioral models , Model-driven engineering - System architecting and design: Architectural design decisions, Architecturalviews, Architectural patterns, Application architectures – Testing: Development testing, Test-drivendevelopment, Release testing, User testing – Software Maintenance: Evolution processes, Understanding software evolution, Making changes to operational software systems, Legacy system management , Making decisions about software change - Quality Assurance& Configuration Management, recent trendsin software development - Software project management..

References

- *Sommerville, software engineering, 10 ed., Pearson India 2018*

CCE 345	Control (2)								Prerequisites
3Cr	8th	Semester	0	Lab.	2	Tutorial	2	Lecture	CSE 221

Introduction to discrete time control systems –Impulse sampling and holding –pulse transfer function – Mapping between S-plane and Z plane –closed loop transfer function using SFG –Stability analysis of closed loop systems in Z plane –Transient and steady state response analysis –design based on root locus method – design based on frequency response analysis -state space representation of discrete time systems –solving discrete time state space equations –pulse transfer function matrix –discretization of continuous time state equations –Lyapunov stability analysis

References

- *Ogata, Katsuhiko. Modern control engineering. Upper Saddle River, NJ: Prentice Hall, 2015*..

Elective Courses Level 400

CCE 411	Industrial Electronics								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	CCE 311

Data acquisition systems – Sensors – Signal Conditioning – Digitizing – Microprocessor based systems – Memory interface – I/O interfaces – Applications in industry.

References

- *Bogdan M. Wilamowski, J. David Irwin, Fundamentals of Industrial Electronics, CRC Press2017.*
- *Shih-Chii Liu, Jorg Kramer, Giacomo Indiveri, “Analog VLSI: Circuits and Principles”, A Bradford Book (November 15, 2002).*
- *G S Sawhney, “Biomedical Electronics and Instrumentation”, I.K.International Publishing House; 1st Edition 2011 edition (November 29, 2011).*

CCE 412	Introduction to Nanotechnology								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 341

Introduction to nano technology science - Wave Nature of Light - Dielectric Waveguides and Optical Fibers - Polarization and Modulation of Light – nsno plasmonic wavrguide – plasmonic sensors – medical applications of nano technology

References

- *Sergey V. Gaponenko, “Introduction to Nanophotonics” 1st Edition, Cambridge University Press; 2010*.

CCE 421	Information Theory								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 232

Introduction to information theory (Information, Entropy, Discrete memory- less channels – Mutual information – Channel capacity). Compression and source coding (Properties of source codes, construction of instantaneous codes, lossy data compression). Channel coding (linear block codes, syndrome calculation, Cyclic codes, Convolutional coding, The code tree, trellis and state diagram, ML decoding of convolutional codes, the Viterbi algorithmShannon theorem of perfect secrecy.

References

- *Yeung, Raymond W, "Information Theory and Network Coding", Springer US, 2008.*

CCE 422	Selected Topics in Communications Engineering								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 331

This course covers the most recently introduced topics in communication systems and applications.

CCE 423	Satellite Communications								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 331

The Geo-stationary (GEO) orbit – The space link – Transmission losses – The link power budget – System noise – Uplink and downlink carrier-to- noise ratios – Inter-modulation noise – Pre-assigned and demand assigned FDMA – TDMA – Frame efficiency and channel capacity – CDMA –Interference between satellite circuits – Antenna gain function – Pass- band interference – Protection ratio – Coordination criterion – LEO satellites – CDMA in LEO satellite systems – Signal to interference ratio (SIR) – Spread slotted ALOHA for LEO satellites – Modified power control –Transmit permission control scheme; non-fading and fading channel – Packet admission control scheme – Power control – Multi-beam LEO satellites

References

- *Louis J. Ippolito Jr., "Satellite Communications Systems Engineering: Atmospheric Effects, Satellite.*

CCE424	Communication Security								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 331

Students have gained fundamental knowledge of security terms and concepts, such as threats, vulnerabilities, protection and incident handling. The purpose of the course is to provide the student with an overview of the field of communication / information security and respective implementation issues for communication systems. The students will be exposed to the spectrum of security activities, its methods, methodologies and mechanisms. Coverage will include cryptographic functions, inspection and protection of assets, detection of and reaction to threats to communication systems, and analysis of incident procedures. Another focus will be set on security related organizational structures and product / system certification with respect to standardized security evaluation crietria.

References

- *Peter Stavroulakis, Mark Stamp.,Handbook of Information and Communication Security. Springer Science & Business Media, Feb 23, 2010 .*

CCE 425	Adapative Filters								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 231

A course that examin es the fundamentals of optimal filtering and estimation,Wiener filters,linear prediction, steepest-descent and stochas ticgradient algorithms; frequency-domain adaptive filters; method of least squares, recursive least squares, fast fixed order and order-recursive (lattice) filters; misadjustment, convergen ceand tracking analyses, stability issues, finiteprecisioneffects; connections with Kalman filtering; and nonlinear adaptive filters.

References

- *Haykin, Simon,* Adaptive Filter Theory, *Prentice-Hall, Inc., 4 ed. 2001*
- *Hayes, Monson H.,* Statistical Digital Signal Processing and Modeling*, John Wiley & Sons, 1996*.

CCE426	Phonics								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	CCE 332

Plane and spherical waves – Simple and compound sound sources – Dynamically analogous mechanical and acoustical circuits – Acoustic transducers – Loudspeakers; types and systems – Microphone; types and systems - Measurements of sound – Acoustics and hearing – Acoustic environment outdoors – Acoustic environment indoors - Ultrasonic applications.

References

- *Frank J. Fahy. Foundations of Engineering Acoustics, Academic Press; 1 ed, 2000*

CCE 427	Wireless Communications								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 331

DFT and its properties – Fading (fast, slow, and flat) – Frequency selective and non-selective – Dual Multi-Tone (DMT) – OFDM – Multi-path propagation – Delay spread values – Guard time and cyclic extension – OFDM parameters – OFDM versus single carrier modulation - Spread Spectrum – PN sequence generators – Direct sequence Spread Spectrum –Probability of error – Frequency Hopping Spread Spectrum – CDMA– DS-CDMA.

Reference

- *Andrea Goldsmith, "Wireless Communications", Cambridge University Press; 1 edition (August 8, 2005).*

CCE 441	Computer Networks (2)								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	CSE 312

Theoretical foundations for building next generation Internet. To provide a detailed introduction to advanced topics in computer net-works including advanced transport layer concepts, adaptive queue management, Quality of Service fundamentals, packet scheduling, multimedia networking, content distribution networks and network measurements. Methodologies and tools in undertaking research in networking - Performance issues and QoS mechanisms in the Internet. Expertise in network programming and computer network simulation.

References

- *Comer, Douglas E. The Internet book: everything you need to know about computer networking and how the Internet works. Chapman and Hall/CRC, 2018.*
- *Cisco Networking Academy. Routing and Switching Essentials Companion Guide. Pearson Education, 2014.*
- *Roger L. Freeman, "Telecommunication System Engineering", Fourth Edition, Wiley; May 2004.*

CCE 442	Design and Programming of Web server								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	CSE 042

This course concentrates on major technologies used in building Web servers. Alternate versions are to be given each year: the Windows-based IIS Server and the Linux-based Apache server. For IIS, ASP. NET along with C# are used for programming Web servers. For Apache, PHP is the language of choice. The course starts with a fast track on client programming, the HTTP protocol, SQL database servers, and XML programming. A weekly lab, two application projects, and a research project constitute the major requirements of the course.

Reference

- *Thomas A. Powell, Web Design: The Complete Reference Paperback – May 12, 2000*

CCE 443	Big Data Analytics								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	CSE 212

Introduction to Data Mining, Data, Collection, Sampling andPreprocessing, Predictive andDescriptive Analytics, Survival Analysis, Social Networks Analysis, Modelling and Benchmarking and privacy, Mini project Application using Hadoop and Map Reduce tools.

Reference

- *Peter Ghavami, Big Data Analytics Methods: Analytics Techniques in Data Mining, Deep Learning and Natural Language Processing 2nd ed., de Gruyter; 2019*

CCE 444	Selected Topics in Computer Engineering								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	CSE 213

Selected topics related to the state of the art in computer engineering.

CCE445	Game Theory and Decision making								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	CSE 411

Game theory provides asset oftools, approaches, and perspective son decision making to mimic the human elements of decision making that is best described by strategy,coercion and cooperation. This course offers an introduction to fundament also fgame theory and decision making with a special emphasis on the foundations of the mathematical background. Topics covered include: static, evolutionary,supermodular, repeated, cooperative, network, potential and congestion games as well as bargaining and uncertainty in games. Students will be assigne dreal-world examples of game theory and strategic decision making to investigate as projects.

Reference

- *R. Duncan Luce , Howard Raiffa, Games and Decisions: Introduction and Critical Survey, Dover Publications; 1989.*

CSE 446	Internet Engineering								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	CSE 042

A course that examines major protocols used in internet engineering: IP, ICMP, TCP, UDP; new technologies introduced on the internet, such as IP Multicast, Mobile IP, IPv6, VPNs, and quality of service; routing on the Internet; network security and firewall design; and an overview of the application protocols such as SMTP, HTTP, RTP, and SNMP.

Reference

- *Computer Networking: A Top-Down Approach, Featuring the Internet, James Kurose and Keith Ross, Addison-Wesley Pub Co, 2004.*
- *Internet & World Wide Web How to Program, 4th edition, Harvey M. Deitel and Paul J. Deitel, , Prentice Hall , 2008.*

CCE 447	Languages Compilers								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	CSE 311

Introduction to the theory of languages - evolution of computer languages and translators - formal specification of languages - context dependent and context free languages - logical structure of a compiler - lexical, syntax and semantic analysis - code generation and optimization - storage and register allocation - runtime considerations

Reference

- *Douglas Thain, Introduction to Compilers and Language Design1st ed. Paperback 2019.*

CCE461	Digital Image Processing								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	CCE 231

Image representation - methods of image processing - enhancement - data compression - reconstruction from projection - features extraction - image analysis - pattern recognition - computer vision

References

- *Understanding digital image processing, Vipin Tyagi, CRC press, 2018.*

CCE462	Biomedical Engineering								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	------------

This course includes an introduction to: general instrumentation configuration, performance ofinstrumentation systems; types and characteristics of transducers; sources and characteristics of bioelectric signals; types and characteristics of electrodes; temperature regulation and measurement; cardiovascular system, measurements, and diagnostic equipment; blood instruments; patient care and monitoring; and electrical safety of medical equipment

References

- *G S Sawhney, "Biomedical Electronics and Instrumentation", I.K.International Publishing House; 1st Edition 2011 edition (2011)*
- *W. Mark Saltzman, Biomedical Engineering, Cambridge University Press; 2 ed 2015*

CCE463	Communication Engineering for Genetics and Bioinformatics								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	-------------

This course presents current research efforts in the emerging interdisciplinary field of communications engineering for genetics and bioinformatics. It shows how concepts and techniques from the field of communications engineering can be applied to central problems from the fields of genetics and bioinformatics. As a basic analogy, voice information is digitized, transmitted, and processed in communications, and DNA information is replicated, transmitted, and processed in genetics. The main topics covered include DNA compression, mutual information for functional genomics, channel coding for gene expression, genomic signal processing, and biological computation

References

- *Rastogi, Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery" paperback 2013*
- *Ruchi Singh and Richa Sharm, Bioinformatics: Basics, Algorithms and Applications Paperback – December 1, 2010*

CCE 464	Neural Engineering								Prerequisites
3Cr	10 th - 9th	Semester	0	Lab.	2	Tutorial	2	Lecture	ECE 231

Introduction to basic concepts for NN-single and multilayer perceptrons- learning algorithms- feedforward and feedback architectures - recurrent networks- associative memory networks- design and hardwareimplementation of NN- typical examples.Introduction to Deep Learning - Deep Computer Vision - Deep Reinforcement Learning - Data Visualization for Machine Learning - Learning and Perception - Deep Sequence Modeling - Deep Generative Models

References

- *Metin Akay, Handbook of Neural Engineering, 2006*

CCE 271	Training (1)								Prerequisites
1 Cr	6 th	Semester	3	Lab.	0	Tutorial	0	Lecture	107 Cr

Training on industrial establishments relevant to the program. Training lasts for total of 90 hours, during a period about three weeks. The program training advisor schedules at least one follow up visit to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. The course is graded as Pass/Fail grade-system.

CCE 371	Training (2)								Prerequisites
1 Cr	8 th	Semester	3	Lab.	0	Tutorial	0	Lecture	CCE 271

Training on industrial establishments relevant to the program. Training lasts for total of 180 hours, during a minimum period of six weeks. The program training advisor schedules at least two follow-up visits to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. The course is graded as Pass/Fail grade-system.

CCE 481	Graduation Project (1)								Prerequisites
2 Cr	9 th	Semester	3	Lab.	0	Tutorial	1	Lecture	125cr

A supervised project in groups of normally 3 students aimed at providing practical experience in some aspects of computer, communications and electrical engineering. Students are expected to define the project, state its objectives, complete a literature survey, set project specifications and select a design method. They are also expected to do some preliminary modeling and analysis and to acquire the necessary material needed for the completion of the project in the spring term. A professional report and an oral presentation are also required from the students.

CCE 482	Graduation Project (2)								Prerequisites
3 Cr	10 th	Semester	6	Lab.	0	Tutorial	1	Lecture	CCE 481

This is a continuation of CCE 401. Students are asked to deliver a product that has passed through the design, analysis, testing and evaluation stages. The course also requires the production of a professional report that includes a description of the design process, implementation and testing, verification and validation and a critical appraisal of the project. An oral presentation and a poster are also within the project deliverables

Chapter Four:

A B. Sc. Program in Mechatronics Engineering (MTE) with Credit Hours System

1. Program Vision

To achieve leadership in the field of engineering education and gain confidence of the local and regional community for program graduates.

2. Program Mission

To prepare qualified engineers in the field of mechatronics while applying total quality in scientific framework to meet the needs of labor market and serve the local and regional community.

3. Graduate Attributes

The academic program of Mechatronics Engineering is keen to graduating distinguished and qualified engineers to enter the workforce and takes into consideration the achievement of the following specifications:

A. Mastering basic engineering sciences in a number of fields including electronics and information systems at one hand and mechanics, design, and control on the other hand.
B. Mastering automatic control science and design of control systems.
C. Ability to model and design integrated systems in which different disciplines overlap.
D. Ability to self-learn and learn by doing.
E. Adopting an approach based on the method of solving problem while giving priority to projects over the years of study.
F. Ability to deal with multidisciplinary team (project management and communication skills).

4. Graduate Competencies in Accordance with the National Academic Standards

According to NARS 2018, a graduate must be able to:

A1: Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.
A2: Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.
A3: Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.
A4: Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.
A5: Practice research techniques and methods of investigation as an inherent part of learning.
A6: Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.
A7: Function efficiently as an individual and as a member of multi-disciplinary and multicultural teams.
A8: Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.
A9: Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.
A10: Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.

In addition to the competencies of most engineering programs, the engineering MTE program has some special competencies, which are as follows:

B1: Model, analyze and design physical systems applicable to the specific discipline by applying the concepts of: Thermodynamics, Heat Transfer, Fluid Mechanics, solid Mechanics, Material Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis, Dynamics and Vibrations.

B2: Plan, manage and carry out designs of mechanical systems and machine elements using appropriate materials both traditional means and computer-aided tools and software contemporary to the mechanical engineering field.

B3: Select conventional mechanical equipment according to the required performance.

B4: Adopt suitable national and international standards and codes; and integrate legal, economic and financial aspects to: design, build, operate, inspect and maintain mechanical equipment and systems.

In addition to the competences for all Engineering Programs (A-Level) and the competencies for the Mechanical Discipline (B-Level), the Mechatronics Engineering Program graduate must be able to (C Level):

C1: Analyze mechatronic system using scientific, mathematical and computer-based models and asses the limitations of particular cases.

C2: Identify and classify the performance of mechatronic systems and components through the use of analytical methods and Modelling techniques

C3: Design a mechatronic system using systems approach to meet a given specification and requirements.

C4: Integrate a wide range of analytical tools, techniques, equipment, and software packages to design and develop mechatronic systems.

5. Mechatronics Engineering Program Structure:

Table 1: Course Codes for Mechanical Engineering Program.

Code	Responsible Department
UNR	University Requirements
BAS	Mathematics & Engineering Physics
CSE	Computers & Systems Engineering
ECE	Communications & Electronics Engineering
ELE	Electrical Engineering
MPE	Mechanical Power Engineering
MTE	Mechatronics Engineering
PDE	Production Engineering & Mechanical Design

Table 2: University Requirements Courses (UNR) for Mechatronics Engineering Program (13 Credit Hours).

Code	Course Title	Credit Hours
UNR061	English Language (1)	2
UNR062	English Language (2)	2
UNR171	History of Engineering and Technology	1
UNR241	Communication and Presentation Skills	2
UNR281	Law and Human Rights	2
UNR461	Ethics and Morals of the Profession	2
UNR471	Marketing	2

Table 3: Faculty Requirements Courses for Mechatronics Engineering Program (45 Credit Hours)

Code	Course Title	Credit Hours
BAS011	Mathematics (1)	3
BAS021	Mechanics (1)	3
BAS012	Mathematics (2)	3
BAS022	Mechanics (2)	3
BAS031	Physics (1)	3
BAS032	Physics (2)	3
BAS041	Engineering Chemistry	3
PDE051	Production Engineering	3
PDE052	Engineering Drawing	3
ENG111	Technical Report Writing	2
BAS113	Mathematics (3)	3
BAS114	Mathematics (4)	3
BAS115	Probability Theory and Statistics	2
ELE151	Electrical Power and Machines	3
BAS215	Mathematics (5)	3
ENG412	Project Management	2

Table 4: Major Requirements Courses for Mechatronics Engineering Program (84 Hours).

Code	Course Title	Credit Hours
BAS121	Solid Body Mechanics	3
CSE051	Introduction to Computer Systems	3
CSE151	Digital Logical Design	3

CSE152	Algorithms and Data Structures	3
ELE161	Electric Circuits	3
MPE171	Basics of Heat and Fluids	3
MPE271	Fluid Mechanics	3
PDE181	Strength of Materials	3
CSE252	Automatic Control Systems	3
ECE261	Electronics (1)	3
ECE262	Electronics (2)	3
MPE272	Thermodynamics	3
PDE281	Materials Science	3
PDE282	Kinematics and Dynamics of Machines	3
PDE283	Mechanical Vibrations	3
MTE291	Instrumentation and Measurements	3
CSE352	Microcontrollers and Operating Systems	2
CSE353	Embedded Systems	2
ECE361	Digital Signal Processing	3
PDE381	Mechanical Design	3
MTE391	Sensors and Actuators	2
PDE382	CNC Machines	3
PDE392	Robotics	3
MPE371	Heat Transfer	3
MPE372	Computational Fluid Dynamics	3
CSE452	Programmable Logic Controllers	3
CSE453	Artificial Intelligence and Machine Learning	3
MPE471	Hydraulic and Pneumatic Control Systems	3
MTE491	Design of Mechatronic Systems	3

Table 5: Group1 of Elective Courses for Level 300 of Mechatronics Engineering Program (6 Credit Hours).

Code	Course Title	Credit Hours
CSE301	Data Base Systems	3
CSE302	Internet of Things	3
ELE301	Power Electronics	3
PDE301	Computer-Aided Design	3
PDE302	Non-Traditional Machining Processes	3
MPE301	Microelectromechanical Systems	3
MPE302	Control in Power Stations and Air conditioning Systems	3
MTE301	Autotronic Systems	3

Table 6: Group2 of Elective Courses for Level 400 of Mechatronics Engineering Program (6 Credit Hours).

Code	Course Title	Credit Hours
CSE401	Software Engineering	3
CSE402	Computer Vision	3
ECE401	Image Processing	3
ELE401	Electric Traction Systems	3
PDE401	Prototyping and Automation	3
PDE402	Mobile and Bipedal Robots	3
MPE401	Design of Renewable Energy Systems	3
MTE401	Medical Mechatronic Systems	3

Table 7: Field Training and Capstone Design Project Courses for Mechatronics Engineering Program (6 Credit Hours).

Code	Course Title	Credit Hours
MTE295	Training (1)	0
MTE395	Training (2)	0
MTE498	Project (1) in Mechatronics	3
MTE499	Project (2) in Mechatronics	3

6. Mechatronics Engineering Program Matrix

Table 8: Mechatronics Engineering Program Matrix.

Level	Course Title	Course Code	Program Graduate competencies According to NARS 2018																	
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	C1	C2	C3	C4
000	Mathematics (1)	BAS011	√																	
	Mechanics (1)	BAS021	√																	
	Physics (1)	BAS031	√	√																
	Engineering Chemistry	BAS041	√	√																
	Engineering Drawing	PDE052	√							√										
	English Language (1)	UNR061								√										
	Mathematics (2)	BAS012	√																	
	Mechanics (2)	BAS022	√																	
	Physics (2)	BAS032	√	√																
	Introduction to Computer Systems	CSE042	√				√													
	Production Engineering	PDE051	√	√																
	English Language (2)	UNR062								√										
100	Mathematics (3)	BAS113	√																	
	Probability Theory and Statics	BAS115	√	√				√												
	Electric Circuits	ELE141	√																	
	Digital Logical Design	CSE151	√	√																
	Strength of Materials	PDE181	√	√																
	History of Engineering and Technology	UNR171			√		√			√										
	Mathematics (4)	BAS114	√																	
	Solid Body Mechanics	BAS121	√																	
	Electric Power and Machines	ELE142	√	√																
	Algorithms and Data Structures	CSE152	√	√			√			√										√
	Basics of Heat and Fluids	MPE171	√	√									√		√					
	Technical Report	ENG111					√			√										

	Writing																			
	Mathematics (5)	BAS215	√	√																
	Electronics (1)	ECE261	√	√													√		√	
	Fluid Mechanics	MPE271	√	√									√		√					
	Materials Science	PDE281	√	√			√						√							
	Kinematics and Dynamics of Machines	PDE282	√	√	√								√	√	√					
	Communication and Presentation Skills	UNR241								√										
200	Thermodynamics	MPE272	√	√									√	√						
	Automatic Control Systems	CSE252	√	√													√	√		
	Electronics (2)	ECE262	√	√													√		√	
	Mechanical Vibrations	PDE283	√	√									√		√	√				
	Instrumentation & Measurements	MTE291	√	√	√		√	√					√				√	√		
	Law and Human Rights	UNR281	√				√													
	Training (1)	MTE295		√	√		√			√	√	√	√	√			√			
	Microcontrollers and Operating Systems	CSE352	√	√													√			√
	Digital Signal Processing	ECE361	√		√													√		
	Sensors and Actuators	MTE391	√	√	√												√		√	
	Mechanical Design	PDE381	√		√					√			√	√	√					
	Heat Transfer	MPE371	√	√									√			√				
	Embedded Systems	CSE353		√	√				√								√			
	Robotics	MTE392		√			√		√	√			√	√			√		√	
300	Computational Fluid Dynamics	MPE372		√	√		√			√	√		√						√	√
	CNC Machines	PDE382		√	√				√	√	√		√	√			√			
	Training (2)	MTE395		√	√		√	√	√	√	√	√	√				√	√		
	Data Base Systems	CSE301			√					√										√
	Internet of Things	CSE302			√		√			√	√									√
	Power Electronics	ELE301	√	√	√													√	√	
	Computer-Aided Design	PDE301			√	√	√		√	√	√		√	√					√	√
	Non-Traditional Machining Processes	PDE302			√	√	√		√	√			√							
	Microelectromecha	MPE301			√	√	√		√									√	√	

	nical Systems																			
	Control in Power Stations and Air conditioning Systems	MPE302			√	√	√		√	√			√	√		√				
	Autotronic Systems	MTE301			√		√		√	√							√	√		
	Programmable Logic Controllers	CSE452		√	√												√	√	√	
	Design of Mechatronic Systems	MTE491		√	√	√	√		√		√								√	√
	Project Management	ENG431				√	√			√	√				√	√				
	Marketing	UNR471				√	√	√		√	√					√				
	Project (1) in Mechatronics	MTE498		√				√	√	√	√	√	√	√			√		√	√
	Artificial Intelligence and Machine Learning	CSE453			√	√			√				√					√		√
	Hydraulic and Pneumatic Control Systems	MPE471		√	√	√			√	√	√		√	√			√			
	Ethics and Morals of the Profession	UNR461				√	√			√	√					√				
400	Project (2) in Mechatronics	MTE499		√	√		√	√	√	√	√	√	√	√			√		√	√
	Software Engineering	CSE401		√	√	√		√		√	√									√
	Computer Vision	CSE402		√	√	√		√	√	√	√							√		
	Image Processing	ECE401		√	√	√		√	√	√	√							√		
	Electric Traction Systems	ELE401		√	√	√		√	√	√	√							√		
	Prototyping and Automation	PDE401		√	√	√		√	√	√	√			√	√					
	Mobile and Bipedal Robots	PDE402		√	√	√		√	√	√	√			√	√				√	
	Design of Renewable Energy Systems	MPE401		√	√	√		√	√	√	√		√	√					√	
	Medical Mechatronic Systems	MTE401		√	√	√		√	√	√	√						√		√	

7. Proposed Study Plan for students in Mechatronics Engineering Program

Table for Level 000:

First Semester

Course Code	Course Title	Hours/Week					Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	Mid Term	Term Work	Lab.	Final	Total	
BAS011	Mathematics (1)	3	2	2	---	4	20	30	--	50	100	-------
BAS021	Mechanics (1)	3	2	2	---	4	20	30	--	50	100	-------
BAS031	Physics (1)	3	2	1	1.5	4.5	20	20	10	50	100	-------
BAS041	Engineering Chemistry	3	2	1	1.5	4.5	20	20	10	50	100	-------
PDE052	Engineering Drawing	3	2	2	---	6	20	30	--	50	100	-------
UNR061	English Language (1)	2	1	2	---	2	20	30	--	50	100	-------
Total		17	11	10	3	25					600	
Total Contact hrs = 24 hrs/week Total SWL = 47 hrs/week												

Second Semester

Course Code	Course Title	Hours/Week					Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	Mid Term	Term Work	Lab.	Final	Total	
BAS012	Mathematics (2)	3	2	2	--	4	20	30	--	50	100	BAS011
BAS022	Mechanics (2)	3	2	2	--	4	20	30	--	50	100	BAS021
BAS032	Physics (2)	3	2	1	1.5	4.5	20	20	10	50	100	-------
CSE042	Introduction to Computer Systems	3	2	1	1.5	4.5	20	20	10	50	100	-------
PDE051	Production Engineering	3	2	--	3	3	20	20	10	50	100	-------
UNR062	English Language (2)	2	1	2	--	2	20	30	--	50	100	UNR061
Total		17	11	8	6	22					600	
Total Contact hrs = 25 hrs/week Total SWL = 47 hrs/week												

Table for Level 100:

Third Semester

Course Code	Course Title	Hours/Week					Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	Mid Term	Term Work	Lab.	Final	Total	
BAS113	Mathematics (3)	3	2	2	--	4	20	30	--	50	100	BAS012
BAS115	Probability Theory and Statics	2	1	2	--	2	20	30	--	50	100	BAS012
ELE141	Electric Circuits	3	2	2	--	4	20	30	--	50	100	BAS032
CSE151	Digital Logical Design	3	2	1	1.5	4	20	20	10	50	100	CSE051
PDE181	Strength of Materials	3	2	2	--	4	20	30	--	50	100	BAS021 BAS031
UNR171	History of Engineering and Technology	1	1	-	-	1	20	30	--	50	100	----------
Total		15	10	9	1.5	19					600	
Total Contact hours = 20.5 hrs/week Total SWL = 39 hrs/week												

Fourth Semester

Course Code	Course Title	Hours/Week					Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	Mid Term	Term Work	Lab.	Final	Total	
BAS114	Mathematics (4)	3	2	2	--	4	20	30	--	50	100	BAS113
BAS121	Solid Body Mechanics	3	2	2	--	4	20	30	--	50	100	BAS022
ELE142	Electric Power and Machines	3	2	2	--	4	20	30	--	50	100	ELE141
CSE152	Algorithms and Data Structures	3	2	1	1.5	4	20	20	10	50	100	CSE151
MPE171	Basics of Heat and Fluids	3	2	1	1.5	4	20	30	--	50	100	BAS031-BAS041
ENG111	Technical Report Writing	2	1	2	--	2	20	30	--	50	100	UNR015
Total		17	11	10	3	22					600	
Total Contact hrs = 24 hrs/week Total SWL = 46 hrs/week												

Table for Level 200:

Fifth Semester

Course Code	Course Title	Hours/Week					Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	Mid Term	Term Work	Lab.	Final	Total	
BAS215	Mathematics (5)	3	2	2	--	4	20	30	--	50	100	BAS115
ECE261	Electronics (1)	3	2	2	--	4	20	30	--	50	100	ELE141
MPE271	Fluid Mechanics	3	2	2	--	4	20	30	--	50	100	MPE171
PDE281	Materials Science	3	2	1	1.5	4	20	20	10	50	100	BAS041
PDE282	Kinematics and Dynamics of Machines	3	2	2	--	4	20	30	--	50	100	BAS121
UNR241	Communication and Presentation Skills	2	1	2	--	2	20	30	--	50	100	ENG111
Total		17	11	11	1.5	22					600	
Total Contact hrs = 23.5 hrs/week Total SWL = 45.5 hrs/week												

Sixth Semester

Course Code	Course Title	Hours/Week					Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	Mid Term	Term Work	Lab.	Final	Total	
MPE272	Thermodynamics	3	2	2	--	4	20	30	--	50	100	MPE171
CSE252	Automatic Control Systems	3	2	2	--	4	20	30	--	50	100	BAS113
ECE262	Electronics (2)	3	2	1	1.5	4	20	30	--	50	100	ECE261
PDE283	Mechanical Vibrations	3	2	2	--	4	20	30	--	50	100	PDE282
MTE291	Instrumentation & Measurements	3	2	1	--	4	20	20	10	50	100	ELE141 – BAS211
UNR281	Law and Human Rights	2	2	--	--	2	20	30	--	50	100	----------
MTE295	Training (1)	--	--	--	6	--	--	50	--	50	100*	----------
Total		17	12	7	9	22					600	
Total Contact hrs = 27.5 hrs/week Total SWL = 49.5 hrs/week												
* Not considered in the sum of grades.												

Table for Level 300:

Seventh Semester

Course Code	Course Title	Hours/Week					Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	Mid Term	Term Work	Lab.	Final	Total	
CSE352	Microcontrollers and Operating Systems	2	1	--	2	4	20	30	--	50	100	CSE151
ECE361	Digital Signal Processing	3	2	2	--	4	20	30	--	50	100	ECE262
MTE391	Sensors and Actuators	2	1	--	2	2	20	30	--	50	100	MTE291
PDE381	Mechanical Design	3	2	2	--	4	20	30	--	50	100	PDE282 – PDE283
MPE371	Heat Transfer	3	2	1	1.5	4	20	20	10	50	100	MPE171
Elective	Elective Course (1): From Table 6	3	2	2	--	4	--	--	--	50	100	According each course
Total		16	10	7	3.5	22					600	
Total Contact hrs = 23 hrs/week Total SWL = 45 hrs/week												

Eighth Semester

Course Code	Course Title	Hours/Week					Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	Mid Term	Term Work	Lab.	Final	Total	
CSE353	Embedded Systems	2	1	--	2	3	20	20	10	50	100	CSE352
MTE392	Robotics	3	2	1	1.5	4	20	20	10	50	100	PDE382
MPE372	Computational Fluid Dynamics	3	2	1	1.5	4	20	30	--	50	100	BAS212 – MPE271
PDE382	CNC Machines	3	2	1	1.5	4.5	20	20	10	50	100	PDE282 – PDE283
Elective	Elective Course: From Table 6	3	2	2	0	5	20	30	--	50	100	According to each course
MTE395	Training (2)	--	--	--	6	--	--	50	--	50	100*	----------
Total		14	9	6	11	20.5					500	
Total Contact hrs = 26 hrs/week Total SWL = 46.5 hrs/week												
* Not considered in the sum of grades												

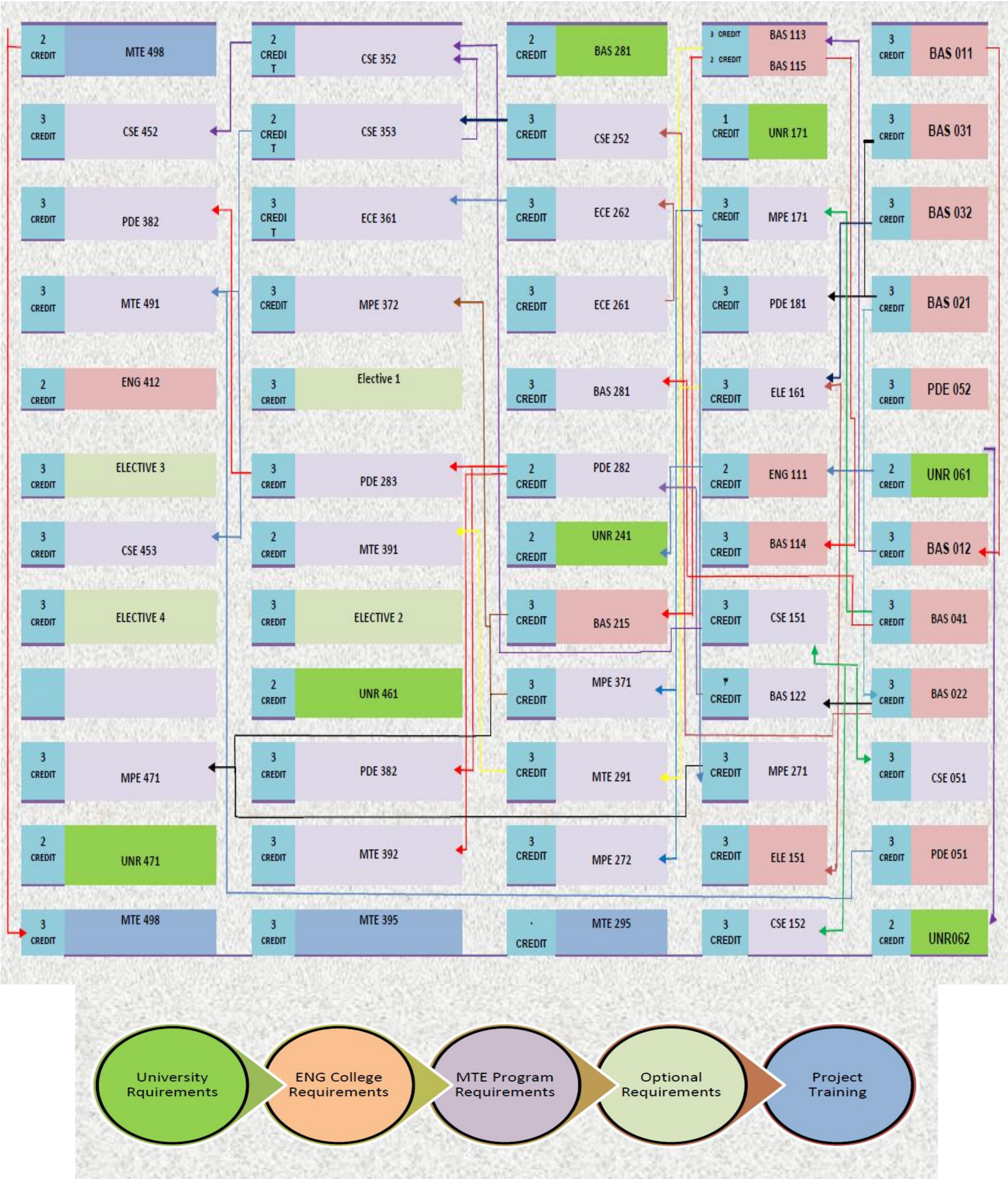
Table for Level 400:

Ninth Semester

Course Code	Course Title	Hours/Week					Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	Mid Term	Term Work	Lab.	Final	Total	
CSE452	Programmable Logic Controllers	3	2	1	1.5	4.5	20	20	10	50	100	CSE151
MTE491	Design of Mechatronic Systems	3	2	--	3	4	20	20	10	50	100	PDE282 - CSE352
ENG431	Project Management	2	2	--	0	2	20	30	--	50	100	------------
UNR471	Marketing	2	2	--	0	2	20	30	--	50	100	------------
Elective	Elective Course (3): From Table 7	3	2	2	0	5	20	20	--	50	100	According each course
MTE498	Project (1) in Mechatronics	3	1	--	6	3	20	30	--	50	100	Completing 120 Cr. H
Total		16	11	3	10.5	20.5					600	
Total Contact hrs = 24.5 hrs/week Total SWL = 45 hrs/week												

Tenth Semester

Course Code	Course Title	Hours/Week					Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	Mid Term	Term Work	Lab.	Final	Total	
CSE453	Artificial Intelligence and Machine Learning	3	2	2	0	5	20	30	--	50	100	CSE352
MPE471	Hydraulic and Pneumatic Control Systems	3	2	1	1.5	4.5	20	20	10	50	100	BAS212 – MPE271
Elective	Elective Course (4) From Table7	3	2	2	0	5	20	30	-	50	100	According each course
UNR461	Ethics and Morals of the Profession	2	2	0	0	4	20	30	-	50	100	-----------
MTE499	Project (2) in Mechatronics	3	1	0	6	3	20	30	--	50	100	Project (1) in Mechatronics
		14	9	5	7.5	21.5					500	
Total Contact hrs = 21.5 hrs/week Total SWL = 43 hrs/week												


2 CREDIT MTE 498
3 CREDIT CSE 452
3 CREDIT PDE 382
3 CREDIT MTE 491
2 CREDIT ENG 412
3 CREDIT ELECTIVE 3
3 CREDIT CSE 453
3 CREDIT ELECTIVE 4
3 CREDIT MPE 471
2 CREDIT UNR 471
3 CREDIT MTE 498
2 CREDIT CSE 352
2 CREDIT CSE 353
3 CREDIT ECE 361
3 CREDIT MPE 372
3 CREDIT Elective 1
3 CREDIT PDE 283
2 CREDIT MTE 391
3 CREDIT ELECTIVE 2
2 CREDIT UNR 461
3 CREDIT PDE 382
3 CREDIT MTE 392
3 CREDIT MTE 395
2 CREDIT BAS 281
3 CREDIT CSE 252
3 CREDIT ECE 262
3 CREDIT ECE 261
3 CREDIT BAS 281
2 CREDIT PDE 282
2 CREDIT UNR 241
3 CREDIT BAS 215
3 CREDIT MPE 371
3 CREDIT MTE 291
3 CREDIT MPE 272
CREDIT MTE 295
3 CREDIT BAS 113
2 CREDIT BAS 115
1 CREDIT UNR 171
3 CREDIT MPE 171
3 CREDIT PDE 181
3 CREDIT ELE 161
2 CREDIT ENG 111
3 CREDIT BAS 114
3 CREDIT CSE 151
CREDIT BAS 122
3 CREDIT MPE 271
3 CREDIT ELE 151
3 CREDIT CSE 152
3 CREDIT BAS 011
3 CREDIT BAS 031
3 CREDIT BAS 032
3 CREDIT BAS 021
3 CREDIT PDE 052
2 CREDIT UNR 061
3 CREDIT BAS 012
3 CREDIT BAS 041
3 CREDIT BAS 022
3 CREDIT CSE 051
3 CREDIT PDE 051
2 CREDIT UNR062
University Rquirements
ENG College Requirements
MTE Program Requirements
Optional Requirements
Project Training

8. Scientific content of courses in Mechatronics Engineering Program

8.1. University Requirements:

UNR061	English (1)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	------
Main skills of the English language - listening to short and long conversations - reading scientific passages - writing reports, summaries, and scientific articles - speaking and presenting new ideas									
References: ▪ *Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011*									

UNR062	English (2)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	2nd	UNR061
Analysis and interpretation of engineering issues - summarizing engineering issues - preparation for language tests.									
References: ▪ *Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011*									

UNR171	History of Engineering and Technology								Prerequisites
1 Cr	Lecture	1	Tutorial	--	Lab.	--	Semester	1st	------
Engineering history: Art, Science, Engineering and technology - Role of engineering and technology in development and establishment of civilizations- Technology and environment - Examples on development of engineering activity.									
References: ▪ *Roger S. Kirby Engineering in History, Dover Publications Inc. New York, United States, 1990, ISBN10 0486264122*									

UNR241	Communication and Presentation Skills								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	ENG111
Communication skills - Presentation planning and preparation - Delivery skills such as eye contact, voice control, gestures, body language and appearance - Presenter's characteristics - Using visuals - Presentation structure - Elevator Pitch									
References: ▪ *Joan van Emden, Lucinda Becker, Presentation Skills for Students, 3rd Edition, Red Globe Press, 2016* ▪ *References*: ▪ *M. Wa Mutua, S. Mwaniki, P. Kyalo, B. Sugut, Communication Skills: A University Book, Succex Publishers, 2016* ▪ *Ian Tuhovsky, Wendell Wadsworth, Communication Skills Training, Ian Tuhovsky, 2015* ▪ *Tabitha Wambui, Alice W. Hibui, Elizaeth Gathuthi, "Communication skills " Vol.1, Students' coursebook, LAP LAMBERT Academic Publishing, 2012*									

<table>
<tr><th>UNR281</th><th colspan="7">Law and Human Rights</th><th>Prerequisites</th></tr>
<tr><td>2 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>--</td><td>Lab.</td><td>--</td><td>Semester</td><td>2^{ed}</td></tr>
<tr><td colspan="9">Systems and laws of institutions - Introduction to Accounting - Labor legislation and laws governing engineering professions - Industrial security legislation and environment - Historical philosophical origins of human rights - international sources of human rights - national sources of human rights - global bodies based on the protection of human rights.</td></tr>
</table>

<table>
<tr><th>UNR461</th><th colspan="7">Ethics and Morals of the Profession</th><th>Prerequisites</th></tr>
<tr><td>2 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>--</td><td>Lab.</td><td>--</td><td>Semester</td><td>2^{ed}</td></tr>
<tr><td colspan="9">General principles of professional ethics - Commitments to society - Responsibilities of the engineer - Detection of violations - Behavior - Case studies and general issues.</td></tr>
<tr><td colspan="9"><u>References:</u>
▪ Lizabeth A. Stephan, David R. Bowman, William J. Park, Benjamin L. Sill, Matthew W. Ohland, "Thinking like an engineer", Published by Pearson 2018.
▪ Harris, C. E., Jr., Pritchard, M. S., & Rabins, M. J. Engineering Ethics. Second edition. Belmont, CA: Wadsworth, 2000</td></tr>
</table>

<table>
<tr><th>UNR471</th><th colspan="7">Marketing</th><th>Prerequisites</th></tr>
<tr><td>2 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>--</td><td>Lab.</td><td>--</td><td>Semester</td><td>1^{st}</td></tr>
<tr><td colspan="9">Principles of products marketing - Marketing research - Customers buying behavior - Marketing mix - Plotting marketing strategy - Building marketing plan - Pinpointing the target market - Marketing on the world wide web - Branding strategy - Developing new products - Advertising and promotions - Costing and pricing strategies - Case studies on products marketing.</td></tr>
<tr><td colspan="9"><u>References:</u>
▪ Principles of Marketing, University of Minnesota Libraries Publishing, 2015, ISBN 13: 9781946135193</td></tr>
</table>

8.2. Faculty Requirements:

<table>
<tr><th>BAS011</th><th colspan="7">Mathematics (1)</th><th>Prerequisites</th></tr>
<tr><td>3 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>2</td><td>Lab.</td><td>--</td><td>Semester</td><td>1^{st}</td></tr>
<tr><td colspan="9"><u>Calculus:</u> Function (definition - theorems) - Basic functions - limits - Continuity - Derivation - definition - theorems - types - higher orders - Applications on derivatives - partial derivatives - indefinite integral - theories and properties of integration.
<u>Algebra:</u> Binomial theorem (with any exponent and applications) - Partial Fractions - Theory of Equations - Matrices - System of linear equations - Gauss elimination method.</td></tr>
<tr><td colspan="9"><u>References:</u>
▪ Akhtar & Ahsan, Textbook of Differential Calculus, second edition, 2009, PHI Learning Private Limited.
▪ Alan Jeffrey, Matrix operations for Engineers and Scientists, 2010, Springer Science & Business Media.</td></tr>
</table>

BAS021	Mechanics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Rectangular components of vector (1D, 2D, Space), ، coplanar forces،Newton's laws - Types of forces Forces in space - Equilibrium of a particle - Conditions, Free-body diagram - Moment - Couple moment - Resultant of a system of forces and couples as a force and couple system - General procedure for reducing force and couple systems - Equilibrium of a rigid body - Conditions of equilibrium of a rigid- free body diagrams – friction،body

References:

- *R.C. Hibbeler, "Engineering Mechanics: Statics and Dynamics, 14th Edition", Pearson Prentice Hall, New Jersey, 2016.*
- *J. L. Meriam, L. G. Kriage, and J. N. Botton, "Engineering Mechanics: Statics, 8th Edition", John Wiley & Sons, New York, 2016.*

BAS012	Mathematics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	BAS011

Integral Calculus: Definite integral - Methods of integration – Applications on definite integral (plane area - volume of revaluation - length of a plane curve - area of surfaces of revolution) - improper integral.

Analytic Geometry: Equations of second degree - Equation of pair of straight lines - Translation of axes - Conic sections - parabola - ellipse - hyperbola) Equation of plane - Equation of sphere.

References:

- *Jumarie, G., Fractional Differential Calculus for Non-Differentiable Functions: Mechanics, Geometry, Stochastics, Information Theory. 2013: LAP Lambert Academic Publishing.*
- *Hestenes, D. and G. Sobczyk, Clifford algebra to geometric calculus: a unified language for mathematics and physics. Vol. 5. 2012: Springer Science & Business Media.*
- *Grossman, S.I., Multivariable calculus, linear algebra, and differential equations. 2014: Academic Press.*

BAS022	Mechanics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	BAS021

Kinematics of a particle: curvilinear motion - Normal and tangential components. - Newton's laws - motion of projectiles - Work and energy of a particle - applications of friction.

References:

- *R.C. Hibbeler, "Engineering Mechanics: Statics, 11th Edition", Pearson Prentice Hall, 2006.*
- *F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg, "Vector Mechanics for Engineering, Statics and Dynamics, 9th Edition", McGraw-Hill, New York, 2010.*

BAS031	Physics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Material properties: Physical quantities - Standard units and dimensions - Mechanical properties for materials - Fluid properties - Periodic motion - Mechanical waves - Sound waves - Waves in elastic media.

Heat and thermodynamics: Temperature measurements and thermometers - Thermal expansion - Specific and latent heat - Heat transfer - Gas motion theory - First law of thermodynamics - Entropy and second law of thermodynamics.

References:
- *Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 6th Edition, Thomson Brooks/Cole 2014.*
- *Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.*

BAS032	Physics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2^{nd}	---

<u>Electricity and Magnetism</u>: Electric charge - Electric force - Electric field- Column's law- Electric flux- Gauss law- Electric potential- Electric capacitance and Dielectrics - Ohm's law and simple circuits- Magnetic field - Baiot and Savart laws.
<u>Optics and Modern physics</u>: Nature of light and laws of geometric optics - Interference - Diffraction - polarization - optical fiber - laser - photoelectric effects - principle of quantum theory - special theory of relativity.

References:
- *Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 9th Edition, Thomson Brooks/Cole 2014.,*
- *Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.*

BAS041	Engineering Chemistry								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1^{st}	---

Equations of state-chemical thermodynamics - Material and energy balance in chemical processes- properties of solutions - Basic principles in electrochemistry and it's applications-selected topics in chemical industry.

References:
- *Brown, L. T, LeMay H. E. Jr; Bursten, B. E.; Murphy, C.J., and Woodward, P.; " Chemistry The Central Science", Pearson International Edition (11th edn), Pearson Printice Hall, (2009).*

PDE051	Production Engineering								Prerequisites
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	2^{ed}	---

Introduction to the following processes (Casting- Forging- Metal filing - Machining- Forming- Woodworking)

References:
- *Hitomi, Katsundo. Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics. Routledge, 2017.*

PDE052	Engineering Drawing								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1^{st}	---

Two-dimensional drawings - Free-hand sketching - Sectional views - Auxiliary views and conventions - Computer-aided drawing (CAD) of 2D and 3D figures.

References:
- *Mcgraw-hill Mint, "Mechanical Drawing Board & CAD Techniques", Student Edition,2011*

ENG111	**Technical Reports Writing**								**Prerequisites**
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	2nd	UNR062

Technical writing definition - audience analysis - technical writing styles - technical document characteristics - automated document organization - official and unofficial document types - structure of different types of technical documents.

References:

- *G. J. Alred, W. E. Oliu, The Handbook of Technical Writing, 12th Edition, Bedford/St. Martin's; 2018*
- *K. Hyland, Teaching and researching writing. 3rd edition Routledge academic publisher, 2016*
- *M. Markel, Technical Communication, 11th edition, MacMillan, 2015.*

BAS113	**Mathematics (3)**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	**BAS012**

Applications of partial differentiation - Maximum values of functions in more than one variable and applications - First order differential equations - Second order differential equations - Laplace transform and its applications - Analytical geometry in space.

References:

- *D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.*
- *S. A. Wirkus, and R. J. Swifi, "A Course of Ordinary Differential Equations", Taylor & Francis Group, LLC, 2015.*

BAS114	**Mathematics (4)**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	**BAS113**

Fourier series - Fourier transform - Complex numbers - Functions of a complex variable - Complex integration - Residue theorem - Direction derivatives - Double integrals - Triple integrals - Line integrals - Surface integrals.

References:

- *J. Brown, and R. Churchill, "Complex Variables and Applications", 9th Edition, McGraw-Hill, 2013.*
- *D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.*

BAS115	**Statistics and Probability Theory**								**Prerequisites**
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	**BAS012**

Measures of tendency and dispersion - Probability distributions - Sampling theorem - tests of hypothesis - non-parametric tests - regression and correlation - time series.

References:

- *Mary C. Meyer, Probability and Mathematical Statistics: Theory, Applications, and Practice in RSBN-10: 1611975778, SIAM (June 24, 2019)*

ELE151	**Electrical Power and Machines**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	---

Power: Electrical power systems - three phase systems - Theory and models of transformers - Transmission line models - Voltage and frequency control - effective and ineffective power - Optimal work of power systems.

،Machines: The theory of operation - The construction of the Direct Current motors. The speed and current characteristics - applications of the DC motors. The theory of operation and ،torque construction of stepper motors - Permanent-magnet DC motor and Low-inertia DC Motors. The theory construction of three phase induction motors.،of operation

References:
- *Nilsson, J.W. and S.A. Riedel, Electric circuits. 2015: Pearson Upper Saddle River, NJ.*
- *Slade, P.G., Electrical contacts: principles and applications. 2017: CRC press.*

BAS215	Mathematics (5)							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester 1st	BAS115

Numerical solution of linear and non-linear systems of equations - Iterative methods - Curve fitting: Least square of (Straight lines, Polynomials), Linearization of nonlinear relationship. Interpolation and polynomial approximation -finite difference operators - Numerical integration and differentiation.

References:
- *Mazumder, Numerical Methods for Partial Differential Equations, Finite Difference and Finite Volume Methods, science direct ,2016.*
- *Sheldon Rose, A First course in probability, Eighth edition, 2010, Pearson Prentice Hall.*

ENG431	Project Management							Prerequisites
2 Cr	Lecture	2	Tutorial	0	Lab.	--	Semester 1st	---

Fundamentals of biomedical project management - Integration management - Scope management - Time management - Cost management - Quality management - Human resources management - Communication management - Risk management - Procurement management - Biomedical projects case studies

References:
- *Kerzner, H. and H.R. Kerzner, Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons, 2017.*
- *Kalpakjian, S., K. Vijai Sekar, and S.R. Schmid, Manufacturing Engineering and technology. Pearson, 2014.*
- *Nigel J. Smith, "Engineering Project Management", 3rd Edition, Wiley-Blackwell, 2008.*

8.3 Major Requirements for Mechatronics Engineering Program:

BAS121	Solid Body Mechanics								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	1st	BAS022

Moment of Inertia: Radius of Gyration, Moments of Inertia of Thin Plates, Moment of Inertia of a Three-Dimensional Body, Composite Bodies. Planar Kinematics of Rigid Bodies: Translation, Rotation, General Plane Motion, Absolute General Plane Motion Analysis, Relative-Motion Analysis: Velocity, Acceleration. Planar Kinetics of Rigid Body: Force and Acceleration, Equations of Motion; Translation, Rotation About a Fixed Axis, General Plane Motion.

References:

1. Rigid Body Mechanics: Mathematics, Physics and Applications, W. Heard, Wiley, 2005
2. Engineering Mechanics B. Bhattacharyya, Oxford University Press, 2008

CSE051	Introduction to Computer Systems								Prerequisites
2 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2nd	

Introduction to the design and operation of a digital computer: data types, representation and number systems – basic computer components and organization – data transfer input/output as well as between components and registers – data processing – machine language – relation between SW and HW – operating systems – compilers – introduction to data network.

References:

1. Donis Marshall, "Programming Microsoft Visual C# 2008: The Language", Microsoft Press.
2. Horstmann, Cay S. Big Java: Compatible with Java 5, 6 and 7. John Wiley & Sons, 2009.
3. Sharp, John. Microsoft Visual C# 2013 step by step. Sebastopol, California: O'Reilly Media/Microsoft Press, 2013.
   Zak, Diane. Programming with Microsoft Visual Basic 2012. Boston, MA: Course Technology, Cengage Learning, 2014.

CSE151	Digital Logical Design								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	CSE051

Boolean algebra and logic gates - simplifying binary functions – analysis and design of combinational logic circuits – components of programmable logic devices - Introduction to sequential systems - analysis of sequential systems and state reduction - design of sequential systems – programmable logic arrays.

References:

1. M. Morris Mano and Michael D. Ciletti digital design 6th edition prentice hall

CSE152	Algorithms and Data Structures								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2nd	CSE151

Pointers and arrays – registers – abstract data – dynamic data structures including different types of linked lists and trees (simple list, queue, stack, ordered list, binary trees, search trees) different operations on dynamic data structures (lists or trees) (add, delete, search …) – recursive algorithms – designing recursive programs efficiently and testing – applications for advanced sorting and search.

References:

1. Handbook of Algorithms and Data Structures Gaston H. Gonnet ,Informatik, ETH Zürich ,Ricardo Baeza-Yates,Dept. of Computer Science, Univ. of Chile, 2011
2. A Practical Introduction to Data Structures and Algorithm Analysis Third Edition (C++ Version), 1 st Edition:, Clifford A. Shaffer, January 2010

ECE161	Electric Circuits								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	1st	BAS032

Constants and variables electrical circuit - elements of electrical circuit - simple resistive circuits - analyze of electrical circuit - switching between electric sources – circuit theories - Star delta conversion – steady state AC circuits – vector representation - power and power factor – resonance circuits - inductive circuits - three-phase circuits.

References:

1. Basic Electric Circuit Analysis, Johnson, Johnson, Hilburn

MPE171	Basics of Fluids and Heat								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2nd	BAS031 – BAS041

Hydrostatics – Conservation of mass – Conservation of momentum – Bernoulli’s theorem

Modes of heat transfer: conduction, convection, and radiation – Conduction mass transfer

Analysis of heat transfer at one dimensional level

References:

1. Fluid Mechanics, Frank White, 7th edition, McGraw Hill, 2010.
2. “Analysis of Heat Transfer” by E R G Eckerst and R M Drake.

MPE271	Fluid Mechanics								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	1st	MPE171

Introduction to fluid dynamics - Physical laws in the field of fluid mechanics – Conservation equations – Mass, momentum and energy conservation equations - Analysis of some engineering applications using control volume analysis – Deducing Navier-Stokes equations and their applications - Marginal layer theory - Using von Karmen's equations to solve boundary layer problems - An introduction to turbulent flow.

References:

1. Fluid Mechanics, Frank White, 7th edition, McGraw Hill, 2010
2. Fundamentals of fluid mechanics, Munsen et al., Wiley, 2012

PDE181	Strength of Materials								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	1st	BAS021 – BAS031

Types of loads affecting mechanical parts - Analysis of equilibrium of simple mechanical elements - Axial forces, shear forces, bending torque and torsion - Stress, strain and hook’s law – Design stress and safety factor - Stress concentration - Thermal stresses - bearing stresses - Direct shear and torsional shear stresses - Bending and shear stresses in Beams - Deflection in Beams - Stress and strain analysis in two dimensions - Principal Stress and Max Shear Stress – Mohr’s Circle - Power Transmission Shafts -

Eccentric Loads - Column buckling Theory – Thin walled vessels.

References:

1. Beer, Ferdinand, John DeWolf, E. Russell Johnston Jr, and David Mazurek. ("Mechanics of materials." (2014

CSE252	Automatic Control Systems								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	-	Semester	2nd	BAS113

Fundamentals of Control - Mathematical Description of linear systems using Laplace transform – Modeling of electromechanical systems – State variables – Time and frequency domain system response – Stability of linear systems – Root locus – Introduction to PID controllers – Analysis using adequate SW - Stationary behavior of closed loop control - Frequency transformed methods - Control design - Optimum control - State-Space-Methods.

References:

1. Modern control engineering, Katsuhiko Ogata, 5th edition, September, 2009
2. Control systems engineering and design, S. Thompson, Novemeber 1989

ECE261	Electronics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	1st	ELE141

Semiconductors – pn junction – biasing of pn junction –types of pn junction diodes – bipolar junction transistors and their properties and applications in DC circuits – Field-effect transistors (JFET& MOSFET)and their properties and applications in DC circuits.

References:

1. Floyd, Thomas L., Electronics Devices. 8th edition Prentice Hall, 2009
2. Sedra, Adel S., and Kenneth Carless Smith. Microelectronic circuits. 7th edition Oxford university press, 2014

ECE262	Electronics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2nd	ELE261

Transistor DC operating point, analysism, bias and stability – Small signal analysis – Audio and radio frequency amplifiers – power audio frequency amplifiers – feedback amplifiers – Differential Amplifiers – Operational amplifiers - Digital integrated circuits - multiple stage amplifiers - output stages in power amplifiers - analogue integrated circuits - filters and resonance amplifiers - oscillators - signal generators – function generators.

References:

1. Sedra, Adel S., and Kenneth Carless Smith. Microelectronic circuits. 7th edition Oxford university press, 2014

MPE272	Thermodynamics								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	2nd	MPE171

Basic concepts – Energy concepts – Thermodynamic properties of pure substance – First law – Second law – Entropy – Thermodynamic equilibrium – Thermodynamic properties of Mixtures and solutions – Thermodynamics of chemical reactions.

References:

1. Engineering Thermodynamics (Principles and Practices), D.S. Kumar, Kataria and Sons, New Delhi, 2012
2. Thermodynamics: An Engineering Approach, Yunus A. Çengel and Michael A. Boles, McGraw – Hill, Collumbus, 2010
3. Fundamentals of Engineering Thermodynamics, Michael J. Moran and Howard N. Shapiro, John Wiley and sons, Hoboken, Toronto, West Sussex, Singapore, 2006
4. Fundamentals of Thermodynamics, Richard E. Sonntag, Claus Borgnakke and Gordon J. Van Wylen; John Wiley and sons, Hoboken, Toronto, West Sussex, Singapore, 2002

PDE281	Materials Science								Prerequisites
3 Cr	Lectures	2	Tutorial	1	Lab.	1.5	Semester	1st	BAS041

Engineering materials, classification of materials and their properties including metals, ceramics, polymers and composites, material properties: electrical, magnetic, optical and thermal, the structure and properties of the most common engineering metals and their alloys, defects in solids, phase diagrams, heat treatment: surface and thermal. Material selection; oxidation and corrosion; Friction, destructive and non-destructive tests of materials.

References:

1. Beer, Ferdinand, John DeWolf, E. Russell Johnston Jr, and David Mazurek. "Mechanics of materials (2014).

PDE282	Kinematics and Dynamics of Machines								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	1st	BAS121

Fundamentals of Kinamatics - Position, Speed and acceleration Analysis of Mechanical Mechanisms - Mechanical Mechanics Design - Dynamics Fundamentals - Dynamic Force Analysis - Cam Design - Gear trains – Flywheel - Balancing Rotating and Reciprocating Machines - Computer Analysis and Design.

References:

1. R.S.Khurmi, JK. Gupta, “Theory of Machines and Mechanisms”, McGrawHill,2005
2. M.Z. Kolovsky, A.N. Evgrafov, Yu.A.Semenov, A.V. Slousch, “Advanced Theroy of Mechanisms and machines”, Springer, 2013.

PDE283	Mechanical Vibrations								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	2nd	PDE282

Reciprocating motion - Free vibration - Forced vibration with hormonic forces - Transient vibration - Vibration analysis for two degrees of freedom - Vibration characteristics of systems with multiple degrees of freedom - Modeling systems using Lagrange equation - Vibration measurement and analysis - Diagnosis of machine errors using vibration analysis - Vibration control.

References:

1. Daniel J. Inman, "Engineering Vibration", 4th Edition, published by Pearson)2014(
2. Michel Geradin, Daniel J. Rixen," Mechanical Vibrations: Theory and Application to Structural Dynamics" published by Wiley)2014(.
3. S. Graham Kelly," Mechanical vibrations: theory and applications" published by Cengage Learning 2012.

MTE291	Instrumentation and Measurements								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	0	Semester	2nd	ELE141 – BAS211

Statistical analysis of experimental data - Uncertainty analysis - Various statistical distributions and test of goodness of fit, correlation coefficient and multivariable regression - Engineering instrumentation including types of passive/active transducers, electronics for instrumentation, computer-based data acquisition, and experiments on pressure, temperature, force measurements. Also electrical measurements such as voltage, current and resistance…etc.

References:

1. Ernest O. Doebelin, " Measurement Systems", McGraw – Hill, Singapore, 1990
2. 2-R. S. Figliola and D. E. Beasley, " Theory and Design for Mechanical Measurements", John Wiley &Sons, Inc., U.S.A., 1995.

CSE352	Microcontrollers and Operating Systems								Prerequisites
2 Cr	Lecture	1	Tutorial	0	Lab.	2	Semester	1st	CSE151

Computer number systems, codes, and arithmetic functions; microprocessor and microcontroller functions, architecture, Busses, Memory, instruction sets, addressing modes, internal operations, PIA interfacing, and I/O operations. Assembly and Machine Language Programming: Branching, Loops, Subroutines, Interrupts, and Troubleshooting. Introduction to operating systems: process management, scheduling, memory management, device drivers, file systems and modern operating systems concepts (kernel/micro kernel designs, concurrency, synchronization, inter-process communication, security and protection)

References:

1. Ogata Modern_Control_Engineering_4th_Ed
2. McGraw-Hill - PIC Microcontroller Project Book by John Lovin
3. Microprocessor and Microcontroller System A. P. Godse and Mrs-

CSE353	Embedded Systems								2 Cr.
2 Cr	Lecture	1	Tutorial	0	Lab.	2	Semester	2nd	CSE352

Examples of embedded systems which can be found as parts of many machines that we rely on every day, like household appliances, consumer electronics (DVD players, MP3s), vehicles, and so forth. Theoretical and practical solutions to typical problems that the students are expected to master and be able to apply to realistic case studies. Microcontroller and its use in the design of embedded systems. Hardware and software architectures of a microcontroller, its programming languages and its applications for a wide range of real-word applications.

References:

1. "PIC Microcontroller Projects in C: Basic to Advanced", Ibrahim Dogan, Newnes, 2 edition, 2014
2. "PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18", Muhammad Ali Mazidi, MicroDigitalEd, 2 edition,2016.

ECE361	Digital Signal Processing								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	1st	ECE262

Signal and Systems - representation of the signals - sampling - intermittent signals - "Z" transform and inverse – Discrete Fourier transform – FFT – Random processes

Analog to Digital Conversion and Digital to Analog Conversion FIR and IIR Filter Design

Steps of digital filters Design, implement filters - coefficient retail, limited word length, Wiener filter - filters harmonization - data coding and compressing – Applications: signals regeneration.

References:

1. Diniz P.S.R., et al. Digital signal processing. System analysis and design (CUP, 2010)(ISBN 0521887755)
2. Chi-Tsong Chen - Digital signal processing _ spectral computation and filter design-Oxford University Press (2001)
3. Ashok Ambardar , Analog-and-Digital-Signal-Processing, Second Edition , Brooks/Cole Publishing Company , 1998

PDE381	Mechanical Design								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	1st	PDE282 – PDE381

Material selection and design for manufacturing and assembly processes - Design steps for some mechanical parts such as fasteners, power screw and springs - Design steps for shafts, keys, permanent joints and belt systems - Design of spur, helical and worm gears – Sliding and roller bearings and lubrication – Design of couplings and brakes - operational, structural and assembly drawings for the presentation of mechanical designs - computer aided design and course project.

References:

1. Peter R.N. Childs, "Mechanical Design Engineering Handbook", Butterworth-Heinemann, 2014.
2. James Bethune, "Engineering Design and Graphics With Solidwork",15 edition, Peachpit Press, 2015
3. Hardback, "Mechanical Design Process", 5th edition, McGraw-Hill Publishing, 2016

MTE391	Sensors and Actuators								Prerequisites
2 Cr	Lecture	1	Tutorial	0	Lab.	2	Semester	1st	MTE291

operational amplifiers, operational amplifier circuits using negative or positive feedback; operational amplifier circuits using diodes; analog signal detection, conditioning and conversion systems; transducers and sensors, difference and instrumentation amplifiers, active filters, basic types of sensors and actuators.

References:

1. "Modern Control Technology: Components and Systems", Christopher T. Kilian, Dalmer, 2nd edition, 2008
2. Lecture on measurement systems design and testing
3. "Modern Control Engineering", Ogata, Pearson India, 5th edition, 2015.

PDE382	CNC Machines								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2nd	PDE282 – PDE283

Physical construction of digital computer control machines: guide systems, transmission systems and engines - digital computer controller - physical controller components: motors and auxiliary devices for the physical components of the controller - remote control panel - control software: Mach3 control software - G code and editor - application software Milling, turning, drawing and computer designing and computer manufacturing programs.

References:

1. "CNC Machining Handbook: Building, Programming, and Implementation" by Alan Overby
2. "Theory and Design of CNC Systems (Springer Series in Advanced Manufacturing)" by Suk-Hwan Suh and Seong Kyoon Kang
3. "Getting Started with CNC (Make)" by Edward Ford.
4. "CNC Machining Technology: Volume II Cutting, Fluids and Workholding Technologies" by Graham T Smith

PDE392	Robotics								Prerequisites
	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2nd	PDE282

Homogeneous transformations - direct kinematics - inverse kinematics - velocity kinematics - path planning - static and stiffness analysis - dynamics: Euler-Lagrange equations - Euler-Newton's iterative formulation - motion control - force control - Robotic arm with high degrees of freedom - Analysis of parallel robots - Qualitative design of parallel robots - Soft elements robots - Leg and wheeled robots - Micrometer and nanometric robots - Remote sensing and control robots - Exoskeleton robots to maximize human performance - Underwater robots - Flying robots - Space robots - Service and field robots - Robots that take care of human health and Rehabilitation - Humanoid robots.

References:

1. Spong, Mark W., Seth Hutchinson, and Mathukumalli Vidyasagar. Robot modeling and control. Vol. 3. New York: wiley, 2006.
2. Siciliano, Bruno, and Oussama Khatib, eds. Springer handbook of robotics. Springer, 2016..

MPE371	Heat Transfer								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	MPE171

Conduction heat and mass transfer – introduction to convective heat and mass transfer – Combined heat and mass transfer – Radiation – Design of heat and exchangers.

References:

1. “Analysis of Heat Transfer” by E R G Eckerst and R M Drake.
2. Heat Transfer: A Practical Approach, Y. Cengel.

MPE372	Computational Fluid Dynamics								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2nd	BAS212 – MPE271

Applied numerical methods for solving algebraic and differential equations to simulate physical processes including fluid flow, heat and mads transfer. Applying commercial computational fluid dynamics (CFD) software packages to simulate real engineering design applications.

References:

1. An Introduction to Computational Fluid Dynamics by Versteeg, H. K.; Malalasekera, W.
2. Computational Fluid Dynamics by John Anderson
3. Essential Computational Fluid Dynamics by Oleg Zikanov
4. Fundamentals of Fluid Mechanics by Bruce R. Munson and Wade W. Huebsch..

CSE452	Programmable Logic Controllers								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	CSE151

Ladder programming and input/output operations - Manipulate data using PLC instruction sets - Advanced motion control programming using instruction set - Designing, configuring and interfacing graphical screens for HMI (Human Machine Interface) units - Architecture and operation of Distributed Control systems - Design of a simple DCS system - Ability to design the overall DCS and process control system - Ability to specify, select and install DCS systems - Understanding of the key ergonomic issues in design of operator displays - modern Distributed Control Systems - Apply advanced control strategies to plant control system - Alarm systems

References:

1. Introduction to PLCs: A beginner's guide to Programmable Logic Controllers Paperback. 2012 by Elvin Pérez Adrover
2. Introduction to PLCs, Second Edition 2nd Edition by Jay F. Hooper 2015.

CSE453	Artificial Intelligence and Machine Learning								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	2nd	CSE352

Supervised learning (generative/discriminative learning, parametric/non-parametric learning, neural networks, support vector machines); unsupervised learning (clustering, dimensionality reduction, kernel methods); learning theory (bias/variance tradeoffs; VC theory; large margins); reinforcement learning and adaptive control. The course will also discuss recent applications of machine learning, such as to robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing.

References:

1. "An introduction to Artificial Intelligence" by Janet Finlay and Alan Dix
2. "Fuzzy Logic with Engineering Applications" by Timothy J. Ross
3. "Fuzzy Systems, Modeling and Identification" by Robert Babuka

MPE471	Hydraulic and Pneumatic Control Systems								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2nd	BAS212 – MPE271

Basics of hydraulic and pneumatic systems - Hydraulic circuits - Main pneumatic circuits - Hydraulic and pneumatic cylinders control - Hydraulic and pneumatic control valves - Characteristics and selection of positive and non-positive displacement pumps - Characteristics and parameters of filters - Linear and rotary hydraulic actuators - Characteristics and design of hydraulic and pneumatic distribution systems - Design and determination of volume - Design of hydraulic and pneumatic systems and their applications.

References:

1. Rabie, M.G., “Fluid Power Engineering”, McGraw-Hill, 2009.
2. Manring, N.D., “Hydraulic Control Systems”, 1st edition, Wiley, 2005
3. Fluid Power Control : Hydraulics and Pneumatics” by Ahmed Abu Hanieh
4. “The Analysis and Design of Pneumatic Systems” by B W Anderson
5. “Hydraulic Power System Analysis” by Richard Smith

MTE491	Design of Mechatronic System								Prerequisites
	Lecture	2	Tutorial	0	Lab.	3	Semester	1st	PDE282 – CSE352

Introduction to mechatronic product development (analysis of user requirements, design constraints, ،analysis of alternatives). Modular design. Mechatronics system design tools (CAD Software Matlab/SimuLink, PROTEUS). Selection of sensors and actuators. Real-time and data acquisition systems. Mini-projects to implement the development of mechatronic systems.

References:

1. Kent Stiffler, “Design with Microprocessors for Mechanical Engineers”, McGraw Hill, 1992.
2. Christopher Kilian, “Modern Control Technology: Components and Systems”, Delmar Thomson Learning, 2nd Ed., Dec. 2000.
3. N. Mahalik, “Mechatronics: Principles, Concepts and Applications”, Tata McGraw-Hill, 2003.

First Group of elective courses (Level 300):

CSE301	Database Systems								Prerequisites
3 Cr	Lecture	2	Tutorial	٢	Lab.	0	Semester		Level 300

Introduction to data bases - data modeling - types of database systems - database management - data dictionary - evaluation and representation - interrelated databases: design - functional dependence – Normalization - SQL Languages, databases: algebra - integration and security - management process and restore – applications to information systems .

References:

1. An Introduction to Database Systems”, C. J. Date, 7th Edition, Addison, 2017
2. Fundamentals of Database Systems (3rd Edition) by Ramez Elmasri and Shamkant Navathe (Aug 1015)

CSE302	Internet of Things								Prerequisite
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester		Level 300

Introduction to IoT – IoT hardware platforms and operating systems – Wireless communication technologies for IoT – IP-connected smart objects and networks – Embedded web services and web things – Tracking industrial networks – Other relevant standardization bodies and protocol.

References:

1. Rouse, Margaret (2019). "internet of things (IoT)". IOT Agenda. Retrieved 14 August 2019.
2. . Acharjya, D.P.; Geetha, M.K., eds. (2017). Internet of Things: Novel Advances and Envisioned Applications. Springer
3. Thomas, Jayant; Traukina, Alena (2018). Industrial Internet Application Development: Simplify IIoT development using the elasticity of Public Cloud and Native Cloud Services. Packt Publishing.

ELE301	Power Electronics								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester		Level 300

Conversion techniques of electric energy – Deign of electronic power devices and circuits - Applications of power electronics in electric machines – Applications of power electronics in Renewable energy systems.

References:

1. Issa Batarseh, "Power Electronic Circuits" by John Wiley, 2003.
2. S.K. Mazumder, "High-Frequency Inverters: From Photovoltaic, Wind, and Fuel-Cell based Renewable- and Alternative-Energy DER/DG Systems to Battery based Energy-Storage Applications", Book Chapter in Power Electronics handbook, Editor M.H. Rashid, Academic Press, Burlington, Massachusetts, 2010.
3. V. Gureich "Electronic Devices on Discrete Components for Industrial and Power Engineering", CRC Press, New York, 2008
4. R. W. Erickson, D. Maksimovic, Fundamentals of Power Electronics, 2nd Ed., Springer

PDE301	Computer-Aided Design								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester		Level 300

Introduction to 2D and 3D software - Create / edit documents, customize user interface, manage user settings - Draw details, define constraints - Create solid model parts, modify part features - Design (multi-part, multi-assemblies) - Drafting, Add / modify directions of view, generate dimensions - detailed dimensions, explanation of the drawing - surfaces: create wire engineering (points, lines, curves) - perform operations: joining, trimming, splitting, transforming, axes transformation - interfaces for finite element analysis.

References:

1. CAD/CAM : Computer-Aided Design and Manufacturing" by M Groover and E Zimmers
2. "Computer-Aided Tolerancing: Proceedings of the 4th Cirp Design Seminar the University of Tokyo" by Fumihiko Kimura
3. "Computer Aided Engineering Design" by Anupam Saxena

PDE302	Non-conventional Machining Processes								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester		Level 300

Introduction to non-conventional machining operations and their classifications - non-conventional mechanical operations (water jet machining, abrasive jet machining, abrasive water jet, abrasive jet finishing, ultrasonic machining and applications) - non-conventional electrical operations (electrochemical operation and applications), non-conventional thermal operations Conventional thermal (electrical discharge machining and its applications, electron beam machining, laser beam machining, plasma arc machining) - non-conventional chemical processes (chemical milling, photochemical milling).

References:

1. " Modern Machining Process" by Pandey and Shah.
2. " Advanced Analysis of Nontraditional Machining" by Hong Hocheng.
3. " Nontraditional Machining Processes" by E Weller.
4. " Non-Traditional Machining Processes" by Jagadeesha T.
5. " Nontraditional Machining Processes: Research Advances" by J Paulo Davim.

MPE302	Microelectromechanical Systems								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester		Level 300

Fundamentals of microfabrication – MEMS devices and packaging – MEMS modeling and design – Microfluidics – BioMEMS – Introduction to top down and bottom up nanofabrication – Introduction to characterization of nanostructures.

References:

1. "MEMS AND Microsystems: Design And Manufacture" by Tai-Ran Hsu
2. " Micromachined Transducers Sourcebook" by Gregory Kovacs. ...
3. " Micromechanical Transducers: Pressure Sensors, Accelerometers and Gyroscopes" by M H Bao.
4. "MEMS Introduction and Fundamentals" by Gad-El-Hak
5. "Microelectromechanical Systems" by Dilip Kumar Bhattacharya and Brajesh Kumar Kaushik

MPE301	Control of Power Plants and Air Conditioning Systems								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester		Level 300

Basic components in the following systems and important parameters to control: power plants, chemical industries, HVAC systems – industrial control equipment – applications on DCS

3 Embedded Systems.

References:

1. R.W. Haines, HVAC Systems Design Handbook, 5th edition, McGraw-Hill Education, 2009.
2. Refrigeration and air conditioning control by Arora C P
3. " A Text book of Refrigeration and Air conditioning" by Kurmi R S and J K Gupta.
4. " Thermal Engineering" by R Rudramoorthy.
5. " Refrigeration and Air Conditioning" by Arora.
6. " Basic Refrigeration and Air Conditioning" by Ananthanarayanan.

MTE302	Autotronic Systems								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	1/2	Level 300

Introduction to automotive mechatronics - Automotive sendors and actuators - Engine systems and automatic control - Transmission and automatic control - Steering and suspension, braking, traction, and stability systems - Automotive safety systems - Electric and hybrid vehicles – LabView + ADAMS + Matlab + CAN bus basics networking of control units.

References:

1. Automotive Mechatronics: Operational and Practical Issues: Volume II (Intelligent Systems, Control and Automation: Science and Engineering) 2011th Edition by B. T. Fijalkowski
2. Automotive Mechatronics: Automotive Networking, Driving Stability Systems, Electronics (Bosch Professional Automotive Information) 2015 Edition, Kindle Edition by Konrad Reif.

Second Group of elective courses (Level 400):

CSE401	Software Engineering								Prerequisites
3 Cr	Lectures	2	Tutorial	2	Lab.	0	Semester		Level 400

Software development processes: waterfall methods, agile methods, rapid application development – system modeling using UML: context models, interaction models, structural models, behavioral models, model-based engineering – system design and design: system architectural design decisions, different views on architecture, architectural patterns, application architectures – testing: development testing, test-based development, release testing, user testing – software maintenance: evolution processes, understanding software development, change to operational software systems, legacy system management, decision-making on program change – quality assurance and management of the organization, modern trends in software development.

References:

1. "Machine Learning Applications In Software Engineering (Series on Software Engineering and Knowledge Engineering)" by Du Zhang and Jeffrey J P Tsai
2. "FUNDAMENTALS OF SOFTWARE ENGINEERING, 2/E 2nd Edition" by Carlo Ghezzi
3. "Fundamentals of Software Engineering" by Rajib Mall

CSE402	Computer Vision							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	Level 400

Image acquisition and filtering – features identification – segmentation – model or rule based identification of patterns – data extraction from the identified figure - tracking moving figures in a video.

References:

1. Computer Vision: Algorithms and Applications by Richard Szeliski
2. Deep Learning by Bengio and Courville

ECE401	Image Processing							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester	Level 400

Contains digital imaging systems and digital images - image statistics -. Cleaning image -. Processes that rely on the principle of blobs, shared statistics and comparing images - shrugging operations - Fourier theory, which depends on the frequency and filters -. Restoration of images, and, reconstruction, encryption and compression. Ways to predict the values of the spatial locations and location and geometrical transformations.

References:

1. Geometric Methods in Bio-Medical Image Processing (Mathematics and Visualization), Dec 21, 2012 , Ravikanth Malladi
2. Advances in Mass Data Analysis of Signals and Images in Medicine, Biotechnology and Chemistry: International..., Jan 16, 2008, Petra Perner and Ovidio Salvetti
3. Petrou, Maria, and Costas Petrou. Image processing : the fundamentals. Chichester, U.K: Wiley, 2010.
4. Sonka, Milan, Vaclav Hlavac, and Roger Boyle. Image processing, analysis, and machine vision. Stamford, CT, USA: Cengage Learning, 2015..

ELE401	Electrical Traction systems							Prerequisites
	Lecture	2	Tutorial	2	Lab.	0	Semester	Level 400

Introduction to electric motor derives – Dynamics of electrical derives – Selection of motor rating – DC motor drives – Induction motor derives – Synchronous motor derives – Special motor derives.

References:

1. " Control of Electrical Drives" by W Leonhard. ...
2. " Vector Control of AC Machines" by P Vas. ...

3. “ Analysis of Thyristor Power Conditioned Motors” by S K Pillai. ...
4. “ Fundamentals of Electrical Drives” by G K Dubey. ...
5. “ ELECTRIC DRIVES” by De Nisit K and Sen Prasanta K.
6. “ Electric Motor Drives” by R Krishnan..

PDE401	Prototyping and Automation								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester		Level 400

Introduction rapid prototyping processes (3D printing) by methods (selective laser sintering, electron beam melting, stereolithography, fused deposition modelling, binder jetting) and medical and industrial applications - model processing and finishing - automation of industrial processes and their use in material transportation by automated guided vehicles, moving belts and robotic arms.

References:

1. Manufacturing and Automation Technology R. Thomas Wright | 2006
2. Automation, Production Systems, and Computer-Integrated Manufacturing Mikell P. Groover | 2014
3. Implementation of Robot Systems An introduction to robotics, automation, and successful systems integration in manufacturing Mike Wilson | 2014

PDE402	Mobile and Bipedal Robots								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester		Level 400

Locomotion - Mobile robot kinematics – Perception – Mobile robot localization – Planning, navigation and obstacle avoidance – Motion control of wheeled mobile robot – Simultaneous localization and mapping - Bipedal robots and walking - Kinematic and dynamic models for walking - Design tools for making bipedal robots - Walking pattern generators – Control of bipedal robots.

References:

1. Kajita, Shuuji, et al. Introduction to humanoid robotics. Vol. 101. Springer Berlin Heidelberg, 2014.
2. Siciliano, Bruno, and Oussama Khatib, eds. Springer handbook of robotics. Springer, 2016

MPE401	Design of Renewable Energy Systems								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester		Level 400

Energy conversion systems- resources of renewable energy- Collection of solar energy – Solar-thermal energy systems - Photovoltaic systems- Wind energy systems - Biomass energy- Geothermal energy- - Biogas production systems - Fuel cells – Energy economics.

References:

1. S.H. Saeed and D. K. Sharma, Non-Conventional Energy Resources, Second Edition, For S.K. Kataria & Sons, New Delhi, 2008.
2. G. Boyle, " Renewable Energy: Power for a Sustainable Future", Third Edition, Oxford University Press, 2012..

MTE401	Medical Mechatronic Systems								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester		Level 400

]\Introduction to bio-mechatronics - human motion control and coordinated motion - Lower extremity Orthotics and Prosthetics - rehabilitation of patients with motion disorders - artificial mechanical systems for the upper extremities - control interfaces for mechanical devices - actuators for mechanical devices - Exo-skeletons - Clinical gait analysis - Motor control in patients with neurological disorders - Artificial sensoric interfaces - Artificial motion control - Functional Electrical Stimulation - Rehabilitation Robotics.

References:

1. "Introduction to Biomedical Instrumentation: The Technology of Patient Care" by Barbara Christe.
2. "Microscopic Imaging Through Turbid Media: Monte Carlo Modeling and Applications (Biological and Medical Physics, Biomedical Engineering)" by Min Gu and Xiaosong Gan
3. Biomedical Engineering Bridging Medicine and Technology W. Mark Saltzman 2015.

Training and capstone design courses:

MTE295	Training (1)								Prerequisites
0 Cr	Lecture	--	Tutorial	--	Lab.	6	Semester	2nd/S	-------

Field training should be performed in external locations for at least 1 month and a total of 120 working hours at least. A report should be presented, and the student defends it orally affront of a committee.

MTE395	Training (2)								Prerequisites
0 Cr	Lecture	--	Tutorial	--	Lab.	6	Semester	2nd/S	-------

Field training should be performed in external locations for at least 1 month and a total of 120 working hours at least. A report should be presented and the student defends it orally afront of a committee.

MTE498	Project (1) in Mechatronics								Prerequisites
3 Cr	Lecture	1	Tutorial	0	Lab.	6	Semester	1st	120 hrs

Students in teams apply knowledge and skills they have learned in early courses to solve real engineering problems. Design constraints, engineering standards, and project management principles must be used. At the end of the project, a report is presented and defended.

MTE499	Project (2) in Mechatronics								Prerequisites
3 Cr	Lecture	1	Tutorial	0	Lab.	6	Semester	2nd	MTE498

Students in teams apply knowledge and skills they have learned in early courses to solve real engineering problems. Design constraints, engineering standards, and project management principles must be used. At the end of the project, a report is presented and defended.

Chapter Five:

A B. Sc. Program in Building and Construction Engineering (BCE) with Credit Hours System

1. Program Definition

Rapid changes have occurred regarding the needs of the local market in Egypt and the surrounding countries, and this is evident in the engineering fields in general and building and construction work in particular. So you find that the graduate (for example) has a reasonable knowledge of the construction aspects and a severe shortage in the field of finishing works, or (on the contrary) a reasonable knowledge of the finishing works and a severe shortage in the construction field. For instance, the student of the Department of Structural Engineering studies only one or two at most of the architectural engineering courses, and at the same time the student of the Department of Architectural Engineering studies only superficial courses of concrete and steel structures and building foundations.

In fact, the architect cannot fulfill the requirements of quality, sufficiency and economics unless he is reasonably familiar with construction theories. Likewise, the structural engineer is required to consider the architectural aspects of the design in order to preserve the aesthetic aspects and achieve the purpose for which the building is built. Therefore, the market is in need of an engineer with reasonable knowledge of the structural and architectural aspects to achieve safety, sufficiency and beauty of the building, in addition to this the old and modern construction methods and appropriate selection of them for the project as well as its economics and its implementation program and evaluation of the implementation stages.

The Building and Construction Engineering program qualifies a student to obtain a new Bachelor's degree in engineering. The study is based on the credit hours system and the primary language of study in the program is English. As the fields of engineering accommodate many subjects, a number of elective courses are designed to cover all areas of engineering related to the major. The program offers a number of necessary (compulsory) courses at the first three levels to provide students with the basics required to study in the program. At the end of the third and fourth levels, the student chooses a number of elective courses and basic design courses .

The program links between three main specializations, including close links, and depends on a number of common core courses. These specializations are:

- **Structural Engineering**
- **Construction Engineering, including construction project management**
- **Architecture**

It was taken into account that the list of courses includes compulsory courses common among the three disciplines that the student needs to graduate as a building and construction engineer. At the same time, a number of optional courses were added, the student can choose a direction to focus on or distribute his interests in more than one direction

2. Basic Information

2.1 Program Vision

Excellence in the field of building and construction engineering at the local and regional levels.

2.2 Message of the Program

Preparing a distinguished graduate in the field of building and construction engineering through an advanced educational process that accompanies the local and regional labor market and community service.

2.3 Program's Objectives

- **A. Providing prepared and trained professionals in the field of building and construction engineering based on the standards of the National Authority for Quality Assurance and Accreditation of Education.**
- **B. Contribute to raising the professional competence and forming a generation of distinguished engineers and qualified researchers in the field of building and construction engineering.**
- **C. Building bridges linking what is taking place in the developed world of research and advanced technology and practical reality.**
- **D. Develop a sense of citizenship, support team spirit, respect time and act as a way of life and progress.**
- **E. Participate in achieving the development plan, putting science at its service to develop the society scientifically and culturally, and providing environmental services to new urban communities.**
- **F. Developing human capabilities to meet the needs of new societies, including building and construction engineers.**

2.4 Program Graduate Attributes

Based on NARS 2018, 2nd Edition Engineering National Standards and as stated in the reference framework, Jan. 2020, a graduate of the Building and Construction Engineering Program must be able to acquire the following general skills:

- **A. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations,**
- **B. Apply analytic critical and systemic thinking to identify, diagnose, and solve engineering problems with a wide range of complexity and variation,**
- **C. Behave professionally and adhere to engineering ethics and standards,**
- **D. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance,**
- **E. Recognize his/her role in promoting the engineering field and contribute to the development of the profession and the community,**

F. Value the importance of the environment, both physical and natural, and work to promote sustainability principles,

G. Use techniques, skills, and modern engineering tools necessary for engineering practice,

H. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies,

I. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner, and

J. Demonstrate leadership qualities, business administration, and entrepreneurial skills.

2.5 Graduate Competencies in Accordance with the National Academic Standards

According to NARS 2018, a graduate must be able to:

A1: Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.

A2: Develop and conduct appropriate experimentation and/or simulation, analyze, and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

A3: Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economical, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

A4: Utilize contemporary technologies, codes of practice, and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

A5: Practice research techniques and methods of investigation as an inherent part of learning.

A6: Plan, supervise, and monitor implementation of engineering projects, taking into consideration other trades requirements.

A7: Function efficiently as an individual and as a member of multi-disciplinary and multicultural teams.

A8: Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools .

A9: Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10: Acquire and apply new knowledge; and practice self, lifelong and other learning strategies

In addition to the competencies of most engineering programs, the engineering BCE program has some special competencies, which are as follows:

B1: Select appropriate and sustainable technologies for construction of buildings and infrastructures; using either numerical techniques or physical measurements and/or testing by applying a full range of civil engineering concepts and techniques of: Structural Analysis and Mechanics, Properties and Strength of Materials, Surveying, Soil Mechanics, Hydrology and Fluid Mechanics.

B2: **Achieve an optimum design of Reinforced Concrete and Steel Structures, Foundations and Earth Retaining Structures; and at least three of the following civil engineering topics: Transportation and Traffic, Roadways and Airports, Railways, Sanitary Works, Irrigation, Water Resources and Harbors; or any other emerging field relevant to the discipline.**

B3: **Plan and manage construction processes; address construction defects, instability and quality issues; maintain safety measures in construction and materials; and assess environmental impacts of projects.**

B4: **Deal with biddings, contracts and financial issues including project insurance and guarantees**

D1: **Produce designs that meet building users' requirements through understanding the relationship between people and buildings, and between buildings and their environment; and the need to relate buildings and the spaces between them to human needs and scale.**

The Program Courses in Line with the Required Competencies

Level	Couse Code	Corse Name	Competencies as Per NARS 2018														
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	D1
000	BAS011	Calculus (1) (Math. 1)	X														
	BAS021	Mechanics (1)	X														
	BAS031	Physics (1)	X	X													
	BAS041	Engineering Chemistry	X	X													
	PDE052	Engineering Drawing	X														
	UNR061	English Language (1)								X							
	BAS012	Calculus (2) (Math. 2)	X														
	BAS022	Mechanics (2)	X														
	BAS032	Physics (2)	X	X													
	IHE101	Civil Drawing	X														
	PDE051	Production Engineering	X		X	X											
	UNR062	English Language (2)								X							
100	STE103	Properties and Strength of Materials		X									X				
	STE101	Structural Analysis (1)											X				
	BAS113	Differential Equations (Math. 3)	X														
	BAS115	Statistics and Probability Theory	X														
	ARC101	Architectural Construction, Technical and Sanitary Installations															X
	ENG111	Technical Reports Writing								X							
	STE102	Building Construction Materials											X				
	ELE151	Electric Powers and Machines												X			
	BAS114	Special Functions (Math. 4)	X														
	PWE101	Plane Surveying											X				
	ARC102	Architectural Design (1)															X
	ARC103	Architecture Theory (1)															X

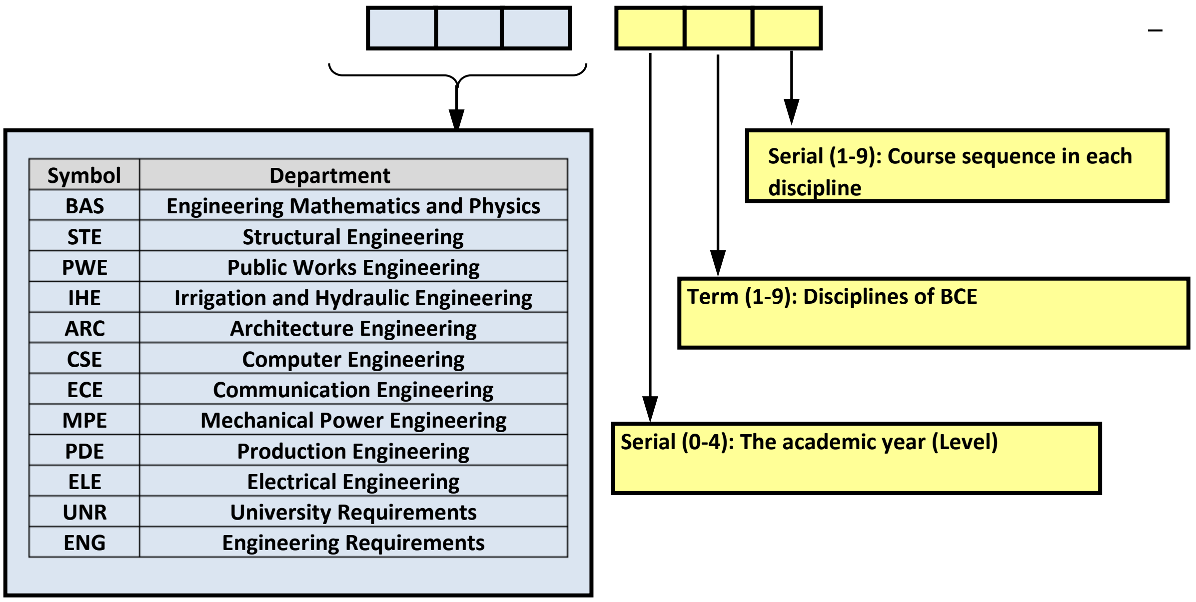
Level	Couse Code	Corse Name	Competencies as Per NARS 2018														
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	D1
	UNR171	History of Technology Engineering			X												
	STE205	Concrete Technology											X				
	STE206	Construction Economics														X	
	STE202	Structural Analysis (2)					X						X				
	BAS215	Numerical Analysis (Math. 5)	X														
	STE204	Engineering Geology and Soil Mechanics											X				
	UNR241	Communication and Presentation Skills								X							
200	STE207	Construction Methods and Equipment												X			
	STE203	Reinforced Concrete (1)				X	X							X			
	ARC203	Shop Drawings											X	X			
	PWE201	Traffic Planning and Traffic Engineering												X			
	IHE201	Hydraulics											X				
	UNR281	Law and Human Rights			X												
	ENG412	Projects Management													X		
	STE201	Training (1) (Summer Semester)						X	X	X	X	X					
	STE315	Specifications and Quantities														X	
	STE305	Steel Structures (1)				X	X							X			
	STE302	Structural Analysis (3)					X						X				
	STE303	Reinforced Concrete (2)				X	X							X			
	STE3XX	Elective (1)															
	STE3XX	Elective (2)															
	STE306	Steel Structures (2)				X	X							X			
	STE307	Foundations (1)												X			
	STE304	Reinforced Concrete (3)												X			
	STE308	Construction Project Management													X		
300	STE316	Contracts and Laws in Construction														X	
	STE301	Training (2) (Summer Semester)						X	X	X	X	X					
	STE309	Studies in the Field of Structural Engineering					X	X							X		
	STE310	Design of Masonry Structures												X			
	STE311	Sustainable Construction			X												
	STE312	Inspection and Maintenance of Structures												X	X		X
	STE313	Quality Control and Confirmation in Structures				X									X		
	ARC301	Architectural Design (2)															X

Level	Couse Code	Corse Name	Competencies as Per NARS 2018														
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	D1
	ARC302	Environmental control and Climate change			X	X											X
	ARC303	Building Information Modeling													X		X
	IHE302	Irrigation and Drainage Engineering												X			
	IHE303	Design of water structures												X			
	PWE302	Topographic Surveying											X				
	PWE303	Maps and Geographic Information Systems											X				
	STE401	Graduation Project (1)						X	X	X	X	X					
	STE403	Finite Element Method					X						X				
	STE405	Foundations (2)												X			
	PWE401	Sanitary Engineering (1)												X			
	PWE402	Highway Engineering												X			
	STE406	Project Evaluation													X		
	STE402	Graduation Project (2)						X	X	X	X	X					
	STE404	Modern Construction Materials											X				
	STE4YY	Elective (3)															
	STE4YY	Elective (4)															
	UNR 471	Marketing														X	
	UNR461	Ethics and Morals of the Profession			X												
	STE407	Reinforced Concrete (4)												X			
	STE408	Steel Structures (3)												X			
	STE409	Structural Dynamics											X				
400	STE410	Analysis and Design of Tall Buildings											X				
	STE411	Shell Structures Design											X				
	STE412	Prestressed Concrete												X			
	STE413	Strut-and-Tie Modeling Method											X				
	STE414	Composite Structural Elements Design												X			
	STE415	Rehabilitation and Strengthening of Concrete Structures												X			
	STE416	Soil Excavated Retaining Systems												X			
	PWE403	Sanitary Engineering (2)												X			
	STE417	Management of Construction Information Systems													X		
	STE418	Monitoring Construction Projects													X		
	STE419	Risk Management in Construction Projects				X									X		

Level	Couse Code	Corse Name	Competencies as Per NARS 2018														
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	D1
	STE420	Computer Applications in Structural Engineering					X						X				
	IHE401	Port Engineering												X			
	ARC401	Architectural Design (3)															X
	ARC402	Architectural Design (4)															X
	ARC403	Architectural Construction (2)															X
	ARC404	Architecture Theory (2)															X

3. Courses Coding System

Courses are coded according to Figure 1, and the course is related to the scientific section that presents it. The first part of the course code is the code of the scientific department, and the second part of the course code consists of three numbers; the first of which represents the level, while the second number represents the specialization number within the scientific department. The third number is a series of courses in the exact specialization in the same study year. Not all of these letters indicate the majors in which the degree is given, some of which represent university requirements, engineering requirements, or specialized courses.



Symbol	Department
BAS	Engineering Mathematics and Physics
STE	Structural Engineering
PWE	Public Works Engineering
IHE	Irrigation and Hydraulic Engineering
ARC	Architecture Engineering
CSE	Computer Engineering
ECE	Communication Engineering
MPE	Mechanical Power Engineering
PDE	Production Engineering
ELE	Electrical Engineering
UNR	University Requirements
ENG	Engineering Requirements

Figure (1): Courses Coding System

Course code refers to the semester in which this course is usually given, but these dates are subject to change, as not all courses are taught every year. Before the start of each semester, students 'affairs in the college display a table of the courses that will be taught in this semester and their teaching dates and those who are responsible for teaching.

4. The Structure and Contents of the Building and Construction Engineering Program

The structure of the Building and Construction Engineering program consists of 163 credit hours distributed as follows:

4.1 University Requirements

The main purpose of university education is not only to prepare students for successful careers but also to provide them with the knowledge and skills necessary to develop a rational and successful personal identity. Moreover, Mansoura University assists students in gaining an appreciation of the natural and cultural environments in which they live and their roles in society and community services. University requirements in undergraduate programs consist of 13 credit hours (7.975% of the total 163 credit hours), which are fulfilled by completing seven (7) courses which are shown in Table (1).

Table (1) Compulsory Courses as UNIVERSITY Requirements
(13 Credit Hours = 7.975% of the total 163)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	semester Works	Lab	Final Term
UNR061	English (1)	2	5	20	30	--	50
UNR062	English (2)	2	5	20	30	--	50
UNR171	History of Engineering and Technology	1	2	20	30	--	50
UNR281	Law and Human Rights	2	4	20	30	--	50
UNR241	Communication and Presentation Skills	2	5	20	30	--	50
UNR461	Ethics and Morals of The Profession	2	4	20	30	--	50
UNR471	Marketing	2	4	20	30	--	50
Total		**13**	**29**				

4.2 Faculty Requirements

The college requirements provide students with the knowledge and skills necessary to develop a successful engineer. The core of the college is applied to all credit hour programs. The standard requirement of the core courses in the college includes basic knowledge courses for all engineering graduates such as mathematics, physics, mechanics, engineering drawing, design, manufacturing, and chemistry. The college requirements for the Bachelor of Engineering and Construction Engineering program consist of 45 credit hours (27.607 % of the total 163 credit hours), which are completed by completing sixteen (16) mandatory courses, as listed in Table (2).

Table (2) Compulsory Courses as FACULTY Requirements
(45 Credit Hours = 27.607% of the total 163)

Code	Course Name	Prerequisite	Credit	Total SWL	Marks Distribution			
					Mid Term	semester Works	Lab	Final Term
BAS011	Calculus (1) (Math. 1)	Not applied	3	8	20	30	--	50
BAS021	Mechanics (1)	Not applied	3	8	20	30	--	50
BAS012	Calculus (2) (Math. 2)	BAS011	3	8	20	30	--	50
BAS022	Mechanics (2)	BAS021	3	8	20	30	--	50
BAS031	Physics (1)	Not applied	3	9	20	20	10	50
BAS032	Physics (2)	Not applied	3	9	20	20	10	50
BAS041	Engineering Chemistry	Not applied	3	9	20	20	10	50
PDE051	Production Engineering	Not applied	3	8	20	20	10	50
PDE052	Engineering Drawing	Not applied	3	10	20	30	--	50
ENG111	Technical Reports Writing	UNR062	2	6	20	30	--	50
BAS113	Differential Equations (Math. 3)	BAS012	3	8	20	30	--	50
BAS114	Special Functions (Math. 4)	BAS113	3	8	20	30	--	50
BAS115	Statistics and Probability Theory	BAS012	2	6	20	30	--	50
ELE151	Electrical Power and Machines	BAS032	3	8	20	30	--	50
BAS215	Numerical Analysis (Math. 5)	BAS114	3	8	20	30	--	50
ENG412	Project Management	Not applied	2	6	20	30	--	50
Total			45	127				

4.3 Requirements for General and Specific Specialization Courses

The requirements for the general specialization and the exact major in the Building and Construction Engineering program for the undergraduate degree consist of 105 Credit hours (64.417% of the total 163 credit hours), which are fulfilled by completing 34 mandatory courses equivalent to 87 credit hours, 4 elective courses equivalent to 12 credit hours, field training and graduation projects equivalent to 6 credit hours as shown in Tables (3a) and (3b):

Table (3a) Compulsory Courses as a Requirement for GENERAL and SPECIFIC Specialization (87 Credit Hours = 53.374% from163)

Course Code	Course Name	Credit Hours	Prerequisite	Total SWL	Marks Distribution			
					Mid Term	semester Works	Lab	Final Term
STE101	Structural Analysis (1)	3	BAS021	9	20	30	--	50
STE103	Properties and Strength of Materials	3	BAS031 + BAS021	8	20	20	10	50
STE202	Structural Analysis (2)	3	STE101	9	20	30	-	50
STE302	Structural Analysis (3)	3	STE202	9	20	30	-	50
STE203	Reinforced Concrete (1)	3	STE202 + STE205	9	20	30	-	50
STE303	Reinforced Concrete (2)	3	STE203	9	20	30	-	50
STE304	Reinforced Concrete (3)	3	STE303 +STE302	9	20	30	-	50
STE305	Steel Structures (1)	3	STE202	9	20	30	-	50
STE306	Steel Structures (2)	3	STE305	9	20	30	-	50
STE204	Engineering Geology and Soil Mechanics	3	STE101	9	20	30	-	50
STE307	Foundations (1)	3	STE204	9	20	30	-	50
STE102	Building Construction Materials	2	STE103	6	20	30	-	50
STE205	Concrete Technology	2	STE102	7	20	20	10	50
STE206	Construction Economics	2	BAS012	6	20	30	-	50
STE308	Construction Project Management	3	STE206 + ENG412	9	20	30	-	50
IHE101	Civil Drawing	3	PDE052	9	20	30	--	50
IHE201	Hydraulics	2	Not applied	6	20	30	-	50
PWE101	Plane Surveying	3	Not applied	9	20	20	10	50
PWE401	Sanitary Engineering (1)	2	IHE201	6	20	30	-	50
PWE402	Highway Engineering	2	Not applied	6	20	30	-	50
STE403	Finite Element Method	3	BAS215 + STE302	8	20	30	-	50
STE404	Modern Construction Materials	2	STE205	6	20	30	-	50
STE405	Foundations (2)	2	STE307	6	20	30	-	50
STE315	Specifications and Quantities	2	STE203	5	20	30	-	50
STE207	Construction Methods and Equipment	2	STE206	6	20	30	-	50
STE316	Contracts and Laws in Construction	2	ENG412	5	20	30	-	50
STE406	Project Evaluation	2	STE308	6	20	30	-	50
ARC101	Architectural Construction, Technical and Sanitary Installations	3	PDE052	9	20	30	--	50
ARC102	Architectural Design (1)	3	PDE052	9	20	30	-	50
ARC203	Shop Drawings	2	ARC102 + ARC101	6	20	30	-	50
ARC103	Architecture Theory (1)	2	PDE052	6	20	30	-	50
PWE201	Traffic Planning and Traffic Engineering	2	BAS115	6	20	30	-	50
ARC303	Building Information Modeling	3	IHE101 + ARC101	8	20	30	-	50
STE419	Risk Management in Construction Projects	3	STE308	7	20	30	-	50

Table (3b) Elective Courses as Requirements for General and Specific Specialization (12 Credit Hours = 7.362% of 163)

Course code	Course name	Credit hours	Prerequisite	Total SWL	Marks Distribution			
					Mid Term	semester Works	Lab	Final Term
STE309	Studies in the Field of Structural Engineering	3	Not applied	9	20	30	--	50
STE310	Design of Masonry Structures	3	STE202 + STE102	9	20	30	--	50
STE311	Sustainable Construction	3	STE205	9	20	30	--	50
STE312	Inspection and Maintenance of Structures	3	STE205	9	20	30	--	50
STE313	Quality Control and Confirmation in Structures	3	STE205	9	20	30	--	50
ARC301	Architectural Design (2)	3	ARC102	9	20	30	--	50
ARC302	Environmental control and climate change	3	ARC102	9	20	30	--	50
IHE302	Irrigation and Drainage Engineering	3	IHE201	9	20	30	--	50
IHE303	Design of Water Structures	3	IHE201	9	20	30	--	50
PWE302	Topographic Surveying	3	PWE101	9	20	30	--	50
PWE303	Maps and Geographic Information Systems	3	PWE302	9	20	30	--	50
STE407	Reinforced Concrete (4)	3	STE304	8	20	30	--	50
STE408	Steel Structures (3)	3	STE306	8	20	30	--	50
STE409	Structural Dynamics	3	STE302	8	20	30	--	50
STE410	Analysis and Design of Tall Buildings	3	STE303 + STE306 + STE302	8	20	30	--	50
STE411	Shell Structures Design	3	BAS113 + STE303 + STE302	8	20	30	--	50
STE412	Prestressed Concrete	3	STE303	8	20	30	--	50
STE413	Strut-and-Tie Modeling Method	3	STE303 + STE302	8	20	30	--	50
STE414	Composite Structural Elements Design	3	STE203 + STE306	8	20	30	--	50
STE415	Rehabilitation and Strengthening of Concrete Structures	3	STE303	8	20	30	--	50
STE416	Soil Excavated Retaining Systems	3	STE405	8	20	30	--	50
PWE403	Sanitary Engineering (2)	3	PWE401	8	20	30	--	50
STE417	Management of Construction Information Systems	3	ENG412	8	20	30	--	50
STE418	Monitoring Construction Projects	3	STE308	8	20	30	--	50
STE420	Computer Applications in Structural Engineering	3	STE403	8	20	30	--	50
IHE401	Port Engineering	3	STE307	8	20	30	--	50
ARC401	Architectural Design (3)	3	ARC301	8	20	30	--	50
ARC402	Architectural Design (4)	3	ARC401	8	20	30	--	50
ARC403	Architectural Construction (2)	3	ARC101	8	20	30	--	50
ARC404	Architecture theory (2)	3	ARC103	8	20	30	--	50

Table (4) Project Decisions, Practical Training, and Field Training (6 Credit Hours)

Course code	Course name	Credit hours	Prerequisite	Total SWL	Marks Distribution			
					Mid Term	semester Works	Lab	Final Term
STE201	Training (1) - Building and Construction Engineering	0	--	--	--	--	--	--
STE301	Training (2) - Building and Construction Engineering	0	STE201	--	--	--	--	--
STE401	Graduation Project (1) - Building and Construction Engineering	3	120 Credit Hours	--	--	50	--	50
STE402	Graduation Project (2) - Building and Construction Engineering	3	STE401	--	--	50	--	50

5. Student's Study Plan Proposal

The following tables clarify a proposal for the regular student to schedule the courses in the first and second semesters for each of the five levels of study, indicating the number of study hours prescribed as lectures, exercises and laboratories, as well as the number of credit hours and contact hours.

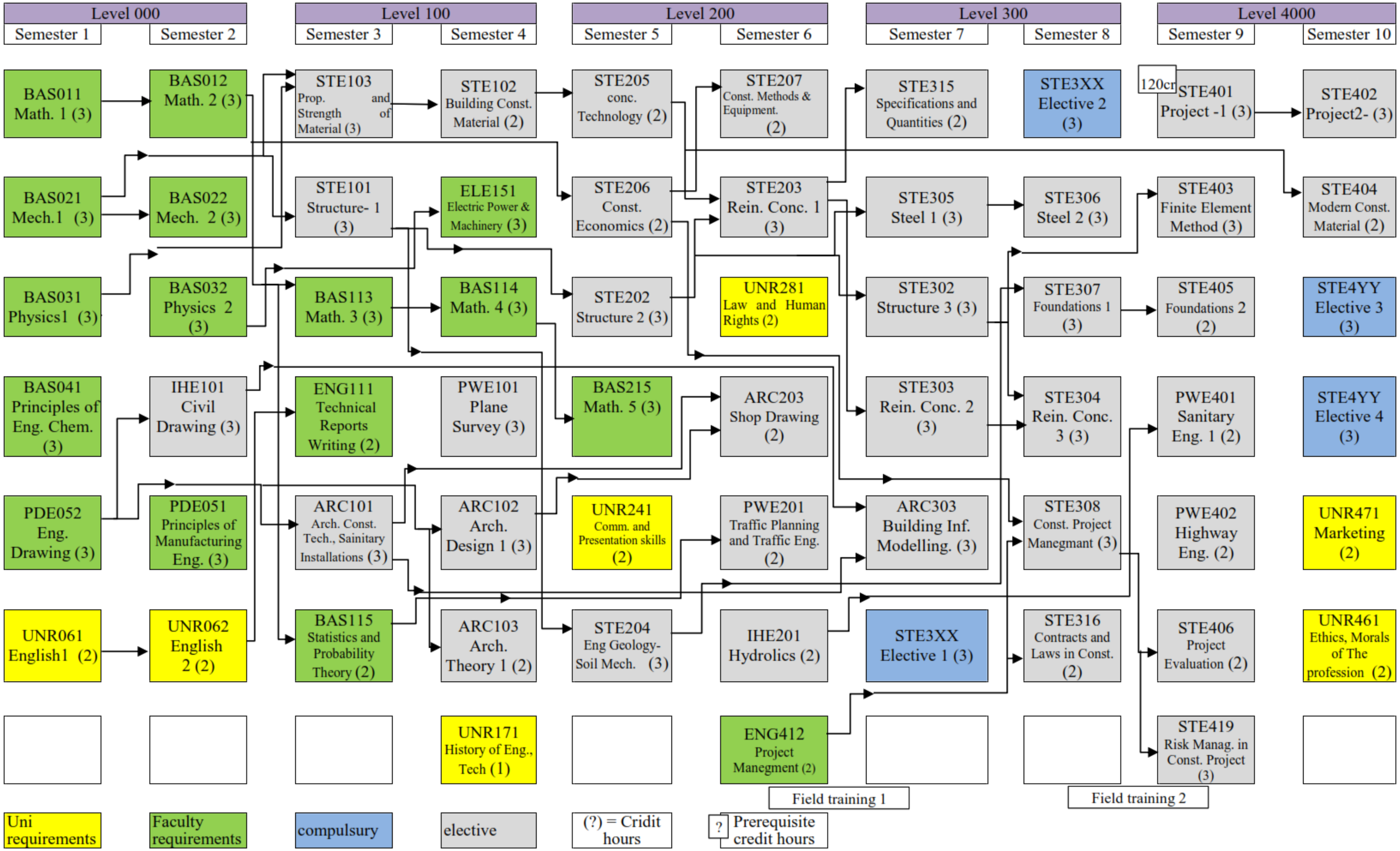

Level 000
Semester 1
Semester 2
Level 100
Semester 3
Semester 4
Level 200
Semester 5
Semester 6
Level 300
Semester 7
Semester 8
Level 4000
Semester 9
Semester 10
BAS011 Math. 1 (3)
BAS012 Math. 2 (3)
STE103 Prop. and Strength of Material (3)
STE102 Building Const. Material (2)
STE205 conc. Technology (2)
STE207 Const. Methods & Equipment. (2)
STE315 Specifications and Quantities (2)
STE3XX Elective 2 (3)
120cr
STE401 Project -1 (3)
STE402 Project2- (3)
BAS021 Mech.1 (3)
BAS022 Mech. 2 (3)
STE101 Structure- 1 (3)
ELE151 Electric Power & Machinery (3)
STE206 Const. Economics (2)
STE203 Rein. Conc. 1 (3)
STE305 Steel 1 (3)
STE306 Steel 2 (3)
STE403 Finite Element Method (3)
STE404 Modern Const. Material (2)
BAS031 Physics1 (3)
BAS032 Physics 2 (3)
BAS113 Math. 3 (3)
BAS114 Math. 4 (3)
STE202 Structure 2 (3)
UNR281 Law and Human Rights (2)
STE302 Structure 3 (3)
STE307 Foundations 1 (3)
STE405 Foundations 2 (2)
STE4YY Elective 3 (3)
BAS041 Principles of Eng. Chem. (3)
IHE101 Civil Drawing (3)
ENG111 Technical Reports Writing (2)
PWE101 Plane Survey (3)
BAS215 Math. 5 (3)
ARC203 Shop Drawing (2)
STE303 Rein. Conc. 2 (3)
STE304 Rein. Conc. 3 (3)
PWE401 Sanitary Eng. 1 (2)
STE4YY Elective 4 (3)
PDE052 Eng. Drawing (3)
PDE051 Principles of Manufacturing Eng. (3)
ARC101 Arch. Const. Tech., Sanitary Installations (3)
ARC102 Arch. Design 1 (3)
UNR241 Comm. and Presentation skills (2)
PWE201 Traffic Planning and Traffic Eng. (2)
ARC303 Building Inf. Modelling. (3)
STE308 Const. Project Manegmant (3)
PWE402 Highway Eng. (2)
UNR471 Marketing (2)
UNR061 English1 (2)
UNR062 English 2 (2)
BAS115 Statistics and Probability Theory (2)
ARC103 Arch. Theory 1 (2)
STE204 Eng Geology- Soil Mech. (3)
IHE201 Hydrolics (2)
STE3XX Elective 1 (3)
STE316 Contracts and Laws in Const. (2)
STE406 Project Evaluation (2)
UNR461 Ethics, Morals of The profession (2)
UNR171 History of Eng., Tech (1)
ENG412 Project Mangement (2)
STE419 Risk Manag. in Const. Project (3)
Field training 1
Field training 2
Uni requirements
Faculty requirements
compulsury
elective
(?) = Cridit hours
? Prerequisite credit hours

Table of level (000)

First Semester

Course code	Course Name	Weekly hours						Course grades distribution					Prerequisite
		Credit Hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
BAS011	Calculus (1) (Math. 1)	3	2	2	--	4	8	20	30	--	50	100	-------
BAS021	Mechanics (1)	3	2	2	--	4	8	20	30	--	50	100	-------
BAS031	Physics (1)	3	2	1	1.5	4.5	9	20	20	10	50	100	-------
BAS041	Engineering Chemistry	3	2	1	1.5	4.5	9	20	20	10	50	100	-------
PDE052	Engineering Drawing	3	2	2	--	6	10	20	30	--	50	100	-------
UNR061	English Language (1)	2	1	2	--	2	5	20	30	--	50	100	-------
	Total	17	11	10	3	25	49					600	
Total Contact Hours = 24 hrs./week Total SWL = 49 hrs./week													

Second Semester

Course code	Course name	Weekly hours						Course grades distribution					Prerequisite
		Credit hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
BAS012	Calculus (2) (Math. 2)	3	2	2	--	4	8	20	30	--	50	100	BAS011
BAS022	Mechanics (2)	3	2	2	--	4	8	20	30	--	50	100	BAS021
BAS032	Physics (2)	3	2	1	1.5	4.5	9	20	20	10	50	100	----
IHE101	Civil Drawing	3	2	3	0	4	9	20	30	--	50	100	PDE052
PDE051	Production Engineering	3	2	--	3	3	8	20	20	10	50	100	-------
UNR062	English Language (2)	2	1	2	--	2	5	20	30	--	50	100	UNR061
	Total	17	11	10	4.5	21.5	47					600	
Total Contact Hours = 25.5 hrs./week Total SWL = 47 hrs./week													

Table of level (100)

Third Semester

Course code	Course name	Weekly hours						Course grades distribution					Prerequisite
		Credit hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
STE103	Properties and Strength of Materials	3	2	1	1	4	8	20	20	10	50	100	BAS031 BAS021
STE101	Structural Analysis (1)	3	2	2	--	5	9	20	30	--	50	100	BAS021
BAS113	Differential equations (Math. 3)	3	2	2	--	4	8	20	30	--	50	100	BAS012
BAS115	Statistics and Probability Theory	2	2	1	--	3	6	20	30	-	50	100	BAS012
ARC101	Architectural Construction, Technical and Sanitary Installations	3	2	2	--	5	9	20	30	--	50	100	PDE052
ENG111	Technical Reports Writing	2	2	--	--	4	6	20	30	--	50	100	UNR062
	Total	16	12	8	1	25	46					600	
Total Contact Hours = 21 hrs./week Total SWL = 47 hrs./week													

Fourth Semester

Course code	Course name	Weekly hours						Course grades distribution					Prerequisite
		Credit hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
STE102	Building Construction Materials	2	2	1	--	3	6	20	30	-	50	100	STE103
ELE151	Electric Powers and Machines	3	2	2	--	4	8	20	30	-	50	100	BAS032
BAS114	Special functions (Math. 4)	3	2	2	--	4	8	20	30	-	50	100	BAS113
PWE101	Plane Surveying	3	2	1	2	5	9	20	20	10	50	100	----------
ARC102	Architectural Design (1)	3	2	2	--	5	9	20	30	-	50	100	PDE052
ARC103	Architecture Theory (1)	2	2	1	--	3	6	20	30	-	50	100	PDE052
UNR171	History of Technology Engineering	1	1	-	-	1	2	20	30	--	50	100	----------
	Total	17	13	9	2	25	48					700	
Total Contact Hours = 24 hrs./week Total SWL = 48 hrs./week													

Table of level (200)

Fifth Semester

Course code	Course name	Weekly hours						Course grades distribution					Prerequisite
		Credit hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
STE205	Concrete Technology	2	2	1	1	3	7	20	20	10	50	100	STE102
STE206	Construction Economics	2	2	1	--	3	6	20	30	-	50	100	BAS012
STE202	Structural Analysis (2)	3	2	2	--	5	9	20	30	-	50	100	STE101
BAS215	Numerical Analysis (Math. 5)	3	2	2	--	4	8	20	30	-	50	100	BAS114
STE204	Engineering Geology and Soil Mechanics	3	2	2	--	5	9	20	30	-	50	100	STE101
UNR241	Communication and Presentation Skills	2	2	--	--	3	5	20	30	-	50	100	--------------
	Total	15	12	8	1	23	44					700	
Total Contact Hours = 21 hrs./week Total SWL = 44 hrs./week													

Sixth Semester

Course code	Course name	Weekly hours						Course grades distribution					Prerequisite
		Credit hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
STE207	Construction Methods and Equipment	2	2	1	-	3	6	20	30	-	50	100	STE206
STE203	Reinforced Concrete (1)	3	2	2	-	5	9	20	30	-	50	100	STE202+ STE205
ARC203	Shop Drawings	2	2	1	-	3	6	20	30	-	50	100	ARC102+ ARC101
PWE201	Traffic Planning and Traffic Engineering	2	1	2	-	3	6	20	30	-	50	100	BAS115
IHE201	Hydraulics	2	2	1	-	3	6	20	30	-	50	100	----------
UNR281	Law and Human Rights	2	2	-	-	2	4	20	30	-	50	100	----------
ENG412	Projects Management	2	2	1	-	3	6	20	30	-	50	100	---------
STE201	Training (1) (Summer Semester)	--	--			--	--	--	--	-	--	--	
	Total	15	13	8	0	22	43					700	
Total Contact Hours = 21 hrs./week Total SWL = 43 hrs./week													

Table of level (300)

Seventh Semester

Course code	Course name	Weekly hours						Course grades distribution					Prerequisite
		Credit hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
STE315	Specifications and Quantities	2	2	1	–	2	5	20	30	–	50	100	STE203
STE305	Steel Structures (1)	3	2	2	–	5	9	20	30	–	50	100	STE202
STE302	Structural Analysis (3)	3	2	2	–	5	9	20	30	–	50	100	STE202
STE303	Reinforced Concrete (2)	3	2	2	–	5	9	20	30	–	50	100	STE203
ARC303	Building Information Modeling	2	2	2	–	4	8	20	30	–	50	100	IHE101 + ARC101
STE3XX	Elective (1)	3	2	2	–	5	9	20	30	–	50	100	Table (3b)
	Total	16	12	11	0	26	49					600	
Total Contact Hours = 23 hrs./week Total SWL = 49 hrs./week													

Eighth Semester

Course code	Course name	Weekly hours						Course grades distribution					Prerequisite
		Credit hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
STE3XX	Elective (2)	3	2	2	–	5	9	20	30	–	50	100	Table (3b)
STE306	Steel Structures (2)	3	2	2	–	5	9	20	30	–	50	100	STE305
STE307	Foundations (1)	3	2	2	–	5	9	20	30	–	50	100	STE204
STE304	Reinforced Concrete (3)	3	2	2	–	5	9	20	30	–	50	100	STE303 + STE302
STE308	Construction Project Management	3	2	2	–	5	9	20	30	–	50	100	ENG412 + STE206
STE316	Contracts and Laws in Construction	2	2	0	–	3	5	20	30	–	50	100	ENG412
STE301	Training (2) (Summer Semester)	–	–	–	–	–	–	–	–	–	–	–	Training (1)
	Total	17	12	10	0	28	50					600	
Total Contact Hours = 22 hrs./week Total SWL = 50 hrs./week													

Table of level (400)

Ninth Semester

Course code	Course name	Weekly hours						Course grades distribution					Prerequisite
		Credit hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
STE401	Graduation Project (1)	3	1	4	–	6	11	–	50	–	50	100	120 Credit hours
STE403	Finite Element Method	3	2	2	–	4	8	20	30	–	50	100	BAS215 + STE302
STE405	Foundations (2)	2	2	1	–	3	6	20	30	–	50	100	STE307
PWE401	Sanitary Engineering (1)	2	2	1	–	3	6	20	30	–	50	100	IHE201
PWE402	Highway Engineering	2	2	1	–	3	6	20	30	–	50	100	-------
STE406	Project Evaluation	2	2	1	–	3	6	20	30	–	50	100	STE308
STE419	Risk Management in Construction Projects	3	2	2	–	3	7	20	30	–	50	100	STE308
	Total	17	13	12	0	25	50					700	
Total Contact Hours = 25 hrs./week Total SWL = 50 hrs./week													

Tenth Semester

Course code	Course name	Weekly hours						Course grades distribution					Prerequisite
		Credit hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
STE402	Graduation Project (2)	3	1	4	--	7	12	--	50	–	50	100	STE401
STE404	Modern Construction Materials	2	1	2	--	3	6	20	30	–	50	100	STE205
STE4YY	Elective (3)	3	2	2	--	4	8	20	30	–	50	100	Table (3b)
STE4YY	Elective (4)	3	2	2	--	4	8	20	30	–	50	100	Table (3b)
UNR471	Marketing	2	2	--	--	2	4	20	30	–	50	100	---------
UNR461	Ethics and Morals of The Profession	2	2	--	--	2	4	20	30	–	50	100	---------
	Total	15	10	10	0	22	42					600	
Total Contact Hours = 20 hrs./week Total SWL = 43 hrs./week													

8. Scientific content of the courses of Bachelor of Building and Construction Engineering

8.1 University requirements

UNR061	English (1)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---
Main skills of the English language – listening to short and long conversations – reading scientific passages – writing reports, summaries, and scientific articles – speaking and presenting new ideas									
References: ▪ *Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011*									

UNR062	English (2)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	UNR061
Analysis and interpretation of engineering issues – summarizing engineering issues – preparation for language tests.									
References: ▪ *Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011*									

UNR171	History of Engineering and Technology								Prerequisites
1 Cr	Lecture	1	Tutorial	--	Lab.	--	Semester	2nd	---
Engineering history: Art, Science, Engineering and technology – Role of engineering and technology in development and establishment of civilizations -Technology and environment - Examples on development of engineering activity.									
References: ▪ *Roger S. Kirby, Engineering in History, Dover Publications Inc. New York, United States, 1990, ISBN10 0486264122*									

UNR281	Law and Human Rights								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	2ed	---
Systems and laws of institutions – Introduction to Accounting – Labor legislation and laws governing engineering professions – Industrial security legislation and environment – Historical philosophical origins of human rights – international sources of human rights – national sources of human rights – global bodies based on the protection of human rights.									

UNR241	Communication and Presentation Skills							Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---

Communication skills – Presentation planning and preparation – Delivery skills such as eye contact, voice control, gestures, body language and appearance – Presenter's characteristics – Using visuals – Presentation structure – Elevator Pitch

References:

- *Joan van Emden, Lucinda Becker, Presentation Skills for Students, 3rd Edition, Red Globe Press, 2016*
- *M. Wa Mutua, S. Mwaniki, P. Kyalo, B. Sugut, Communication Skills: A University Book, Succex Publishers, 2016*
- *Ian Tuhovsky, Wendell Wadsworth, Communication Skills Training, Ian Tuhovsky, 2015*
- *Tabitha Wambui, Alice W. Hibui, Elizaeth Gathuthi, "Communication skills " Vol.1, Students' coursebook, LAP LAMBERT Academic Publishing, 2012*

UNR461	Ethics and Morals of The Profession								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	1st	---

General principles of professional ethics – Commitments to society – Responsibilities of the engineer – Detection of violations – Behavior – Case studies and general issues.

References:

- *Lizabeth A. Stephan, David R. Bowman, William J. Park, Benjamin L. Sill, Matthew W. Ohland, "Thinking like an engineer", Published by Pearson 2018.*
- *Harris, C. E., Jr., Pritchard, M. S., & Rabins, M. J. Engineering Ethics. Second edition. Belmont, CA: Wadsworth, 2000*

UNR471	Marketing								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	1st	---

Principles of products marketing – Marketing research – Customers buying behavior – Marketing mix – Plotting marketing strategy – Building marketing plan – Pinpointing the target market – Marketing on the world wide web – Branding strategy – Developing new products – Advertising and promotions – Costing and pricing strategies – Case studies on products marketing

References:

- *Principles of Marketing, University of Minnesota Libraries Publishing, 2015, ISBN 13: 9781946135193*

8.2 Faculty Requirements:

BAS011	Calculus (1) (Math. 1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Calculus: Function (definition - theorems) - Basic functions - limits - Continuity - Derivation - definition - theorems - types - higher orders - Applications on derivatives - partial derivatives - indefinite integral - theories and properties of integration.

Algebra: Binomial theorem (with any exponent and applications) - Partial Fractions - Theory of Equations - Matrices - System of linear equations - Gauss elimination method.

References:

- *Akhtar & Ahsan, Textbook of Differential Calculus, second edition, 2009, PHI Learning Private Limited.*
- *Alan Jeffrey, Matrix operations for Engineers and Scientists, 2010, Springer Science & Business Media.*

BAS021	Mechanics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Newton's laws - Types of forces، coplanar forces، Rectangular components of vector (1D, 2D, Space), Forces in space - Equilibrium of a particle - Conditions, Free-body diagram - Moment - Couple moment - Resultant of a system of forces and couples as a force and couple system - General procedure for reducing force and couple systems - Equilibrium of a rigid body - Conditions of equilibrium of a rigid-body، free body diagrams – friction

References:

- *R.C. Hibbeler, "Engineering Mechanics: Statics and Dynamics, 14th Edition", Pearson Prentice Hall, New Jersey, 2016.*
- *J. L. Meriam, L. G. Kriage, and J. N. Botton, "Engineering Mechanics: Statics, 8th Edition", John Wiley & Sons, New York, 2016.*

BAS012	Calculus (2) (Math. 2)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2nd	**BAS011**

Integral Calculus: Definite integral - Methods of integration – Applications on definite integral (plane area - volume of revaluation - length of a plane curve - area of surfaces of revolution) - improper integral.

Analytic Geometry: Equations of second degree - Equation of pair of straight lines - Translation of axes - Conic sections - parabola - ellipse - hyperbola) Equation of plane - Equation of sphere.

References:

- *Jumarie, G., Fractional Differential Calculus for Non-Differentiable Functions: Mechanics, Geometry, Stochastics, Information Theory. 2013: LAP Lambert Academic Publishing.*
- *Hestenes, D. and G. Sobczyk, Clifford algebra to geometric calculus: a unified language for mathematics and physics. Vol. 5. 2012: Springer Science & Business Media.*

Grossman, S.I., Multivariable calculus, linear algebra, and differential equations. 2014: Academic Press.

BAS022	Mechanics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	**BAS021**

Kinematics of a particle: curvilinear motion - Normal and tangential components. - Newton's laws - motion of projectiles - Work and energy of a particle - applications of friction.

References:

- *R.C. Hibbeler, "Engineering Mechanics: Statics, 11th Edition", Pearson Prentice Hall, 2006.*
- *F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg, "Vector Mechanics for Engineering, Statics and Dynamics, 9th Edition", McGraw-Hill, New York, 2010.*

BAS031	Physics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Material properties: Physical quantities - Standard units and dimensions - Mechanical properties for materials - Fluid properties - Periodic motion - Mechanical waves - Sound waves - Waves in elastic media.

Heat and thermodynamics: Temperature measurements and thermometers - Thermal expansion - Specific and latent heat - Heat transfer - Gas motion theory - First law of thermodynamics - Entropy and second law of thermodynamics.

References:
- *Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 6th Edition, Thomson Brooks/Cole 2014.*
- *Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.*

BAS032	Physics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2nd	---

Electricity and Magnetism: Electric charge - Electric force - Electric field- Column's law- Electric flux- Gauss law- Electric potential- Electric capacitance and Dielectrics - Ohm's law and simple circuits- Magnetic field - Baiot and Savart laws.
Optics and Modern physics: Nature of light and laws of geometric optics - Interference - Diffraction - polarization - optical fiber - laser - photoelectric effects - principle of quantum theory - special theory of relativity.

References:
- *Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 9th Edition, Thomson Brooks/Cole 2014.,*
- *Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.*

BAS041	Engineering Chemistry								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Equations of state-chemical thermodynamics - Material and energy balance in chemical processes- properties of solutions - Basic principles in electrochemistry and it's applications- selected topics in chemical industry.

References:
- *Brown, L. T, LeMay H. E. Jr; Bursten, B. E.; Murphy, C.J., and Woodward, P.; " Chemistry The Central Science", Pearson International Edition (11th edn), Pearson Printice Hall, (2009).*

PDE051	Production Engineering								Prerequisites
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	2ed	---

Introduction to the following processes (Casting- Forging- Metal filing - Machining- Forming- Woodworking)

References:
- *Hitomi, Katsundo. Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics. Routledge, 2017.*

PDE052	Engineering Drawing								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Two-dimensional drawings - Free-hand sketching - Sectional views - Auxiliary views and conventions - Computer-aided drawing (CAD) of 2D and 3D figures.

References:
- *Mcgraw-hill Mint, "Mechanical Drawing Board & CAD Techniques", Student Edition,2011*

ENG111	Technical Reports Writing							Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	2nd	UNR062

Technical writing definition - audience analysis - technical writing styles - technical document characteristics - automated document organization - official and unofficial document types - structure of different types of technical documents.

References:

- *G. J. Alred, W. E. Oliu, The Handbook of Technical Writing, 12th Edition, Bedford/St. Martin's; 2018*
- *K. Hyland, Teaching and researching writing. 3rd edition Routledge academic publisher, 2016*
- *M. Markel, Technical Communication, 11th edition, MacMillan, 2015.*

BAS113	Differential equations (Math. 3)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	**BAS012**

Applications of partial differentiation - Maximum values of functions in more than one variable and applications - First order differential equations - Second order differential equations - Laplace transform and its applications - Analytical geometry in space.

References:

- *D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.*
- *S. A. Wirkus, and R. J. Swifi, "A Course of Ordinary Differential Equations", Taylor & Francis Group, LLC, 2015.*

BAS114	Special Functions (Math. 4)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	**BAS113**

Fourier series – Fourier transform – Complex numbers – Functions of a complex variable – Complex integration – Residue theorem – Direction derivatives – Double integrals – Triple integrals – Line integrals – Surface integrals.

References:

- *J. Brown, and R. Churchill, "Complex Variables and Applications", 9th Edition, McGraw-Hill, 2013.*
- *D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.*

BAS115	Statistics and Probability Theory								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	**BAS012**

Measures of tendency and dispersion – Probability distributions – Sampling theorem – tests of hypothesis – non-parametric tests – regression and correlation – time series.

References:

- *Mary C. Meyer, Probability and Mathematical Statistics: Theory, Applications, and Practice in RSBN-10: 1611975778, SIAM (June 24, 2019)*

ELE151	Electrical Power and Machines								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2nd	---

Power: Electrical power systems – three phase systems – Theory and models of transformers – Transmission line models – Voltage and frequency control – effective and ineffective power – Optimal work of power systems.

Machines: The theory of operation – The construction of the Direct Current motors. The speed، torque، and current characteristics – applications of the DC motors. The theory of operation and construction of stepper motors – Permanent-magnet DC motor and Low-

inertia DC Motors. The theory of operation، construction of three phase induction motors.
References: ▪ *Nilsson, J.W. and S.A. Riedel, Electric circuits. 2015: Pearson Upper Saddle River, NJ.* ▪ *Slade, P.G., Electrical contacts: principles and applications. 2017: CRC press.*

BAS215	Numerical Analysis (Math. 5)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	**BAS113**
Numerical solution of linear and non-linear systems of equations – Iterative methods – Curve fitting: Least square of (Straight lines, Polynomials), Linearization of nonlinear relationship. Interpolation and polynomial approximation –finite difference operators – Numerical integration and differentiation.									
References: ▪ *Mazumder, Numerical Methods for Partial Differential Equations, Finite Difference and Finite Volume Methods, science direct ,2016.* ▪ *Sheldon Rose, A First course in probability, Eighth edition, 2010, Pearson Prentice Hall.*									

ENG412	Project Management								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---
Fundamentals of project management – Integration management – Scope management – Time management – Cost management – Quality management – Human resources management – Communication management – Risk management – Procurement management – Projects case studies									
References: ▪ *Kerzner, H. and H.R. Kerzner, Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons, 2017.* ▪ *Kalpakjian, S., K. Vijai Sekar, and S.R. Schmid, Manufacturing Engineering and technology. Pearson, 2014.* ▪ *Nigel J. Smith, "Engineering Project Management", 3rd Edition, Wiley-Blackwell, 2008.*									

8.3 Requirements for general and specific specialization courses

STE103	Properties and Strength of Materials								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	1	Lab	1	Semester	First	Physics (1) BAS031 + Mechanics (1) BAS021
Content: Introduction to the characteristics and tests materials – machines testing and calibration – the behavior of engineering materials under the influence : tensile static, pressure static, bending static, shear static – shock – fatigue – discuss the physical properties of the basic mechanical and for a variety of materials related to civil engineering , such as concrete, asphalt, wood, vehicles **Fibers – Safety factor selection for design stresses – Metal rust – Fracture types – Fracture mechanics.**									
References: ▪ *Neville, A.M., "Properties of Concrete",5th ed., Longman, 2010.*									

STE101	Structural Analysis (1)								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	1st	Mechanics (1) BAS021

Content:

Types of loads – Types of support points – Reactions – statically determinate structures - internal forces in statically determinate beams, trusses, frames, and arches – analysis of statically determinate trusses.

Influence lines for statically determinate beams, trusses, and frames.

References:

- *Kassimali, A. "Structural Analysis (Si Edition)". Stamford USA: Cengage Learning 2011.*
- *Kenneth M. Leet, Chia-Ming Uang, Joel T. Lanning, Anne M. Gilbert. "Fundamentals of Structural Analysis". McGraw-Hill Education, 2018.*

STE102	Building Construction Materials								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	1	Lab	0	Semester	2nd	Properties and Strength of Materials STE103

Content:

General introduction to concrete and its components – Cement (chemical and physical properties of cement types – cement tests) – Aggregate (Aggregate classification – Aggregate properties) – Chemical additives – Substitution materials for cement - Advanced and modern materials - Concrete industry – Properties and tests of fresh and hardened concrete – Lime – Gypsum – water – iron.

References:

- *P. Purushothama Raj, " Building Construction Materials and Techniques". Pearson Education India, ISBN: 9789332579118, 2016.*
- *M L Gambhir and Neha Jamwal, " Building and Construction Materials: Testing and Quality Control, (Lab Manual Series)". McGraw Hill Education (India) Private Limited, ISBN: 1259029662, 2014.*

ARC101	Architectural Construction, Technical and Sanitary Installations								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	1st	Engineering Drawing PDE052

Content:

Principles of architectural construction – the basics of construction work (stone – brick – concrete– iron) – architectural and construction codes and materials for materials – types of buildings – structural – load bearing walls - construction methods for each type and structural elements– insulating layers, floors, and stairs – methods of moisture insulation, drainage Rain water – building materials, finishing materials and equipment used – applications with simplified building drawings of buildings – an introduction to the installations and sanitary installations of the building – a study of how to implement the various stages of construction operations in theory and field locations . Introduction to technical installations.

References:

- *Ching F. D. K. "Building Construction illustrated, CBS publishers& distributors", India, 2014.*

ARC102	Architectural Design (1)								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	2nd	Engineering Drawing PDE052

Content:

Developing the ability to perceive architectural formations and their design – design considerations and functional requirements, study functional relationships, guidance, privacy and space configurations– simplified projects that address the aesthetic, cultural, environmental, functional and structural determinants of architectural form and space – the foundations for the use and design of internal and external spaces and services and vertical and horizontal communication – and focus those topics to human needs and its interaction with the surrounding environment ' natural and built – applications of architectural models and methods of studying directing and Manifesting architectural projects.

References:

- **Neufert, E. "Architect's Data, Crosby Lockwood Staples", 5th edition, London, 2019.**
- **Francis D. K. Ching. "Architectural Graphics", Amazon Digital Services LLC, April 2015.**
- **Ernest R. Norling. "Perspective Made Easy** (Dover Art Instruction)**", 2012.**
- **Nikolas, D. & Jokiniemi, E. "Dictionary of Architecture and Building Construction", 1st Ed. 2008.**
- **Crosbie, Michael J. "Time Saver Standards for Architectural Design Data", McGraw Hill book company, New York, 2009.**

ARC103	Architecture Theory (1)								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	1	Lab	0	Semester	2nd	Engineering Drawing PDE052

Content:

The concept of architecture and its theories – architectural formation (line, level, and mass) – principles of formation (unity – symmetry – homogeneity – rhythm – hierarchy – diversity - ….) – types of buildings - factors that influence architectural design – the concept of public and private spaces – Design standards, rates, capabilities, and design limitations based on providing efficiency, comfort, and safety – Spatial relationships – Scale and dimensions of the human body and its relationship to design standards for architectural spaces – Elements of horizontal movement and elements of vertical movement in buildings – Service units for individuals, equipment supply, and infrastructure.

References:

- **Ching, Francis D.K. "Architecture: form, space and order", van nostrand reinhold company, 4ed, NY, 2014.**
- **Nikos A. Salingaros. "A Theory of Architecture", 2016.**

IHE101	Civil Drawing								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	3	Lab	0	Semester	1st	Engineering Drawing PDE052

Content:

Irrigation works: earthworks for canals, drains, and roads. Retaining walls: brick walls – the walls of ordinary concrete – RC walls. Various types of bridges, culverts, siphons, arches, and wasters. Obsession . RC works: tiles – beams – columns – bases . Metal works: connections with nails, between beams, between columns and beams, and between columns and bases .

References:

- *Singh, Gurcharan. "Civil Engineering Drawing". Standard publications-Delhi, 2009.*

PWE101	Plane surveying								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	1	Semester	2^{nd}	----
Content: Introduction to mapping and surveying science – Definitions and branches of surveying science and its applications – Different surveying instruments and their uses – The surveying maps and their types – Point positioning techniques – Introduction to vertical control in surveying – Different surveying instruments used for height difference measurement – Ordinary and precise leveling – Calculation of leveling – Applications of leveling – Grid leveling and generation of contour lines – Longitudinal profiles and cross sections. Introduction to Total Station.									
References: ▪ *Johnson, Aylmer. "Plane and Geodetic Surveying 2nd Edition". CRC Press, 2014.* ▪ *Bossler, and Moffit. "Surveying 10th Edition". 2004.*									
Lab	The use of tape – Tidolite – levels								

STE202	Structural Analysis (2)								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	1st	Structural Analysis (1) STE101
Content: Normal Stresses: properties of plane areas, straining actions, distribution of normal stresses in homogeneous sections, distribution of normal stresses in heterogeneous sections, core of cross sections. Shear stresses: Shear Stresses in homogeneous section due to shearing force and torsion moments, shear stresses on bolts, riveted (bolted) and welded connections due to shearing force and torsion moments. Combined stresses analytically and graphically using Mohr's circle.									
References: ▪ *George, N. Frantziskonis. "Essentials of the Mechanics of Materials, Second Edition". USA: DEstech Publications, Inc., 2013.* ▪ *Pytel, A. and Kiusalaas, J. "Mechanics of Materials Second Edition". Cengage Learning2012.* ▪ *Kelly, Pa. "Solid Mechanics Part I: An Introduction to Solid Mechanics". http://homepages.engineering.auckland.ac.nz/~pkel015/SolidMechanicsBooks/Part_I/. 2018.*									

STE203	Reinforced Concrete (1)								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	2nd	Structural Analysis (2) STE202 + Concrete Technology STE205
Content: Physical and mechanical properties of concrete and steel reinforcement - structural systems and systems for floor slabs and the distribution of loads on structural elements – design for moment – design of short and long columns under centric and eccentric loads - design of RC beams for moment and shear forces and diagonal tension and compression using limit states design method - the bond between the steel and concrete and the development length - Details of reinforced beams - serviceability limit states (cracking and deflection). Design and detailing of one- and two-way solid slabs.									
References:									

- *Fanella, David A. "Reinforced Concrete Structures: Analysis and Design". McGraw-Hill Professional Publishing, 2010.*
- *Jack C. McCormac, Russell H. Brown. "Design of Reinforced Concrete". 2013.*

STE204	Engineering Geology and Soil Mechanics								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	2nd	Structural Analysis(1) STE101

Content:

Introduction to Geology and the origins of the Earth - rocks, composition and types - geological maps in Egypt - Introduction to soil mechanics : soil characteristics; soil types and soil structure - soil composition : terms and characteristics of volumetric and gravimetric - definitions and relationships especially mechanics of soil - mechanical analysis of soil - soil texture and Atrberg limits - soil - soil classification systems - stresses on soil as a result of weight and as a result of external loads (analysis of the strains within the soil) - Introduction to soil Hydraulics - water movement in the soil - soil permeability and uni flow and dual direction directional - Shear force- cementing and landing - lateral soil presur slope stability.

References:

- *Das, Braja M., "Principles of Foundation Engineering," 2010.*
- *"Egyptian Code for Soil Mechanics and Design and Execution of Foundations", 2002.*
- *Barnes, G. E. "Soil Mechanics: Principles and Practice". Macmillan Education UK, 2000*

STE205	Concrete Technology								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	1	Lab	1	Semester	1st	Building Construction Materials STE102

Content :

Concrete materials : cement - aggreagte - mixing water - additives . Concrete mix design : engineering design methods - empirical methods . Concrete: storage of materials - Mixing - Transporting - casting - compaction - Treatment – construction joints - movement joints – shrinkage joints - forming and shuttering – ready mixed concrete . Pouring concrete in hot climates: the definition of hot weather – problems of pouring concrete in hot climates - precautions to be followed for pouring concrete in hot climates. Fresh concrete properties: slump - workability – separation, etc. Properties of hardened concrete: compresive strength - tensile strength - shear strength – bond strength – volume changes of concrete - elasticity and creep- durability and permeability - non destructive tests: hammer - ultrasound – core test. Quality control of concrete . Special types of concrete: polymeric concrete - fiber concrete – lightwieght concrete.

References:

- *Neville, A.M., "Properties of Concrete", 5th ed., Longman, 2010.*

STE206	Construction Economics								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	1	Lab	0	Semester	1st	Calculus (2) (Math. 2) BAS012

Content:

Basic concepts and importance of studying engineering economics - The concept of building economics analysis - The time value of money and life-cycle costs - Cash flows and the present value of fixed and variable payments. Economic evaluation of alternatives using the current value and internal return method - life cycle costs - cost-benefit ratio analysis. Industry applications, depreciation, estimating cost of operating and leasing equipment, replacement, profit and others.

References:

- *Danny Myers, "Construction Economics: A New Approach ", 2nd edition, Routledge; , 2008.*
- *Stephen L. Gruneberg, "Construction Economics: A New Approach ", Springer Nature, DOI.*
- *D.G. Newnan, J. Whittaker, T.G. Eschenbach and J.P. Lavelle, "Engineering economic Analysis", 3rd edition, Don mills, Toronto, Ontario, 2014.*

STE207	Construction Methods and Equipment								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	1	Lab	0	Semester	2nd	Construction Economics STE206

Content:

Introduction - Construction methods: concrete, excavation, forms, and tunnels – dewatering systems and design methods, shoring, planning construction sites - costs and operating of equipment – factors affecting selection of construction equipment and productivity calculation - transporting and excavating soil - Soil stabilization and compaction equipment - Dewatering - Cranes - Formwork design - Production and expansion of hot asphalt mixtures.

References:

- *Leonhard E. B., " Construction Equipment and Methods: Planning, Innovation, Safety", Wiley, 2013.*

ARC303	Building Information Modeling BIM								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	1st	Civil Drawing IHE101 + Architectural Construction, Technical and Sanitary Installations ARC101

-Content:

Introduction to BIM and its applications in construction – Its starting and developing - Creating basic building and structural components – Model viewing and presenting - Detailing, drafting and clash detection - Massing studies - Creating documentation standards - Creating BOQ and schedules - Templates and file management - Project collaboration and work sharing - Working with families.

References:

- *- Neufert, E. "Architect's Data, Crosby Lockwood Staples", 5th edition, London, 2019.*
- *- Francis D. K. Ching. "Architectural Graphics", Amazon Digital Services LLC, April 2015.*
- *- Ernest R. Norling. "Perspective Made Easy (Dover Art Instruction)", 2012.*
- *- Nikolas, Davies & Jokiniemi, Erkki. "Dictionary of Architecture and Building construction", 1st Edition. 2008.*
- *- Crosbie, Michael J. "Time Saver Standards for architectural design data", McGraw Hill book company, NY, 2009.*

ARC301	Architectural Design (2)								Prerequisites
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/ 2nd	Architectural Design (1) ARC102

Content:

Addressing the design process in its various dimensions - studying design performance techniques - analyzing the elements of medium-sized projects and installation - principles of studying the environmental impact of projects at the design stage - studying the importance of the structural idea in shaping architectural voids - simple structural systems and the architectural function - application with educational projects and studying architectural voids from In terms of quantity and quality.

References:

- *- Neufert, E. "Architect's Data, Crosby Lockwood Staples", 5th edition, London, 2019.*
- *- LAWSON, Bryan. "The Language of Space", Architectural Press, Oxford, 2015.*
- *- Annie R. Prerace, Yong Han Ahn and HanmiGlobal. "Sustainable Buildings and Infrastructure", by Routledge in USA and Canada, 2012.*

ARC302	Environmental control and climate change								Prerequisites
3 Cr Elective	Lecture	2	Tutorial	2	Lab.	--	Semester	1st/2 nd	ARC102

Studying thermal effects on humans in architectural and urban space, and how to create an architectural environment within the scope of thermal comfort, study the possibility of application through software simulating of heat, wind movement, sound and light in buildings.

Studying different mathematical methods for solar radiation angles on building and the ways to deal with it to reduce or increase light or heat according to environmental site

References:

- *Dynamic thermal environment and thermal comfort, Y. Zhu Q. Ouyang B. Cao X. Zhou J. Yu First published:14 July 2015*
- *Renewable and Sustainable Energy Reviews, Science direct journal, vol 65*
- *Architectural acoustics, M Long - 2005*
- *Environmental and architectural acoustics,Z Maekawa, J Rindel, P Lord - 2010*

ARC203	Shop Drawings								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	1	Lab	0	Semester	1st	Architectural design (1) ARC102 + Architectural Construction, Technical and Sanitary Installations ARC101

Content:

Basis of preparation and clarification of all elements in the projections, sectors and interfaces - a detailed study of the preparation of drawings of architectural full of projects large - a detailed study through implementation at the sites - and the preparation of research in the various construction methods to cover the large spans and specialized buildings - drawings of architectural full of that preparation Projects - Make field visits to engineering projects sites under construction to study operational details on the ground.

References:

- *- Rosemary Kilmer, W. Otie Kilmer. "Construction Drawings and Details for Interiors", 3rd Edition, January 2016.*

STE201	Training (1)								Prerequisite
0 Cr Compulsory	Lectures	0	Tutorials	0	Lab	0	Semester	Summer	----

Content:

Training on industrial establishments relevant to the program. Training lasts for total of 120 hours, during a period about four weeks. The program training advisor schedules at least one follows up visit to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. *The course is graded as Pass/Fail grade- system*.

STE301	Training (2)								Prerequisite
0 Cr Compulsory	Lectures	0	Tutorials	0	Lab	0	Semester	Summer	Training (1)

Content:

Training on industrial establishments relevant to the program. Training lasts for total of 120 hours, during a minimum period of four weeks. The program training advisor schedules at least two follow-up visits to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. *The course is graded as Pass/Fail grade- system*.

IHE201	Hydraulics								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	1	Lab	0	Semester	1st	----

Content:

Fluid properties - hydrostatics - buoyancy and flotation – Kinematics fluid flow - energy considerations for the flow of stable applications and the amount of movement and strong in the flow of fluid - models analog and meta-analysis.

References:

- *Saeid Eslamian, " Handbook of engineering hydrology : environmental hydrology and water management", Crc Press, 2014.*

STE302	Structural Analysis (3)								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	1st	Structural Analysis (2) STE202

Content:

Double integration method – methods of conjugate beam and moment area – three moment equations for indeterminate structures – Virtual work method. The method of compatible deformation – slope deflection method - the moment distribution method.

References:

- *Kassimali, A. "Structural Analysis (Si Edition)". Stamford USA: Cengage Learning 2011.*
- *Kenneth M. Leet, Chia-Ming Uang, Joel T. Lanning, Anne M. Gilbert. "Fundamentals of Structural Analysis". McGraw-Hill Education, 2018.*
- *McCormac, C.J. "Structural Analysis Using Classical and Matrix Methods". United States of America.: 4th Edition , John Wiley & Sons, Inc, , 2007*

STE303	Reinforced Concrete (2)								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	1st	Reinforced Concrete (1) STE203

Content :

Flat slab: An introduction to the structural system of flat slab, areas of use, limits of specifications and different methods, analysis of internal stresses. Shear in slabs and design of slabs and columns and openings in slabs and reinforcement detailing. The design of hollow block slabs with one- and two-way ribs - design of paneled beams - structural systems for halls with large spans - design of frames and arches - design of arched roofs.

References:

- *Fanella, David A. "Reinforced Concrete Structures: Analysis and Design". McGraw-Hill Professional Publishing, 2010.*
- *Jack C. McCormac, Russell H. Brown. "Design of Reinforced Concrete". 2013.*
- *El-behairy, S., "Reinforced Concrete Design Handbook", Fifth edition, Cairo, 2002.*

STE304	Reinforced Concrete (3)								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	2nd	Reinforced Concrete (2) STE303 + Structural Analysis (3) STE302

Content :

Revolutionary surfaces: methods of forming surfaces of revolution of various types; cones and domes, an introduction to the theory of analysis of shell structures and internal stresses under different loads, design and arrangement of reinforcement in these surfaces. Types of tanks; circular (elevated and ground) and rectangular tanks. Forces and methods of loading of these forces and the method of internal stresses and design of deep beams, and rebar detailing in sections and plans.

References:

- *Fanella, D. A. "RC Structures: Analysis and Design". McGraw-Hill Professional Publishing, 2010.*
- *Jack C. McCormac, Russell H. Brown. "Design of Reinforced Concrete". 2013.*
- *El-Behairy, S., "Reinforced Concrete Design Handbook", Fifth edition, Cairo, 2002.*

STE305	Steel Structures (1)								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	1st	Structural Analysis (2) STE202

Content :

Introduction – general layout for steel halls - Design methods of steel buildings (ASD - LRFD Methods) - type of loads – Design of trusses, tension members, compression members, beams (subjected to static and dynamic load), bolted connections, and welded connections.

References:

- *Alan Williams. "Steel Structures Design (ASD/LRFD)". USA: International Code Council, 2011.*
- *Liang, Q. Q. "Analysis and Design of Steel and Composite Structures". USA: Taylor & Francis, 2015.*
- *"Egyptian code of practice for steel construction and bridges (ASD)", Code No. ECP 205-2001, Edit 2009, Ministry of Housing, Utilities, & Urban Development.*

STE306	Steel Structures (2)								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	2nd	Steel Structures (1) STE305

Content :

Design of steel roofs for halls – Design of frames – Design of beams (subjected to static and dynamic loads) - Design of columns and beam-columns - Design of different types of foundations (roller, hinged, and fixed bases) – Design of rigid connections – Design of different bracings systems - Design of built-up sections - Workshop drawings

References:

- *Alan Williams. "Steel Structures Design (Asd/Lrfd)". USA: International Code Council, 2011.*
- *Liang, Qing Quan. "Analysis and Design of Steel and Composite Structures". USA: Taylor & Francis Group, 2015.*
- *"Egyptian code of practice for steel construction and bridges (ASD)", Code No. ECP 205-2001, Edit 2009, Ministry of Housing, Utilities, & Urban Development.*

STE307	Foundations (1)								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	2nd	Engineering Geology and Soil Mechanics STE204

Content:

Foundations settlements -Types of foundations - bearing capacity of the soil - design of shallow foundations under vertical loads - methods of foundation design - design of different types of concrete footings (combined footing - strip footing – strap footings – footing subjected to eccentricity – raft foundations- design different types of retaining walls).

References:

- *Das, Braja M., "Principles of Foundation Engineering," 2010.*
- *"Egyptian Code for Soil Mechanics and Design and Execution of Foundations", 2002.*
- *Barnes, G. E. "Soil Mechanics: Principles and Practice". Macmillan Education UK, 2000*

STE308	Construction Project Management								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	2nd	Projects Management ENG412 + Construction Economics STE206

Content:
Project planning, scheduling and resource management. Scheduling recurring projects: linear projects, scheduling written projects considering resources, short timelines for repetative projects, balance line and time sitemap. Time program pressure: the relationship between cost and cost of the activity and the relationship between cost and time of the project. Cash flow analysis and contract pricing: direct and indirect costs, project cash flow, pricing and price policy. Project monitoring: schedule update, analysis and earned value management.

References:

- *Hegazy, T., "Computer-Based Construction Project Management", 2002*
- *Paul Netscher, " Construction Project Management: Tips and Insights", Panet Publications, 2017.*

STE315	Specifications and Quantities								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	1	Lab	0	Semester	1st	Reinforced Concrete (1) STE203

Content:
Calculate the quantities of the various items and counting methods. Explore concepts, methods, and procedures used to estimate construction. Study the principles and application of construction cost estimates. Initial cost estimation: unit method, space method, etc., adjusting initial costs for time, space and time factors, detailed costing of materials, equipment and workers, estimating business costs, building information modeling, estimating and costs from the point of view of the contractor or the owner's engineers. Estimate details with an emphasis on labor, materials and equipment, indirect cost estimation, margin estimation, business item pricing and assay composition and pricing policies.

References:

- *Datta, B.N., " Estimating and Costing in Civil Engineering: Theory & Practice Including Specifications and Valuation", Sangam Books Ltd, 27 revised edition, 2002.*

STE316	Contracts and Laws in Construction								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	0	Lab	0	Semester	2nd	Projects Management ENG412

Contents:
Contracts: a definition of contracts, how they are drafted, and the different types of contracts - the components of the contract and the points it must include - how to bid the bid - parties involved in construction work and the relationship between them - project delivery methods - contract documents

Laws: laws in construction, the law of tenders and auctions, disputes and methods for resolving them, arbitration, introduction and definition of the requirements of international law (FIDIC).

References:

- *شامل هادي نجم العزاوي "الإلتزامات المتعاقد في عقود التشييد ونقل الملكية B.O.T: دراسة مقارنة"، المركز القومي للإصدارات القانونية – القاهرة مصر.*
- *N. M. Fraser and E.M. Jewkes, "Engineering economics: Financial decision making for Engineers", 5th edition, Pearson, Toronto, Ontario, 2013.*
- *D.G. Newnan, J. Whittaker, T.G. Eschenbach and J.P. Lavelle, "Engineering economic Analysis", 3rd edition, Don mills, Toronto, Ontario, 2014.*

STE309	Studies in the Field of Structural Engineering							Prerequisite	
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	----

Content:

One or more topics in the specialization of Structural Engineering that are not covered by the other program courses and/or present recent or advanced development of interest to the structural engineers in the areas of building materials, solid mechanics, analysis and design of structures.

STE310	Design of Masonry Structures								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/ 2nd	Building Construction Materials STE102 + Structural Analysis 2 STE202

Content:

Types and specifications of traditional bricks and reinforced bricks - types and specifications of the used mortar - factors affecting the bearing strength of bricks and mortar - relationship between strength of brick, mortar, and building strength - the design of the masonry walls under compression - the design of the masonry walls under the effect of horizontal forces - the design of the walls and columns in masonry structures - Design of roof slabs constructed from brick and reinforced bricks - Design of roofs constructed from bricks and their types.

References:

- *Egyptian code for design and construction of building walls, ECP 204, 2005.*

STE311	Sustainable Construction								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/ 2nd	Concrete Technology STE205

Content:

Deals with Decision on impacts of environmental design and construction processes - discusses the concept of sustainable construction as a means of reducing these not revolted. To identify the principles of sustainable construction, which seeks to reduce the negative impacts on environmental buildings by enhancing efficiency and rationalizing the use of natural resources and energy. Environmental assessment of building materials, resource efficiency, recycling, energy strategies and sustainable water management, methods for assessing environmental sustainability of construction projects - dynamic systems for sustainability analysis.

References:

- *Charles J. Kibert, Sustainable Construction: Green Building Design and Delivery, 4th Edition, wiley, ISBN: 978-1-119-05517-4, 2016.*

STE312	Inspection and Maintenance of Structures								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/ 2nd	Concrete Technology STE205

Content:

Introduction - the causes of deterioration and maintenance needs - methodology and strategy of maintenance - symptoms, diagnosis and treatment - Assessment of resistance of concrete structures - repair: materials, methods, and strengthening - brick walls: inspection and repair.

References:

- *Bakhoum, M.M., and Juan A. Sobrino. "Case Studies of Rehabilitation, Repair, Retrofitting, and Strengthening of Structures". IABSE, 2010*

STE313	Quality Control and Confirmation in Structures								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/ 2nd	Concrete Technology STE205

Content:

Definition of Quality control - Program and Plan Quality Assurance - Quality control internally and externally - the role of quality during the project life - stages of quality control - monitoring and quality control of concrete - tests on concrete during construction - Non-destructive tests - Load test of elements in concrete structures.

References:

- *Abdul Razzak Rumane. "Quality Management in Construction Projects ". CRC Press; 2 edition, 2017.*

STE404	Modern Construction Materials								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	2nd	Concrete Technology STE205

Content:
Introduction to technological development of materials science, classification of modern construction materials, composite materials and their applications. Fibers, insulation, polymers and nanomaterial.

References:

- *P. P. Raj, "Building Construction Materials and Techniques". Pearson Education India, 2016.*
- *M L Gambhir, Neha Jamwal, " Building and Construction Materials: Testing and Quality Control, (Lab Manual Series)". McGraw Hill Education (India) Private Limited, ISBN: 1259029662, 2014.*

IHE302	Irrigation and Drainage Engineering								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Hydraulics IHE201

Content:
Introduction to Irrigation and Drainage Engineering - water relationship with soil - water needs - when irrigation is needed - agricultural cycle and shifts of irrigation - various irrigation areas systems in Egypt - irrigation methods - modern irrigation - sprinkler irrigation - drip irrigation - drainage - types of exchange - planning and design of Irrigation projects .

References:

- *Sturm, Terry W., "Open channel hydraulics", New York: McGraw-Hill, 2010.*

IHE303	Design of Water Structures								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Hydraulics IHE201

Content:
Design of some types of retaining walls – An introduction to bridge design - design of Siphons - design of Culverts - design of Estuaries end - different ways of lining irrigation streams.

References:

- *Austroads, "Waterway Design: A Guide to the Hydraulic Design of Bridges, Culverts and Floodways", 1994*

PWE201	Traffic Planning and Traffic Engineering								Prerequisite
2 Cr Compulsory	Lectures	1	Tutorials	2	Lab	0	Semester	2nd	Statistics and Probability Theory BAS115

Content:

Transportation and surveys planning - generating flight - flight distribution - allocation of traffic movement on the road network - the distribution of trips to transport modes - assessment of transportation alternatives - Introduction to Traffic Engineering - the characteristics of the flow of traffic - traffic volume, capacity and level of service - Studies parking facilities - Traffic lights.

References:

- *Roess, R. P., E. S. Prassas, and W. R. McShane., "Traffic Engineering", Fourth Edition, International Edition, Pearson, 2011.*
- *Ortuzar, J.D. and L.G. Willumsen., "Modelling Transport", Third Edition, Jon Wiley&Sons, Inc., 2011.*

PWE302	Topographic Surveying								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	1	Lab	1	Semester	1st/ 2nd	Plane Surveying PWE101

Content:

Horizontal curves and vertical curves - spaces and volumes - an introduction to error theory - an introduction to pictorial science - an introduction to remote sensing science - an introduction to global meteorology using satellites

Practical (Integrated Meteorological Station).

References:

- *Johnson, Aylmer. "Plane and Geodetic Surveying 2nd Edition". CRC Press, 2014.*
- *Bossler, and Moffit. "Surveying 10th Edition". 2004.*

PWE303	Maps and Geographic Information Systems								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Topographic Surveying PWE302

Content:

Maps - Metrics - GIS assets - GIS data: Point - line - polygon. Raster and vector data. Database structures: data types - continuous, ordinal and separate data. Incorporating different data and data types - overview.

References:

- *Johnson, Aylmer. "Plane and Geodetic Surveying 2nd Edition". CRC Press, 2014.*
- *Bossler, and Moffit. "Surveying 10th Edition". 2004.*

STE401	Graduation project (1)								Prerequisite
3 Cr Compulsory	Lectures	1	Tutorials	4	Lab	0	Semester	1st	120 Credit Hours

Content:

Students undertake a major project as part of the program. The aim of the project is to provide the students, who work in groups, with an opportunity to implement appropriate concepts and techniques to a particular design. Students are required to select and research the expected project to be designed and implemented in the following course Graduation Project-2. The student should give an oral presentation to be approved.

Reinforced Concrete – Structural Analysis – Steel Structures – Properties and Strength of Materials – Soil Mechanics and Foundations – Construction Project Management.

STE402	Graduation Project (2)								Prerequisite
3 Cr Compulsory	Lectures	1	Tutorials	4	Lab	0	Semester	2nd	Graduation Project (1) STE401

Content:

All students undertake a major project as part of the program. The aim of the project is to provide the students, who work in groups, with an opportunity to implement the appropriate concepts and techniques to a particular design. A dissertation on the project is submitted on which the student is examined orally.

Reinforced Concrete – Structural Analysis – Steel Structures – Properties and Strength of Materials – Soil Mechanics and Foundations – Construction Project Management.

STE403	Finite Element Method								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	1St	Numerical Analysis (Math. 5) BAS215 + Structural analysis (3) STE302

Content:

This course should cover the principles of the finite element method: generalized stress-generalized strain concept, principle of virtual displacement. The basic finite elements should be addressed, e.g., truss element, beam element, constant strain triangle, bilinear displacement rectangle, three dimensional solid element, etc. Basic problems such as plane stress, plane strain, plate element, axisymmetric problem and three-dimensional problems should be treated.

References:

- *Karnovsky, I. A., "Advanced Methods of Structural Analysis", 2010.*
- *Eugenio Oñate, " Structural Analysis with the Finite Element Method", springer 2009.*

STE420	Computer Applications in Structural Engineering								Prerequisite
3 Cr Elective	Lectures	3	Tutorials	2	Lab	0	Semester	1st/ 2nd	Finite Element Method STE403

Content:
The use of modern applications and programs in structural analysis and design, in which the analysis is carried out according to the finite element method, in solving problems and issues in the field of structural engineering, through some prefab programs such as (SAP - SAFE - ETABS - PERFORM 3D, Etc.)

References:

- *Karnovsky, I. A., "Advanced Methods of Structural Analysis", 2010.*

STE405	Foundations (2)								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	1	Lab	0	Semester	1^{St}	Foundations (1) STE307

Content:
Introduction to deep foundations - Types of piles and methods of construction - Load capacity of the pile vertically and horizontally - structural design of piles – Piles testing - Analysis of Pile Groups – settlements of Piles - design of Piles caps - Methods of solving flow problems in porous media - groundwater flow in soil and its impact on the foundations - dewatering, systems and methods of implementation - design of sheets and various shoring systems.

References:

- *Das, Braja M., “Principles of Foundation Engineering,” 2010.*
- *"Egyptian Code for Soil Mechanics and Design and Execution of Foundations", 2002.*
- *Barnes, G. E. "Soil Mechanics: Principles and Practice". Macmillan Education UK, 2000*

STE406	Project Evaluation								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	1	Lab	0	Semester	1^{St}	Construction Project Management STE308

Content:
Methods of assessment of civil engineering projects - studying the causes of delaying and cost in construction projects and methods of treatment - delays analysis in the construction and identification of project responsibilities - occupational health and safety in sites, preparation of safety and security project plan, risk analysis and methods of response, planning construction sites to respond to the requirements of safety occupational health, identifying the elements of temporary services during construction - value engineering, functional analysis, the stages of the application of value engineering - sustainability projects construction and methods of evaluation of projects to achieve the requirements of sustainability - evaluation of multiple alternatives, hierarchical method of analysis - analysis and evaluation of results, dynamic systems, maps and statistical control.

References:

- *Knut Samset, " Project Evaluation: Making Investments Succeed", Fagbokforlaget, 2003.*

PWE401	Sanitary Engineering (1)								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	1	Lab	0	Semester	1st	Hydraulics IHE201

Content :

Drinking water treatment and wastewater treatment plants: preliminary studies and specifications of drinking water - components of drinking water purification plants - design of purification plants, sedimentation, filtration and sterilization process - primary studies, wastewater characteristics and environmental protection requirements from pollution - components of sanitation projects - Design of primary and biological treatment units - sludge treatment and disposal.

References:

- *Metcalf & Eddy, " Wastewater Engineering (Treatment, Disposal& Reuse)", Forth Edition, Mc Graw-Hill Book Co., 2003.*

PWE402	Highway Engineering								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	1	Lab	0	Semester	1st	----

Content: Introduction - Visibility distance - Cross section elements - Horizontal road planning - Vertical planning of roads - Types of paving - Foundation layer properties - Properties of road construction materials: bitumen and aggregates - Volumetric properties and design of asphalt mixtures - Traffic loads - Structural design of paving.

References

- *Meyer, Michael D. "Transportation planning handbook", Wiley, 2016.*
- *Ceder, A., "Public Transit Planning and Operation: Theory, Modeling and Practice" Burlington, MA: Elsevier, 2007.*
- *Vuchic, Vukan R. "Urban transit systems and technology", John Wiley & Sons, 2007.*
- *Transit Capacity and Quality of Service Manual", 3rd Edition, Transportation Research Board, 2013.*

STE407	Reinforced Concrete (4)								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Reinforced Concrete (3) STER304

Content:

Lateral loads, earthquake and wind; Lateral load resisting systems, analysis, design, and detailing. Prestressed concrete design; Reinforced concrete bridges, loads, types and systems, analysis, design, detailing, special considerations.

References:

- *Fanella, David A. "Reinforced Concrete Structures: Analysis and Design". McGraw-Hill Professional Publishing, 2010.*
- *Jack C. McCormac, Russell H. Brown. "Design of Reinforced Concrete". 2013.*
- *El-behairy, S., "Reinforced Concrete Design Handbook", Fifth edition, Cairo, 2002.*

STE408	Steel Structures (3)								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/ 2nd	Steel Structures (2) STE306

Content :
Introduction to different types of bridges (railway bridges – roadway bridges – pedestrian bridges) – Different statical systems for bridges (Plate girder bridge - Truss girder bridge - Arch bridge - Cable-stayed Bridge - Suspension bridge - Box girder bridges) – Loads on Bridges and Allowable Stresses - Design of bridge elements (Design of Floor Beams - Main Girder - Design of Stiffeners- different bearings types and splices) - Analysis and design of wind bracing system – Design of truss bridge - design of Box section Bridge

References:
- *Unsworth, John F. "Design and Construction of Modern Steel Railway Bridges". CRC Press, 2017.*
- *Lebet, Jean-Paul, Hirt, Manfred A. "Steel Bridges - Conceptual and Structural Design of Steel and Steel-Concrete Composite Bridges". Taylor & Francis, 2013.*
- *"Egyptian code of practice for steel construction and bridges (ASD)", Code No. ECP 205-2001, Edit 2009, Ministry of Housing, Utilities & Urban Development.*

STE409	Structural Dynamics								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Structural Analysis (3) STE302

Content:
Dynamic equilibrium; Equations of motion for SDOF systems; Analysis of free and forced vibration; Response to impulsive loading; Numerical evaluation of dynamic response; Generalized SDOF systems; Dynamic equations of motion for MDOF systems; Natural vibration properties of structures; Damping; Introduction to response spectra; Vibrations of bars and beams; Computer applications.

References:
- *Aggarwal P., Shrikhande, M., "Earthquake Resistant Design of Structures", Prentice Hall India Learning Private Limited; 1 edition, 2006.*
- *Anil K. Chopra, " Dynamics of structures", Prentice Hall, UUSA; 4th edition, 2012.*
- *Ray W. Clough, J. Penzien "Dynamics of structures", Computers & Structures, Inc, USA; 1st Ed., 2003*.

STE410	Analysis and Design of Tall Buildings								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Reinforced Concrete (2) STE303 + Steel Structures (2) STE306 + Structural Analysis (3) STE302

Content:
Deals with the structural aspects of high-rise buildings, analyzes the behavior of various forms of building structures including frames, shear walls, tubular, and outrigger systems. Considering design criteria, loads, and various structural systems. The dynamic response of structures exposed to strong winds and earthquakes. Approximate methods of analysis.

References:
- *Aggarwal P., Shrikhande, M., "Earthquake Resistant Design of Structures", Prentice Hall India Learning Private Limited; 1 edition, 2006.*
- *Anil K. Chopra, " Dynamics of structures", Prentice Hall, United States of America; 4th edition, 2012*
- *Ray W. Clough, J. Penzien "Dynamics of structures", Computers & Structures, Inc., USA; 1st Ed., 2003*

STE411	Shell Structures Design								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Reinforced Concrete 2 STE303 + Math. 3 BAS113 + Structural Analysis 3 STE302

Content:
Analysis of Fourier Series - Differential geometry of surfaces – Membrane theory for shells of revolution - Analysis and design of cylindrical shells, shells of revolution, elliptic parboiled shells, and hyperbolic shells - design of folded plates roofs.

References:

- *Maria Radwańska, Anna Stankiewicz, Adam Wosatko, Jerzy Pamin, " Plate and Shell Structures: Selected Analytical and Finite Element Solutions 1st Edition", Wiley, 2017.*

STE412	Prestressed Concrete								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Reinforced Concrete (2) STE303

Content:
Design of prestressed concrete structures – calculation of stresses, losses, and deflection - design for shear, splicing and development length - structural behavior and modes of failure of prestressed structures, design of prestressed concrete structures with large spans - selected topics.

References:

- *Antoine E. Naaman, "Prestressed Concrete Analysis and Design 3rd Edition", Techno Press 3000, 2012.*

STE413	Strut-and-Tie Modeling Method								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/ 2nd	Reinforced Concrete (2) STE303 + Structural Analysis (3) STE302

Content:
The basic principles of the strut-and-tie model - Bernoulli and discontinuities regions – strengths of struts, ties, and nodes - applications for deep beams and deep beams with openings, prestressed concrete, and pile caps, etc.

References:

- *S. El-Metwally, W. Chen, " Structural Concrete: STMs for Unified Design", CRC, Taylor & francis, 2017*.

STE414	Composite Structural Elements Design								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/ 2nd	Reinforced Concrete (1) STE203 + Steel Structures (2) STE306

Content:
Types of composite structural elements and their properties – Methods of design according to the specifications - Loads and types of composite beams; with shoring, without shoring, Design of shear connectors, Encased steel beams) - Composite columns concrete filled steel tube (CFST) and Encased steel section under axial load - Composite slab - Composite columns subjected to axial compression or tension and bending – Connections – Design of composite walls - fire resistance of composite structures - Detailing of composite structures.

References:

- *Alan Williams. "Steel Structures Design (ASD/LRFD)". USA: International Code Council, 2011.*
- *Liang, Q. Q. "Analysis and Design of Steel and Composite Structures". USA: Taylor & Francis, 2015.*
- *"Egyptian code of practice for steel construction and bridges (ASD)", ECP 205-2001, Edit 2009.*

STE415	Rehabilitation and Strengthening of Concrete Structures								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Reinforced Concrete(2) STE303

Content:
Reasons for defects - Methods to avoid cracks in concrete - Evaluation of defects of structures - Materials used in the rehabilitation and protection of concrete structures - Methods for rehabilitation and reinforcement of various structural elements - Corrosion of structures and cathodic protection.

References:

- *Bakhoum, M.M., and Juan A. Sobrino. "Case Studies of Rehabilitation, Repair, Retrofitting, and Strengthening of Structures". IABSE, 2010*

STE416	Soil Excavated Retaining Systems								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Foundation (2) STE405

Prerequisite: Foundations (2) STE405

Content: Soil pressure on flexible and propped walls – soil ties - the walls of Berlin – H-beam and H-pile walls - secant and contiguous pile walls – sheet pile walls - diaphragm walls – filed dams.

References:

- *Klaas Jan Bakker, "Soil Retaining Structures 1st edition". CRC Press, 2000.*

STE417	Management of Construction Information Systems								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Projects Management ENG412

Content: Introduction to information systems, information management systems, information technology in industry, classification of information systems, personal information systems to support planning and control and support decision - making process at the level of implementation and policy, information flow models, the impact of the exchange of electronic information, knowledge management, Developing an organization's information management system, choosing the appropriate system, applying to construction companies, making use of information technology, providing information, and case studies.

References:

- *A. Galiano Garrigos, L. Mahdjoubi, C. A. Brebbia, R. Laing, "Building Information Systems in the Construction Industry". WIT Press, 2018.*

STE418	Monitoring Construction Projects								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/ 2nd	Construction Project Management STE308

Content: The basic principles of project planning and control - the project's dismantling structure and cost elements as a project control tool - project update - deviation of time and costs - methods used to plan, program, estimate and control costs in projects - delays analysis - earned value method - case studies, program applications used in monitoring the project.

References:

- *Hegazy, T., "Computer-Based Construction Project Management", 2002*
- *Paul Netscher, " Construction Project Management: Tips and Insights", Panet Publications, 2017.*
- *Nigel J. Smith, "Engineering Project Management", 3rd Edition, Wiley-Blackwell, 2008*.

STE419	Risk Management in Construction Projects								Prerequisite
2 Cr Compulsory	Lectures	2	Tutorials	0	Lab	0	Semester	1st	Construction Project Management STE308

Content:
Sources of uncertainty and risk in the construction, the need for projects to risk management, risk management steps, hazard identification, assessment and risk analysis, Firecracker qualitative and quantitative risk analysis, ways to reduce and transfer risk, control risk, the way Burt to analyze the project considering the risk, model Monte Carlo simulation , Decisions based on the study of risks, the role of different parties in dealing with risks, case studies, computer software applications for risk management.

References:

- *Nigel J. Smith, Tony Merna, Paul Jobling, " Managing Risk in Construction Projects, 3rd Edition", Wiley blackwell, 2014*

PWE403	Sanitary Engineering (2)								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/ 2nd	PWE401

Content :
Sewage drinking water networks: Preliminary studies and behavior calculation - Types and design of different drinking water tanks - Systems, forms and design of different drinking water supply networks - Valve champers - Implementation and testing of drinking water networks. Preliminary studies and sources of wastewater and behavior accounting - systems, forms and design of sewage lines - manholes - lifting stations and sewage ejection lines - implementation and testing of sewage lines.

References:

- *Metcalf & Eddy, " Wastewater Engineering(Treatment, Disposal& Reuse)", Forth Edition, Mc Graw-Hill Book Co., 2003*

IHE401	Port Engineering								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Foundations (1) STE307

Content:
Introduction - natural phenomena and technical studies - tidal - wind - sea currents - the principles of marine survey - waves - refraction waves - port planning - Breakwater - internal navigation - design navigational channels - Guidance signs of navigation.

References:

- *Tsinker, Gregory P., ed. "Port engineering: planning, construction, maintenance, andsecurity", John Wiley & Sons, 2004*

ARC401	Architectural Design (3)								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Architectural Design (2) ARC301

Content:
Methods for determining dealing with design problems - studying void spaces in terms of formation and function - studies assessing the environmental impact of openings on ventilation and natural lighting of buildings - construction materials and how to adapt design with its components and elements to the surrounding environment, habits and human characteristics - conducting research and field visits and applying them to architectural design projects .

References:

- *Neufert, E. “Architect’s Data, Crosby Lockwood Staples”, 5th edition, London, 2019.*
- *Annie R Pearce. “Sustainable Buildings and Infrastruction”, 2012.*
- *Mary Guszowski. “Towards Zero-energy Architecture New Solar Design”, laurence king, 2010.*

ARC402	Architectural Design (4)								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	Architectural Design (3) ARC401

Content:
Studying the external environmental effects with the architectural projects in terms of context, location, blocks and voids - the quality of the relationship between the external space and the forms of buildings with the urban character and the surrounding fabric - studying the importance of the structural idea in forming large architectural voids. Raising the efficiency of dealing with aspects that violate the process of designing multi-component projects and overlapping internal relations - an advanced study of strategic and environmental studies of green architectural projects.

References:

- *Neufert, E. “Architect’s Data, Crosby Lockwood Staples”, 5th edition, London, 2019.*

ARC403	Architectural Construction (2)								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/ 2nd	Architectural Construction, Technical and Sanitary Installation ARC101

Content:
The components of the building - theoretical and field study of construction materials and systems - types of foundations - thermal insulation of final roofs and exterior walls - an introduction to finishing work and equipment used in building finishing, with application to a limited space example - study of different methods of constructing buildings – skeleton buildings - frames - sliding slabs – prestressed concrete – folded plates – shell structures - steel constructions - trusses - details of constructing stairs .

References:

- *Neufert, E. “Architect’s Data, Crosby Lockwood Staples”, 5th edition, London, 2019.*
- *Francis D. K. Ching. “Architectural Graphics”, Amazon Digital Services LLC, April 2015.*
- *Ernest R. Norling. “Perspective Made Easy (Dover Art Instruction)”, 2012.*
- *Nikolas, Davies & Jokiniemi, Erkki. “Dictionary of Architecture and Building construction”, 1st Edition. 2008.*
- *- Crosbie, Michael J. “Time Saver Standards for architectural design data”, McGraw Hill book company, New York, 2009.*

ARC404	Theory of Architecture (2)								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/ 2nd	ARC103

Content:
An analytical study of factors affecting architectural design (economic, functional, social, human, psychological, and environmental) - Building materials technology - Study of architectural theories and design determinants of building elements - vertical distribution units and horizontal corridors - theories of residential buildings - Administrative buildings - commercial buildings - study the visual relationships of buildings and means of lighting and natural ventilation.

References:

- *Ching, Francis D.K. "Architecture: form, space and order", van nostrand reinhold company, 4ed, NY, 2014.*
- *Nikos A. Salingaros. "A Theory of Architecture", 2016.*

Chapter Six:

A B. Sc. Program in Infrastructure and Environmental Engineering (IEE) with Credit Hours System

1. Introduction to the Program

The Infrastructure and Environmental Engineering Program (IEE) follows a unique approach between the traditional civil engineering disciplines and various other disciplines, as this program is concerned with the application of engineering systems to environmental issues related to the design of infrastructure in urban areas through the identification of transport systems and construction of road networks, supply of potable water, Collection and treatment of industrial and wastewater, environmental protection from air pollution, water, soil, solid waste management (garbage) and disposal, treatment of civil and industrial environmental issues. This program has been developed to suit the labor market at the local and global level. Therefore, this program aims to prepare a graduate who is aware of the modern, environmentally friendly foundations that are required in all aspects of daily life, risk assessment, and studies of the reform process of existing traditional systems. The program also helps to develop students 'ability to understand and respond to the challenges posed by development projects and environmental changes to mitigate severity Environmental problems and obtain a clean and environmentally friendly engineering product.

The Infrastructure and Environmental Engineering program qualifies for a new Bachelor's degree in engineering. It depends on the system of credit hours in the study. As the fields of engineering extend to many topics, a number of optional courses have been designed to cover all areas of engineering related to infrastructure projects such as surveying, roads, transportation, transportation systems, drinking water supply systems, environmental protection projects against wastewater pollution, solid waste, and so forth in urban settings. . The program offers a number of basic courses at the first three levels to provide students with the basics required to study engineering in the program. At the end of the third and fourth levels, a number of elective courses and basic design courses must be selected and chosen.

The IEE program connects three main specializations, including close links, and depends on a number of basic courses involved. These specializations are:

1- Soil science, surveying and environment:

- The role of surveying in engineering projects, land evaluation and management.
- Geographical Information Systems and Remote Sensing.
- Study of soil and rock formation to prepare for engineering projects and vital installations.

2- Roads, transportation and the environment

- Planning and designing transportation and traffic, while assessing the environmental impacts resulting from it.
- Modern systems for planning and designing roads, airports and railways on environmental bases.

3- Water, Air and Environment:

- Planning and designing drinking water purification, wastewater treatment and industrial wastewater.
- Planning and designing solid waste treatment and waste management
- Monitoring and controlling air pollution

It was taken into account that the list of study schedules include inter-disciplinary courses.

2. Basic Information

2.1. Program Vision

Pioneering in the field of infrastructure and environmental engineering at the local and regional levels.

2.2. Program Mission

Preparing a distinguished graduate and researcher in the field of infrastructure engineering and the environment, able to compete in the local and regional labor market.

2.3. Program Aims

The program aims are summarized as follows:

A. Use the information and foundations for infrastructure engineering and the necessary environment, which is a mixture of basic sciences and various engineering and environmental studies, both in theory and in practice.

B. An understanding of the phenomena that make up the modern world around us, training in presentation skills and the use of computer applications.

C. The ability to design various infrastructure facilities for modern urban life, evaluate alternatives and choose the best alternative.

D. Working with the modern foundations for planning, designing and managing environmental systems and assessing the resulting environmental impact, as well as assessing risks.

E. Study the latest methods of environmental protection and analysis of urban engineering systems.

F. Studying costs in planning environmental and regional facilities, planning, designing and managing the highway and transport network and airports, designing, operating and treating different water stations and managing solid waste.

G. Setting specifications and tender documents, studying financial bids, evaluating infrastructure projects and protecting the built environment

2.4. Specifications of the Program Graduate

The academic program for infrastructure and environmental engineering is keen to graduate distinguished and qualified engineers for the labor market. The program graduate will be able to:

A. Apply general and specialized knowledge and theories in the field of infrastructure engineering and the environment.

B. Conduct critical thinking to solve problems that can or cannot be expected in the context of infrastructure engineering and environment specialization taking into account all variables

C. Master an expanded set of specialized skills in the field of infrastructure engineering and the environment.

D. Apply critical evaluation of the results of the completed tasks and building technical expertise. Apply cost-effectiveness measures.

E. Master the usual and unusual contexts in the field of infrastructure engineering. Conduct digital and media tools to tackle professional and academic challenges in an innovative way.

F. Study and work independently under the general rules and regulations. Make correct decisions in the context of infrastructure engineering and the environment.

G. Apply exploitation and development of workplace resources.

H. Apply business ethics.

I. Apply quality assurance standards in all procedures related to infrastructure and environmental engineering.

2.5. Graduate Competencies in Accordance with the National Academic Standards

According to NARS 2018, a graduate must be able to:

A1: Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.

A2: Develop and conduct appropriate experimentation and/or simulation, analyze, and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

A3: Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

A4: Utilize contemporary technologies, codes of practice, and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

A5: Practice research techniques and methods of investigation as an inherent part of learning.

A6: Plan, supervise, and monitor implementation of engineering projects, taking into consideration other trades requirements.

A7: Function efficiently as an individual and as a member of multi-disciplinary and multicultural teams.

A8: Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

A9: Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10: Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.

In addition to the competencies of most engineering programs, the engineering IEE program has some special competencies, which are as follows:

B1: Choose appropriate and sustainable technologies for infrastructure and environment projects.

B2: Apply optimal design for infrastructure projects such as transportation, traffic, roads, airports, stations and drinking water and sewage networks

B3: Plan and manage infrastructure projects and assess their environmental impacts.

B4: Deal with tenders, contracts and financial issues related to infrastructure and environmental projects.

3. Course Coding System

The course code is composed of three letters and three digits. The letters indicate the course specialization department. The second part of the course code consists of three numbers, the first of which represents the level, while the second number represents the exact specialization number within the scientific department. The third digit is the course sequence in each discipline.

1. Not all of these letters indicate the majors in which the degree is given, some of which represent university requirements, engineering requirements, or specialized courses.
2. Course descriptions refer to the semester in which this course is usually given. However, these dates are subject to change and not all courses are taught every year. Before the start of each semester, the College's Student Affairs display a table of the courses that will be taught in this semester and the dates of their teaching and those who are teaching.

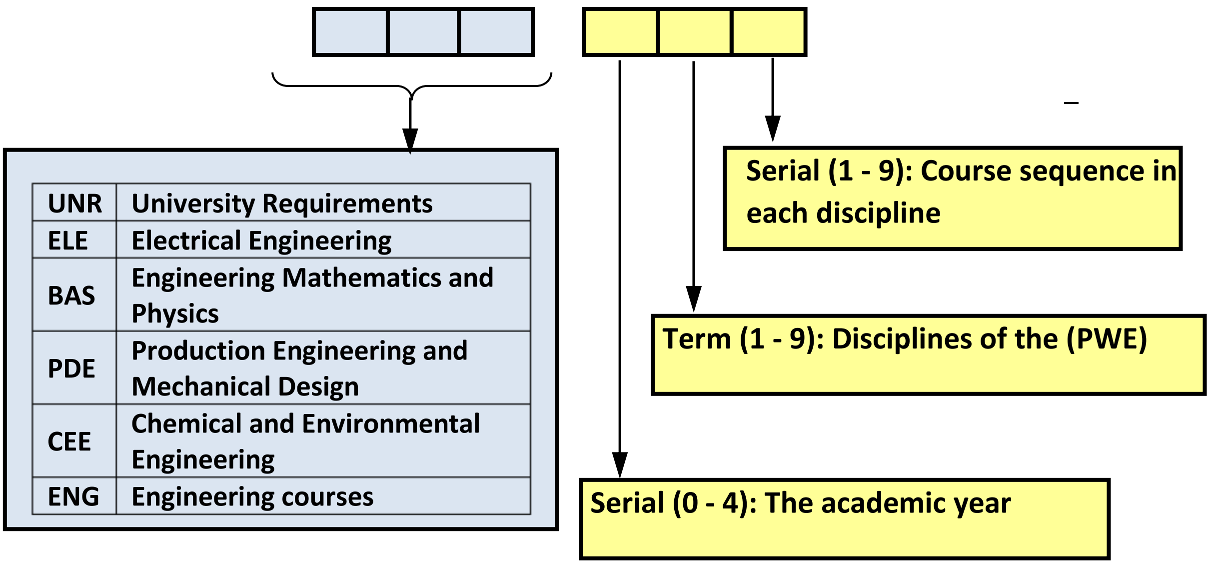


Figure (1): Courses coding system

4. Structure and Contents of the IEE Program

The structure of the Infrastructure and Environmental Engineering program consists of 160 credit hours distributed as follows:

4.1 University Requirements

The main purpose of university education is not only to prepare students for successful careers but also to provide them with the knowledge and skills necessary to develop a rational and successful personal identity. Moreover, Mansoura University assists students in gaining an appreciation of the natural and cultural environments in which they live and their roles in society and community services. The university requirements in the undergraduate programs consist of 13 credit hours

(8% of the total 160 credit hours), which are fulfilled by completing seven (7) courses which are shown in Table (1).

Table (1): The University Requirements (13 Credit)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	semester Works	Lab	Final Exam
UNR061	English (1)	2	5	20	30	--	50
UNR062	English (2)	2	5	20	30	--	50
UNR171	History of Engineering and Technology	1	2	20	30	--	50
UNR281	Law and Human Rights	2	4	20	30	--	50
UNR241	Communication and Presentation Skills	2	5	20	30	--	50
UNR461	Ethics and Morals of The Profession	2	4	20	30	--	50
UNR471	Marketing	2	4	20	30	--	50
Total		13	29				

4.2 Faculty Requirements

The college requirements provide students with the knowledge and skills necessary to develop a successful engineer. The essence of the joint college is applied in all credit hour programs. The standard requirement of the core courses in the college includes basic knowledge courses for all engineering graduates such as mathematics, physics, mechanics, engineering drawing, design, manufacturing, and chemistry. The college requirements for the infrastructure and environment engineering program for the undergraduate degree consist of 45 credit hours (28.125% of the total 160 credit hours), which are completed by completing sixteen (16) mandatory courses, as listed in Table 2.

Table (2): The College Requirements (45 Credit)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	semester Works	Lab	Final Exam
BAS011	Mathematics (1)	3	8	20	30	--	50
BAS021	Mechanics (1)	3	8	20	30	--	50
BAS012	Mathematics (2)	3	8	20	30	--	50
BAS022	Mechanics (2)	3	8	20	30	--	50
BAS031	Physics (1)	3	9	20	20	10	50
BAS032	Physics (2)	3	9	20	20	10	50
BAS041	Engineering Chemistry	3	9	20	20	10	50
PDE051	Production Engineering	3	8	20	20	10	50
PDE052	Engineering Drawing	3	10	20	30	--	50
ENG111	Technical Reports Writing	2	6	20	30	--	50
BAS113	Mathematics (3)	3	8	20	30	--	50
BAS114	Mathematics (4)	3	8	20	30	--	50

BAS115	Statistics and Probability Theory	2	6	20	30	--	50
ELE151	Electrical Power and Machines	3	8	20	30	--	50
BAS215	Mathematics (5)	3	8	20	30	--	50
ENG412	Project Management	2	6	20	30	--	50
Total		45	127				

4.3 Major and Minor Requirements for IEE

The requirements for general and rigorous specialization in the undergraduate program in infrastructure engineering and the environment consist of 102 credit hours (63.75% of a total of 160 credit hours), which are fulfilled by completing 26 compulsory courses equivalent to 76 credit hours, 6 elective courses equivalent to 18 credit hours Field training and graduation projects are equivalent to 8 credit hours as shown in the following tables.

Table 3: Compulsory Courses for General and Specific Specialization Requirements for Infrastructure and Environmental Engineering (76 credit hours, 48.125% of the total 160 credit hours)

Code	Course Name	Credit Hours
PWE 001	Environmental Pollution and its Methods of Measurement	2
STE 101	Structural Analysis (1)	3
STE 102	Reinforced Concrete (1)	3
STE 103	Properties and strength of Materials	3
IRE 101	Civil Drawing	3
PWE111	Plane Surveying	3
PWE 121	Engineering Geology and Soil Mechanics	3
PWE 201	Characterization of Road Materials	3
PWE 202	Asphalt Materials	3
STE 203	Soil Mechanics and Foundation	3
IRE 201	Hydrology and fluid mechanics	3
MPE 201	Electromechanical Equipment and Machines	3
PWE 211	Topographic Surveying and Geodesy	3
PWE 212	Introduction to Photogrammetry and Remote Sensing	3
PWE 214	Environmental Impact Assessment and Project Life Cycle	3
PWE 222	Transportation and Traffic Engineering	3
ARE 301	Building Construction	3
STE 301	Design of steel Structures	3
PWE 321	Infrastructure Project Equipment and Construction Methods	3
PWE 322	Structural Design of Flexible Pavement	3
PWE 323	Geometric Design of Highways	3
PWE 331	Drinking Water Supply Purification and Networks	3
PWE 332	Wastewater Treatment and Networks	3
PWE 333	Solid Waste Management and Treatment	3
PWE 341	Railway Engineering	3
PWE 441	Water Surveying	2

Table 4: Elective Courses for Specific Specialization Requirements for Infrastructure and Environmental Engineering (18 credit hours, 11.25% of the total 160 credit hours) – Elective Courses for 300 Level (2 courses only)

Code	Course Name	Credit Hours
STE 302	Structural Analysis (2)	3
STE 303	Reinforced Concrete (2)	3
STE 304	Structural Design of Water Tanks	3
STE 305	Design of Bridges and Concrete Tunnels	3
STE 306	Specifications, Quantities and Contracts	3
ARE 302	Urban and Regional Planning	3
PWE 312	Theory of Errors and Global Positioning with Satellites (GPS)	3
PWE 313	Photogrammetry and Remote Sensing	3
PWE 314	Tunnels and Mines Surveying	3
PWE 315	Engineering and Applied Geodesy	3
PWE 316	Physical Geodesy	3
PWE 324	Airport Planning and Design	3

Table 5: Elective Courses for Specific Specialization Requirements for Infrastructure and Environmental Engineering (18 credit hours, 11.25% of the total 160 credit hours) Cont'd – Elective Courses for 400 Level (4 courses only)

Code	Course Name	Credit Hours
PWE 411	Geology of Rocks and Groundwater Reservoirs	3
PWE 412	Structural Design of Rigid Pavement	3
PWE 413	Pavement Maintenance and Rehabilitation	3
PWE 422	Regional and Urban Transport Planning	3
PWE 423	Intelligent Transport Systems	3
PWE 424	Cargo Transportation, Freight and Container Systems	3
PWE 425	Modern Trends of Designing and Evaluating Asphalt Mixtures and Pavement Maintenance Management	3
PWE 431	Water Desalination Systems	3
PWE 432	Industrial Wastewater Treatment	3
PWE 433	Biological Treatment	3
PWE 442	Geographic Information Systems and Their Applications in Infrastructure Projects	3
PWE 443	Computer Applications in Engineering Projects	3

Table 6: Graduation Projects and Field Training (8 credit hours, 4.375% of the total 160 credit hours)

Code	Course Name	Credit Hours
PWE 351	Training (1)	1
PWE 451	Training (2)	1
PWE 461	Graduation Project (1)	3
PWE 462	Graduation Project (2)	3

5. The Semester Contents of the Infrastructure-Engineering Program

The curriculum presents the credit units weekly contact hours either for lectures, tutorial and practical work for all courses. The curriculum also presents SWL and Marks distribution in addition to the senior project the summer training according to **NARS 2018**. It is clear from the table that the total contact hours (lectures + tutorial+ practical) in addition to the hours of self-learning range from 44 to 49 hours per week for all levels with an average of 46 hours per week.

LEVEL 000

First Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
BAS011	Mathematics (1)	3	2	2	--	4	8	20	30	--	50	100	---
BAS021	Mechanics (1)	3	2	2	--	4	8	20	30	--	50	100	---
BAS031	Physics (1)	3	2	1	1.5	4.5	9	20	20	10	50	100	---
BAS041	Engineering Chemistry	3	2	1	1.5	4.5	9	20	20	10	50	100	---
PDE052	Engineering Drawing	3	2	2	--	6	10	20	30	--	50	100	---
UNR061	English (1)	2	1	2	--	2	5	20	30	--	50	100	---
Total		17	11	10	3	25	49					600	
Total Contact hours = 24 hours/week Total SWL = 49 hours/week													

Second Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
BAS012	Mathematics (2)	3	2	2	--	4	8	20	30	--	50	100	BAS011
BAS022	Mechanics (2)	3	2	2	--	4	8	20	30	--	50	100	BAS021
BAS032	Physics (2)	3	2	1	1.5	4.5	9	20	20	10	50	100	------
PWE041	Environmental Pollution and its Methods of Measurement	2	2	--	1.5	4.5	8	20	20	10	50	100	------
PDE051	Production Engineering	3	2	--	3	3	8	20	20	10	50	100	------
UNR062	English (2)	2	1	2	--	2	5	20	30	--	50	100	UNR061
Total		16	11	7	6	22	46					600	
Total Contact hours = 24 hours/week Total SWL = 46 hours/week													

LEVEL 100

Third Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
BAS113	Mathematics (3)	3	2	2	--	4	8	20	30	--	50	100	BAS012
BAS115	Probability Theory and Statistics	2	1	2	--	3	6	20	30	--	50	100	BAS012
STE 101	Structural Analysis (1)	3	2	2	--	5	9	20	30	--	50	100	----------
IRE 101	Civil Drawing	3	2	2	--	4	8	20	30	--	50	100	PDE052
PWE111	Plane Surveying	3	2	--	2	5	9	20	20	10	50	100	----------
ENG 111	Writing of Technical Reports	2	1	2	--	3	6	20	30	--	50	100	UNR061
Total		16	10	10	2	24	46					600	
Total Contact hours = 22 hours/week Total SWL = 46 hours/week													

Fourth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
BAS114	Mathematics (4)	3	2	2	--	4	8	20	30	--	50	100	BAS113
STE102	Reinforced Concrete (1)	3	2	2	--	4	8	20	30	--	50	100	STE101
STE103	Properties and strength of Materials	3	2	1	1	5	9	20	20	10	50	100	------
PWE121	Engineering Geology and Soil Mechanics	3	2	2	--	5	9	20	30	--	50	100	------
ELE151	Electromechanical Equipment and Machines	3	2	2	--	4	8	20	30	--	50	100	BAS032
UNR 171	History of Technology	1	1	--	--	1	2	20	30	--	50	100	------
Total		16	11	9	1	23	44					600	
Total Contact hours = 21 hours/week Total SWL = 44 hours/week													

LEVEL 200

Fifth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
BAS215	Mathematics (5)	3	2	2	--	4	8	20	30	--	50	100	BAS113
PWE211	Topographic Surveying and Geodesy	3	2	1	1	4	8	20	20	10	50	100	PWE111
UNR241	Communication and Presentation Skills	2	1	2	--	2	5	20	30	--	50	100	----------
PWE214	Environmental Impact Assessment and Project Life Cycle	3	2	2	--	4	8	20	30	--	50	100	PWE041
PWE 201	Characterization of Road Materials	3	2	2	--	5	9	20	30	--	50	100	----------
IRE201	Hydrology and fluid mechanics	3	2	2	--	4	8	20	30	--	50	100	----------
Total		17	11	11	1	23	46					600	
Total Contact hours = 23 hours/week Total SWL = 46 hours/week													

Sixth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
PWE212	Introduction to Photogrammetry and Remote Sensing	3	2	1	1	5	9	20	20	10	50	100	------
STE203	Foundation and Soil Mechanics	3	2	2	--	5	9	20	30	--	50	100	PWE121
MPE201	Electromechanical	3	2	2	--	2	6	20	30	--	50	100	BAS032
UNR281	Law and Human Rights	2	2	--	--	2	4	20	30	--	50	100	------
PWE202	Asphalt Materials	3	2	2	--	5	9	20	30	--	50	100	PWE121
PWE222	Transportation and Traffic Engineering	3	2	2	--	4	8	20	30	--	50	100	------
PWE351	Training (1)	1	--	--	3	--	3	--	50	--	50	100	------
Total		18	12	9	4	23	48					700	
Total Contact hours = 25 hours/week Total SWL = 48 hours/week													

LEVEL 300

Seventh Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
Elective	Elective Course (1)	3	2	2	--	5	9	20	30	--	50	100	Depends
ARE301	Building Construction	3	2	2	--	5	9	20	30	--	50	100	IRE101
PWE322	Structural Design of Flexible Pavement	3	2	2	--	4	8	20	30	--	50	100	PWE201
PWE331	Drinking Water Supply Purification and	3	2	2	--	4	8	20	30	--	50	100	PWE041
PWE321	Infrastructure Project Equipment and Construction	3	2	2	--	4	8	20	30	--	50	100	STE102
STE301	Design of steel Structures	3	2	2	--	4	8	20	30	--	50	100	----------
Total		18	12	12	--	26	50					600	
Total Contact hours = 24 hours/week Total SWL = 50 hours/week													

Eighth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
Elective	Elective Course (2)	3	2	2	--	5	9	20	30	--	50	100	Depends
PWE322	Railway Engineering	3	2	2	--	4	8	20	30	--	50	100	------
PWE323	Geometric Design of Highways	3	2	1	1	5	9	20	20	10	50	100	PWE111
PWE333	Solid Waste Management and Treatment	3	2	2	--	4	8	20	30	--	50	100	PWE041
PWE332	Wastewater Treatment and Networks	3	2	2	--	4	8	20	30	--	50	100	PWE041
PWE451	Training (2)	1	--	--	3	--	3	--	50	--	50	100	------
Total		16	10	9	4	22	45					600	
Total Contact hours = 23 hours/week Total SWL = 45 hours/week													

LEVEL 400

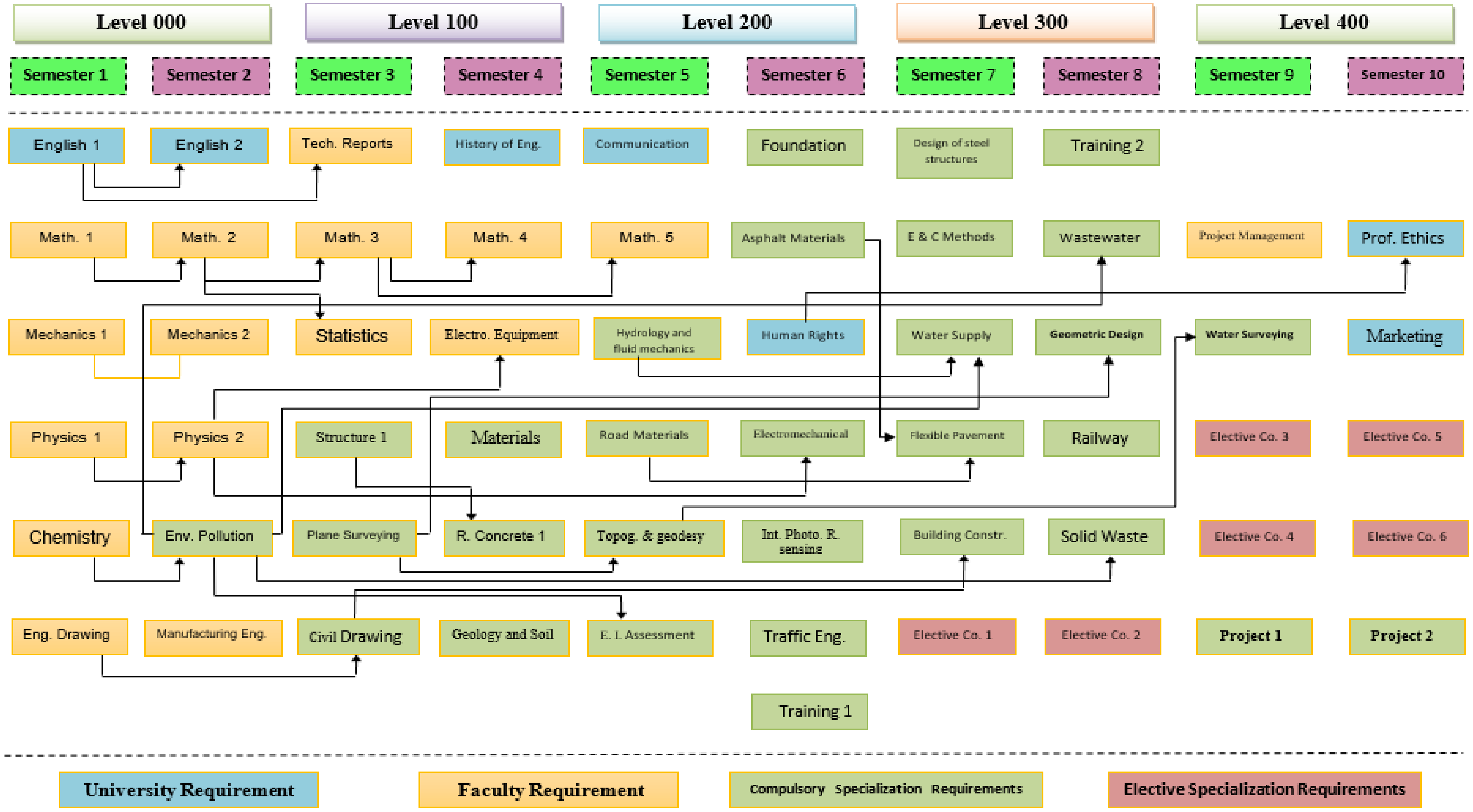
Ninth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
Elective	Elective Course (3)	3	2	2	--	5	9	20	30	--	50	100	Depends
Elective	Elective Course (4)	3	2	2	--	5	9	20	30	--	50	100	Depends
ENG412	Project Management	2	1	2	--	3	6	20	30	--	50	100	------
PWE441	Water Surveying	2	2	--	--	4	6	20	30	--	50	100	PWE211
PWE461	Graduation Project (1)	3	2	--	--	8	10	--	50	--	50	100	------
Total		13	9	6	--	25	40					600	
Total Contact hours = 15 hours/week Total SWL = 40 hours/week													

Tenth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
Elective	Elective Course (5)	3	2	2	--	5	9	20	30	--	50	100	Depends
Elective	Elective Course (6)	3	2	2	--	5	9	20	30	--	50	100	Depends
UNR461	Etiquette and Professional Ethics	2	2	--	--	3	5	20	30	--	50	100	------
UNR471	Marketing	2	2	--	--	2	4	20	30	--	50	100	------
PWE462	Graduation Project (2)	3	4	2	--	6	12	--	50	--	50	100	------
Total		13	12	6	--	21	39					500	
Total Contact hours = 18 hours/week Total SWL = 39 hours/week													

Infrastructures & Environmental Engineering (IEE)



Matrix of Competencies and Courses for IEE Program

Level	Course Code	Course Title	Graduate Competencies According to NARS 2018													
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4
000	BAS011	Mathematics (1)	√													
	BAS021	Mechanics (1)	√													
	BAS031	Physics (1)	√	√												
	BAS041	Engineering Chemistry	√	√												
	PDE052	Engineering Drawing	√		√											
	UNR061	English (1)								√						
	BAS012	Mathematics (2)	√													
	BAS022	Mechanics (2)	√													
	BAS032	Physics (2)	√	√												
	PWE041	Environmental Pollution and its Methods of Measurement	√		√	√	√									
	PDE051	Manufacturing Engineering Principles	√	√		√										
	UNR062	English (2)								√						
100	BAS113	Mathematics (3)	√													
	BAS115	Probability Theory and Statistics	√	√				√								
	STE 101	Structural Analysis (1)	√	√			√				√					
	IRE 101	Civil Drawing	√	√				√			√	√				
	PWE111	Plane Surveying	√	√				√	√	√				√		
	ENG 111	Writing of Technical Reports					√			√						
	BAS114	Mathematics (4)	√													
	STE102	Reinforced Concrete (1)	√	√									√	√		
	STE103	Properties and strength of Materials	√									√				
	PWE121	Engineering Geology and Soil Mechanics	√	√			√					√				
	ELE151	Electromechanical Equipment and Machines	√	√									√	√		
	UNR 171	History of Technology Engineering				√	√			√		√				
200	BAS215	Mathematics (5)	√	√												
	PWE211	Topographic Surveying and Geodesy	√	√			√					√				
	UNR241	Communication and Presentation Skills						√	√	√	√	√				
	PWE214	Environmental Impact Assessment and Project Life Cycle	√			√			√			√	√		√	
	PWE 201	Characterization of Road Materials	√	√	√							√	√			
	IRE201	Hydrology and fluid mechanics	√	√	√						√					

	PWE212	Introduction to Photogrammetry and Remote Sensing	√	√								√				
	STE203	Foundation and Soil Mechanics	√	√	√	√							√	√		
	MPE201	Electromechanical	√	√	√								√	√		
	UNR281	Law and Human Rights	√				√		√	√		√				
	PWE202	Asphalt Materials	√	√									√	√		
	PWE222	Transportation and Traffic Engineering	√	√									√			
	PWE351	Training (1)		√	√	√		√	√	√	√	√				
300	Elective	Elective Course (1)	√	√		√	√					√				
	ARE301	Building Construction	√				√		√			√				
	PWE322	Structural Design of Flexible Pavement	√	√	√	√										
	PWE331	Drinking Water Supply Purification and Networks	√	√	√								√	√	√	
	PWE321	Infrastructure Project Equipment and Construction Methods	√	√	√	√	√				√	√	√			
	STE301	Design of steel Structures	√	√	√				√	√	√	√				
	Elective	Elective Course (2)	√	√	√								√	√		
	PWE322	Railway Engineering	√	√	√	√							√	√		
	PWE323	Geometric Design of Highways	√	√	√	√	√					√	√			
	PWE333	Solid Waste Management and Treatment	√	√		√	√					√	√		√	
	PWE332	Wastewater Treatment and Networks	√	√	√	√			√	√	√	√	√	√	√	
	PWE451	Training (2)		√	√	√		√	√	√	√	√				√
400	Elective	Elective Course (3)	√	√		√	√					√	√		√	
	Elective	Elective Course (4)	√	√	√		√						√	√	√	
	ENG412	Project Management	√	√	√	√					√	√				
	PWE441	Water Surveying	√	√	√	√	√	√	√	√	√					
	PWE461	Graduation Project (1)	√	√		√	√	√	√	√	√	√	√	√	√	√
	Elective	Elective Course (5)	√	√	√	√	√	√	√	√	√	√				
	Elective	Elective Course (6)	√	√	√	√				√	√					
	UNR461	Ethics and Morals of the Profession	√			√	√		√	√	√	√				
	UNR471	Marketing	√	√	√	√	√	√				√				
	PWE462	Graduation Project (2)	√	√	√	√	√	√	√	√	√	√	√	√	√	√

IEE Program Courses Syllabi

University Requirements:

UNR061	English (1)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---
Main skills of the English language - listening to short and long conversations - reading scientific passages - writing reports, summaries, and scientific articles - speaking and presenting new ideas									
References: Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011									

UNR062	English (2)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	UNR061
Analysis and interpretation of engineering issues - summarizing engineering issues - preparation for language tests.									
References: Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011									

UNR171	History of Engineering and Technology								Prerequisites
1 Cr	Lecture	1	Tutorial	--	Lab.	--	Semester	2nd	---
Engineering history: Art, Science, Engineering and technology - Role of engineering and technology in development and establishment of civilizations -Technology and environment - Examples on development of engineering activity.									
References: Roger S. Kirby, Engineering in History, Dover Publications Inc. New York, United States, 1990, ISBN10 0486264122									

UNR281	Law and Human Rights								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	2ed	---
Systems and laws of institutions - Introduction to Accounting - Labor legislation and laws governing engineering professions - Industrial security legislation and environment - Historical philosophical origins of human rights - international sources of human rights - national sources of human rights - global bodies based on the protection of human rights.									

UNR241	Communication and Presentation Skills								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---
Communication skills - Presentation planning and preparation - Delivery skills such as eye contact, voice control, gestures, body language and appearance - Presenter's characteristics - Using visuals - Presentation structure - Elevator Pitch									
References: - Joan van Emden, Lucinda Becker, Presentation Skills for Students, 3rd Edition, Red Globe Press, 2016 - M. Wa Mutua, S. Mwaniki, P. Kyalo, B. Sugut, Communication Skills: A University Book, Succex Publishers, 2016 - Ian Tuhovsky, Wendell Wadsworth, Communication Skills Training, Ian Tuhovsky, 2015 - Tabitha Wambui, Alice W. Hibui, Elizaeth Gathuthi, "Communication skills " Vol.1, Students' coursebook, LAP LAMBERT Academic Publishing, 2012									

UNR461	Ethics and Morals of The Profession								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	1st	---
General principles of professional ethics - Commitments to society - Responsibilities of the engineer - Detection of violations - Behavior - Case studies and general issues.									
References: - Lizabeth A. Stephan, David R. Bowman, William J. Park, Benjamin L. Sill, Matthew W. Ohland, "Thinking like an engineer", Published by Pearson 2018. - Harris, C. E., Jr., Pritchard, M. S., & Rabins, M. J. Engineering Ethics. Second edition. Belmont, CA: Wadsworth, 2000									

UNR471	Marketing								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	1st	---
Principles of biomedical products marketing - Marketing research - Biomedical customers buying behavior - Marketing mix - Plotting marketing strategy - Building marketing plan - Pinpointing the target market - Marketing on the world wide web - Branding strategy - Developing new products - Advertising and promotions - Costing and pricing strategies - Case studies on biomedical products marketing									
References: Principles of Marketing, University of Minnesota Libraries Publishing, 2015, ISBN 13: 9781946135193									

College Requirements:

BAS011	Mathematics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Calculus: Function (definition - theorems) - Basic functions - limits - Continuity - Derivation - definition - theorems - types - higher orders - Applications on derivatives - partial derivatives - indefinite integral - theories and properties of integration.
Algebra: Binomial theorem (with any exponent and applications) - Partial Fractions - Theory of Equations - Matrices - System of linear equations - Gauss elimination method.

References:

- Akhtar & Ahsan, Textbook of Differential Calculus, second edition, 2009, PHI Learning Private Limited.
- Alan Jeffrey, Matrix operations for Engineers and Scientists, 2010, Springer Science & Business Media.

BAS021	Mechanics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Newton's laws - Types of forces، coplanar forces، Rectangular components of vector (1D, 2D, Space), Forces in space - Equilibrium of a particle - Conditions, Free-body diagram - Moment - Couple moment - Resultant of a system of forces and couples as a force and couple system - General procedure for reducing force and couple systems - Equilibrium of a rigid body - Conditions of equilibrium of a rigid-body، free body diagrams – friction

References:

- R.C. Hibbeler, "Engineering Mechanics: Statics and Dynamics, 14th Edition", Pearson Prentice Hall, New Jersey, 2016.
- J. L. Meriam, L. G. Kriage, and J. N. Botton, "Engineering Mechanics: Statics, 8th Edition", John Wiley & Sons, New York, 2016.

BAS012	Mathematics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	**BAS011**

Integral Calculus: Definite integral - Methods of integration - Applicationson definite integral (plane area - volume of revaluation - length of a plane curve - area of surfaces of revolution) - improper integral.
Analytic Geometry: Equations of second degree - Equation of pair of straight lines - Translation of axes - Conic sections - parabola - ellipse - hyperbola) Equation of plane - Equation of sphere.

References:

- Jumarie, G., Fractional Differential Calculus for Non-Differentiable Functions: Mechanics, Geometry, Stochastics, Information Theory. 2013: LAP Lambert Academic Publishing.
- Hestenes, D. and G. Sobczyk, Clifford algebra to geometric calculus: a unified language for mathematics and physics. Vol. 5. 2012: Springer Science & Business Media.
- Grossman, S.I., Multivariable calculus, linear algebra, and differential equations. 2014: Academic Press.

BAS022	Mechanics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	**BAS021**

Kinematics of a particle: curvilinear motion - Normal and tangential components. - Newton's laws - motion of projectiles - Work and energy of a particle - applications of friction.

References:

- R.C. Hibbeler, "Engineering Mechanics: Statics, 11th Edition", Pearson Prentice Hall, 2006.
- F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg, "Vector Mechanics for Engineering, Statics and Dynamics, 9th Edition", McGraw-Hill, New York, 2010.

BAS031	Physics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Material properties: Physical quantities - Standard units and dimensions - Mechanical properties for materials - Fluid properties - Periodic motion - Mechanical waves - Sound waves - Waves in elastic media.

Heat and thermodynamics: Temperature measurements and thermometers - Thermal expansion - Specific and latent heat - Heat transfer - Gas motion theory - First law of thermodynamics - Entropy and second law of thermodynamics.

References:

- Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 6th Edition, Thomson Brooks/Cole 2014.
- Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.

BAS032	Physics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Electricity and Magnetism: Electric charge - Electric force - Electric field- Column’s law- Electric flux- Gauss law- Electric potential- Electric capacitance and Dielectrics - Ohm’s law and simple circuits- Magnetic field - Baiot and Savart laws.

Optics and Modern physics: Nature of light and laws of geometric optics - Interference - Diffraction - polarization - optical fiber - laser - photoelectric effects - principle of quantum theory - special theory of relativity.

References:

- Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 9th Edition, Thomson Brooks/Cole 2014.,
- Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.

BAS041	Engineering Chemistry								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Equations of state-chemical thermodynamics - Material and energy balance in chemical processes- properties of solutions - Basic principles in electrochemistry and it's applications-selected topics in chemical industry.

References:

Brown, L. T, LeMay H. E. Jr; Bursten, B. E.; Murphy, C.J., and Woodward, P.; " Chemistry The Central Science", Pearson International Edition (11th edn), Pearson Printice Hall, (2009).

PDE051	Production Engineering								Prerequisites
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	2ed	---

Introduction to the following processes (Casting- Forging- Metal filing - Machining- Forming-Woodworking)

References:

Hitomi, Katsundo. Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics. Routledge, 2017.

PDE052	Engineering Drawing								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Two-dimensional drawings - Free-hand sketching - Sectional views - Auxiliary views and conventions - Computer-aided drawing (CAD) of 2D and 3D figures.

References:

Mcgraw-hill Mint, "Mechanical Drawing Board & CAD Techniques", Student Edition,2011

ENG111	Technical Reports Writing								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	2ed	---

Technical writing defenition - audience analysis - technical writing styles - technical document characteristics - automated document organization - official and unofficial document types - structure of different types of technical documents.

References:

- G. J. Alred, W. E. Oliu, The Handbook of Technical Writing, 12th Edition, Bedford/St. Martin's; 2018
- K. Hyland, Teaching and researching writing. 3rd edition Routledge academic publisher, 2016
- M. Markel, Technical Communication, 11th edition, MacMillan, 2015.

BAS113	Mathematics (3)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	**BAS012**

Applications of partial differentiation - Maximum values of functions in more than one variable and applications - First order differential equations - Second order differential equations - Laplace transform and its applications - Analytical geometry in space.

References:
- D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.
- S. A. Wirkus, and R. J. Swifi, "A Course of Ordinary Differential Equations", Taylor & Francis Group, LLC, 2015.

BAS114	Mathematics (4)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	**BAS113**

Fourier series - Fourier transform - Complex numbers - Functions of a complex variable - Complex integration - Residue theorem - Direction derivatives - Double integrals - Triple integrals - Line integrals - Surface integrals.

References:
- J. Brown, and R. Churchill, "Complex Variables and Applications", 9th Edition, McGraw-Hill, 2013.
- D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.

BAS115	Statistics and Probability Theory								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	**BAS012**

Measures of tendency and dispersion - Probability distributions - Sampling theorem - tests of hypothesis - non-parametric tests - regression and correlation - time series.

References:

Mary C. Meyer, Probability and Mathematical Statistics: Theory, Applications, and Practice in RSBN-10: 1611975778, SIAM (June 24, 2019)

ELE151	Electrical Power and Machines								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	---

Power: Electrical power systems - three phase systems - Theory and models of transformers - Transmission line models - Voltage and frequency control - effective and ineffective power - Optimal work of power systems.

Machines: The theory of operation ، The construction of the Direct Current motors. The speed، torque، and current characteristics - applications of the DC motors. The theory of operation and construction of stepper motors - Permanent-magnet DC motor and Low-inertia DC Motors. The theory of operation، construction of three-phase induction motors.

References:
- Nilsson, J.W. and S.A. Riedel, Electric circuits. 2015: Pearson Upper Saddle River, NJ.
- Slade, P.G., Electrical contacts: principles and applications. 2017: CRC press.

BAS215	Mathematics (5)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	**BAS113**

Numerical solution of linear and non-linear systems of equations - Iterative methods - Curve fitting: Least square of (Straight lines, Polynomials), Linearization of nonlinear relationship. Interpolation and polynomial approximation -finite difference operators - Numerical integration and differentiation.

References:
- Mazumder, Numerical Methods for Partial Differential Equations,Finite Difference and Finite Volume Methods, science direct ,2016.
- Sheldon Rose, A First course in probability, Eighth edition, 2010, Pearson Prentice Hall.

ENG412	Project Management								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---
Fundamentals of project management - Integration management - Scope management - Time management - Cost management - Quality management - Human resources management - Communication management - Risk management - Procurement management - Biomedical projects case studies									

References:
- Kerzner, H. and H.R. Kerzner, Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons, 2017.
- Kalpakjian, S., K. Vijai Sekar, and S.R. Schmid, Manufacturing Engineering and technology. Pearson, 2014.
- Nigel J. Smith, "Engineering Project Management", 3rd Edition, Wiley-Blackwell, 2008.

IEE Program Requirements

IEE Program Compulsory courses

PWE 001	Environmental Pollution and its Methods of Measurement							Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	2	Compulsory	BAS041
Elements and components of the environment, the water cycle in nature and various sources of water pollution, indicators of physical, chemical and biological water quality, atmospheric air and greenhouse gas components, soil contamination with oils and greases and heavy metals, radioactive materials.								

References:
- *Judith Petts, "Handbook of Environmental Impact Assessment", 1999*

STE 101	Structural Analysis (1)							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	
Introduction - types of structures - reactions - internal forces in the beams - internal forces in the tires - internal forces in trusses - lines of influence - vertical stresses - shear stress - compound stresses - twisting.								

References:
- *V.N. Vazirani, M.M. Ratwani, & S.K. Duggal, "Analysis of structures", Khanna publishers, sixteenth edition, 2005*

STE 102	Reinforced Concrete (1)							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	STE 101

Introduction to reinforced concrete - Design philosophy and methods of design - Design of reinforced concrete sections subjected to bending moment - Development length, splices, curtailment of bars and reinforcement details - Shear stresses in concrete beams - Design of solid slabs - Design of continuous beams - Design and analysis of columns and sections subjected to moment and axial loads - Design of reinforced concrete walls - Design of R/C sections using working stress method.

References:

- *Mehta, P.K., "Properties of concrete & Structures", Prentice Hall Inc., New Jersey, 1998.*
- *Neville, A.M., "Properties of Concrete", Longman, 5th ed., 2010.*

IRE 101	Civil Drawing							Prerequisites
3 Cr	Lecture	1	Tutorial	4	Lab.		Compulsory	PDE052

Using the Autocad program in the work of horizontal and vertical projections and the methods of inferring any unknown projection from the known projections, the visible and hidden letters, sectors and the methods of drawing and marching them, applications that start with simple shapes and are graded to include simple machines and some simple structural and architectural elements

References:

- *Singh, "Civil Engineering Drawing", Standard publications-Delhi, 2009*

STE 103	Properties and strength of Materials							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	

Concrete uses, features and defects in relation to other structural materials - Methods of design for concrete mixes - Properties of fresh concrete - Mechanical properties of concrete - Concrete durability - Dimensional changes - Quality control - Special concrete - Creeping of concrete - Thermal properties of materials - Non-destructive tests for concrete.

References:

- *Neville, A.M., "Properties of Concrete", Longman, 5th ed., 2010*

PWE111	Plane Surveying							Prerequisites
3 Cr	Lecture	2	Tutorial		Lab.	2	Compulsory	
Introduction - Surveying Units - Sources and Types of Errors - Surveying - Classification of Surveying Sciences – Graphical Scale – Areas Computations - Land Division - Levelling - Volumes – Grid levelling – Cross sections – Contour lines - calculating the volumes from contour lines - An introduction to the theory of errors and their applications in Surveying.								

References:

- *Kavanagh, B., Surveying Principles and Applications . Prentice Hall, 2008*
- *B. C. Punmia, A. K. Jain & A. K. Jain, Surveying Vol. I, Laxmi Publications*
- *Bossler,. & Moffit, "Surveying", 10th ed., 2004*

PWE 121	Engineering Geology and Soil Mechanics							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	
An introduction to geology and Earth's origins - rocks and their composition - geological maps in Egypt - an introduction to soil mechanics: soil and its properties; soil types and soil structure - soil composition: terms and volumes and weights - definitions and relationships - mechanical analysis of soils - soil texture and soil limits - soil compactness - Soil classification systems - soil permeability - shear force theory - soil compactness, balance inclination - compressibility and consolidation.								

References:

- *Braja Das, "Principles of Geotechnical Engineering", 2010*

STE 203	Soil Mechanics and Foundation							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	PWE 121
Distribution of stresses in the soil - soil susceptibility to compression and consolidation - shear resistance to the soil - soil compactness - tendency balance - soil lateral pressure - soil loading capacity - design of shallow foundations - design of piles, measurements and support structures.								

References:

- *Das, Braja M., "Advanced Soil Mechanics," 1983.*
- *Das, B.M., "Principals of Foundation Engineering", 1988.*
- *"Egyptian Code for Soil Mechanics and Design and Execution of Foundations", 2002*

IRE 201	Hydrology and fluid Mechanics							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	
Introduction to hydrology - General introduction and basics of open channels - types of flow - principles of energy in open channels - hydraulic jump and its types - resistance to flowing waterways - forms of water surface and methods of calculating their lengths - flow resistance equations in open channels and the calculation of behaviors - different methods of channel design - hydraulics of rivers – Hydraulic machines (water turbines - Pletten - France - Kaplan).								

References:

- *Currie, Iain G., and I. G. Currie. "Fundamental mechanics of fluids", Crc Press, 2002*

MPE 201	Electromechanical Equipment and Machines							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	BAS032

Introduction to Thermal Systems Engineering - First Law of Thermodynamics and its Applications - Second Law of Thermodynamics and its Applications - Fundamentals of Heat Transfer - Fundamentals of Internal Combustion Engine, Transmission Systems. Construction equipment - Lifting equipment - Soil compacting equipment, basic electrical theory - transmission and distribution networks - Energy storage methods - Electrical systems for lightning protection - Electrical installations - Ohm's law lighting systems, current, circuits - electrical systems in a building.

References:

- *Charles K. Alexander, Matthew N. Sadiku, "Fundamentals of electric circuits", fifth edition McGraw Hill, 2012.*
- *Michael J. Moran, Howard N. Shapiro, Bruce R. Munson, and David P. DeWitt, "Introduction to Thermal system engineering" John wiley & sons, 2003.*

PWE 211	Topographic Surveying and Geodesy							Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1	Compulsory	PWE 111

Introduction - Theodolite - permanent adjustment of theodolite - surveying with theodolite - Bearings - theodolite traverses – Traverse Adjustment - Tachometric measurement - Electronic distance measurement - Total station – Intersection- Resection - Geometric geodesy - Triangulations – Computational surface of the earth- Coordinate systems. co-ordinate transformation methods- Elements of map projections – Introduction to global navigation satellite system GNSS

References:

- *Kavanagh, B., Surveying Principles and Applications . Prentice Hall, 2008*
- *B. C. Punmia, A. K. Jain & A. K. Jain, Surveying Vol. I, Laxmi Publications*
- *Smith, James.R. Introduction to Geodesy: The History and Concepts of Modern Geodesy, John Wiley & Sons. Inc., 1997, ISBN: 0-471-16660-X*

PWE 212	Introduction to Photogrammetry and Remote Sensing							Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1	Compulsory	

Introduction - Basics of Photogrammetry - aerial photos - scale of aerial photos - displacement – flight planning - Parallax - creating stereoscopic models in aerial photos - principles of remote sensing - basic concepts and physical principles - Use of optical, infrared and microwave methods – geometric and radiometric corrections- RADAR-LiDAR.

References:

- *Manual Photogrammetry, McGlone, C., Edward, M. and Bethel, J, American Society For Photogrammetry and Remote Sensing, Bethesda, MaryLand, USA. 2005.*
- *Wolf, Paul.R.,Elements of Photogrammetry ,2nd ed.,McGraw-Hill,New York,1983.*
- *Curran, Paul J., (1985); Principles of Remote Sensing, Longman, London & New York.*

PWE 222	Transportation and traffic engineering							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	

This is an introductory course to key analytical techniques and design methods of Transportation Engineering and Planning. The course covers the following general topics: transportation and the socio-economic environment, components of transportation systems, different modes of transportation, design controls, fundamentals of vehicle motion, vehicle stability on horizontal curves, design of key highway geometric elements, fundamentals of traffic flow theory, capacity analysis, fundamentals of transportation planning methodologies, introduction to traffic safety analysis, and introduction to transportation impact studies and evaluation techniques of transportation projects.

References:

- *Roess, R. P., E. S. Prassas, and W. R. McShane. Traffic Engineering, Fourth Edition. International Edition, Pearson (2011)*
- *Ortuzar, J.D. and L.G. Willumsen. Modelling Transport, Third Edition, Jon Wiley&Sons, Inc. (2011)*
- *Papacostas, C.S. and Prevedouros, P.D. Transportation Engineering and Planning. Third Edition, Pearson Canada, Toronto, 2000.*

ARE 301	Building Construction							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	IRE 101

Principles and principles of architectural construction - the basics of construction work (stone - brick - concrete - iron) - architectural and structural codes and terms for materials - types of buildings (structural - load bearing walls), construction methods for each type and structural elements - insulating layers, floors, and stairs - methods of moisture insulation, drainage Rain water - building materials, finishing materials and equipment used - applications with simplified building drawings of buildings - an introduction to the installations and sanitary installations of the building - a study of how to implement the various stages of construction operations theoretically and in the field.

References:

- *Ching F. D . K, building construction illustrated, CBS publishers& distributors, India, 2008.*
- *LYONS, Arthur, Materials for architects and Builders, Oxford: Elsevier, 2007.*
- *McGRATH, B., GARDNER, J., Cinemetrics - Architectural Drawing Today, John Wiley & Sons - England - 2007.*
- *NIKOLAS, Davies & JOKINIEMI, Erkki, Dictionary of Architecture and Building construction, 1st Edition. 2008*

PWE 201	Pavement Material Characterization							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	

Resilient modulus testing - Correlations with other tests (CBR, R-value, other tests) - Characterization of unbound granular materials - Characterization of subgrade and fine-grained soils - Characterization of stabilized materials - Portland cement concrete usage in pavement structure - Modulus of subgrade reaction.

References:

- *E. Ray and Prithvi S. Kandhal and Freddy L. Roberts and Y. Richard Kim and Dah-Yinn Lee and Thomas W. Kennedy Brown, "Hot Mix Asphalt Materials, Mixture Design, and Construction", NCAT, 3rd edition, 2009*

PWE 202	Bituminous Materials							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	

Marshall mix design - SUPERPAVE mixture design system - Fundamental properties of aggregates and asphalt binders - SUPERPAVE laboratory tests for asphalt binders, aggregates, and mixtures - Selection of a design aggregate structure - Selection of the Design asphalt binder content - Design, analysis, and interpretation of volumetric data - Evaluation of moisture sensitivity AASHTO T283 - Performance evaluation testing of asphalt mixture.

References:

- *E. Ray and Prithvi S. Kandhal and Freddy L. Roberts and Y. Richard Kim and Dah-Yinn Lee and Thomas W. Kennedy Brown, "Hot Mix Asphalt Materials, Mixture Design, and Construction", NCAT, 3rd edition, 2009*

PWE 322	Structural Design of Flexible Pavement							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	

Flexible Pavement design process and design factors - Stress-Strain analysis for flexible pavements - Analysis of traffic loads - Unbound Material characterization - Fundamental properties of aggregates and asphalt binders - Material considerations in design (Properties, Environmental Effects, and Evaluation) - Factors effecting design, serviceability concept and failure criteria - Asphalt Institute thickness design method for full depth, conventional and stabilized pavements - AASHTO 1993 design method for structural design of flexible pavements.

References:

- *E. Ray and Prithvi S. Kandhal and Freddy L. Roberts and Y. Richard Kim and Dah-Yinn Lee and Thomas W. Kennedy Brown, "Hot Mix Asphalt Materials, Mixture Design, and Construction", NCAT, 3rd edition, 2009*

PWE 323	Geometric Design of Highways							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	

Introduction to geometric design criteria - Human and vehicle characteristics - Elements of highway cross-section. Stopping and passing sight distances - Horizontal alignment of a roadway - Superelevation and spiral curves - Widening on horizontal curves - Vertical alignment of a roadway - Intersection and interchange design.

References:
- *E. Ray and Prithvi S. Kandhal and Freddy L. Roberts and Y. Richard Kim and Dah-Yinn Lee and Thomas W. Kennedy Brown, "Hot Mix Asphalt Materials, Mixture Design, and Construction", NCAT, 3rd edition, 2009*

PWE 341	Railway Engineering						Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	

Introduction to rail engineering - The main elements of the railway - A dynamic study of rail movement - Engineering planning of railway lines - Design of railway structural elements - Aircraft types, design and signature methods - Planning and design of stations - Signal types - Means of securing rail traffic within cities - Maintenance - Lines and methods of design and analysis of railway capacity for single and double lines - Calculating periods of flow - Design of rail junctions - Design of horizontal and vertical curves of railways.

References:
- *Hay, W. W., "Railroad Engineering", Wiley; 2 edition, 1982.*
- *Chandra, S., & Agarwal, M.M., "Railway Engineering", 2 edition, 2013.*

PWE 331	Drinking Water Supply Purification and Networks							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	PWE 001, IRE 201

Drinking water quality standards - the characteristics of potable water - water resources available for treatment plants-preliminary studies to calculate the required flow – estimate the number of population for the future – components of water treatment plants – design of water treatment units including intake, coagulation and flocculation, sedimentation, filtration and disinfection – design criteria for water networks – Special pieces used in networks – Elevated tanks design – design of valves and fire hydrants –testing and evaluation of water networks.

References:
- *Qasim S.R., Motley E. M. and Zhu G., "Water Works Engineering: Planning, Design & Operation," A hand book, Eastern Economy Edition, 2004*

PWE 332	Wastewater Treatment and Networks							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	PWE 001, PWE 331

Characteristics of wastewater - wastewater analysis – domestic and industrial wastewater sources preliminary studies to calculate the discharged flow – estimate the number of population for the future – wastewater treatment plant components – sewage networks design – pump stations and force main design of sewage - design criteria for the design of primary stage and biological stage for wastewater treatment – wastewater treatment using different technologies such as aerobic and anaerobic ponds, oxidation ditchs, wetlands ,SBR and MBBR - sludge treatment

References:
- *Metcalf & Eddy, " Wastewater Engineering(Treatment, Disposal& Reuse)", Forth Edition, Mc Graw-Hill Book Co., 2003*

PWE 333	Solid Waste Management and Treatment						Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	PWE 001

General introduction to solid waste management- Elements of solid waste management system- Characteristics, components and waste sources– Methods of reducing the generation of solid waste – local storage of domestic solid waste – Design of solid waste collection processes – temporary waste transfer stations – Recycling and reuse of wastes – waste separation at source – Anaerobic fermentation of organic waste – Safe disposal of waste– incineration plants design –landfills design – assessment of solid waste management system – industrial solid waste – hazardous waste.

References:

- *George Tchobanoglous, F., " Handbook of Solid Waste Management, Second Edition", Kreith, 2004*

PWE 214	Environmental Impact Assessment and Project Life Cycle						Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	PWE 001

Introduction and foundations of environmental impact assessment - global regulations governing the principles of environmental preservation - Egyptian environmental law - other environmental-related legislation - environmental ethics and regulation - procedures for environmental impact assessment - classification of projects into categories according to the severity and size of projects - requirements for providing environmental impact assessment studies - foundations Life cycle assessment of industrial system components - material and energy balances - impact of projects on wildlife and rare breeds - requirements for gas emissions - ecosystems - awareness of risks.

References:

- *Judith Petts, "Handbook of Environmental Impact Assessment", 1999*

STE 301	Design of steel Structures						Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	STE 302

Types of steel constructions - Types of loads on metal constructions - Methods of designing metal constructions according to Egyptian specifications - Permissible stresses in structural elements - Design of elements prone to tension stresses - Design of elements prone to pressure stresses - Design of elements prone to pressure stresses - Design of metal columns under the influence of axial loads - Calculation of strength in truss members - Design of different members - Design of load-bearing beams - Design of joints using welding - Design of joints using screws.

References:

- *Almon, F., "Analysis and Design of steel structure", 1950.*
- *Morris, L.J., & Plum, D.R., "Structural Steel Work Design", Nichols Publishing, New York, 1989.*
- *Machaly, S.B., "Behavior, Analysis, and Design of structural Steel Members", Volume(1), Cairo, 2002, Fourth edition, Cairo University Press*

PWE 441	Water Surveying							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	PWE 211

Objectives and basic principles of hydrographic surveying. Tides water levels and reference surfaces. Underwater acoustics including velocity and system parameters. Sonar and echosounder systems. Acoustic positioning concepts. Depth determination and sounding: Single & multi-beams and Sea water properties & Tide Gauge. Sea bed exploration. The Vertical positioning and datums. Types of surveys and specifications-GNSS systems. Error sources.

References:

- *Hydrography, by C D de Jong, G Lachapelle, S Skone, and I A Elema, 2nd ed, DUP BluePrint, 2003.*
- *Leick, A., GPS Satellite Surveying. John Wiley and Sons, 2004*

PWE 461	Graduation project (1)							Prerequisites
3 Cr	Lecture	2	Tutorial	6	Lab.		Compulsory	135 Cr

The student prepares a project in one of the following majors: Surveying and land management - Geographical information systems - Roads and airports engineering - Transport, traffic and railway engineering - Sanitary engineering - Solid waste management.

References:

- *According to the project subject*

PWE 462	Graduation project 2							Prerequisites
5 Cr	Lecture	2	Tutorial	6	Lab.		Compulsory	145 Cr

The student prepares a project in one of the following majors: Surveying and land management - Geographical information systems - Roads and airports engineering - Transport, traffic and railway engineering - Sanitary engineering - Solid waste management.

References:

- *According to the project subject*

PWE 443	Infrastructure Project Equipment and Construction Methods							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	

Introduction - factors affecting the cost of operating the equipment - estimating the productivity of the equipment - methods and equipment for drilling, transporting and leveling the soil - drilling equipment - supporting sides of the excavation - ground drain - compacting equipment - - asphalt mixture brushes equipment - maintenance equipment - smart equipment for the implementation and maintenance of roads. Tunnel construction methods and equipment – pump stations construction methods

References:
- *Peurifoy, R.L. and Ledbetter, W. B., Construction planning equipment, and methods, McGraw-Hill International , 1987*

IEE Program Elective courses

STE 304	Structural Design of Water Tanks							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	STE 303
Design of concrete structures that have a long life - Water structures and their types - Loads exposed to water installations - Introduction to water installations and design of sectors under the influence of moments without cracking - Design of circular concrete tanks - Design of rectangular concrete tanks								

References:
- *Macgregor, J.G., "Reinforced Concrete Mechanics & Design", Prentice-Hall International Inc., New Jersey, USA, 1997*

STE 305	Design of Bridges and Concrete Tunnels							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	STE 303
Historical view - Economics of bridges and tunnels - Loads - Materials - Verbs - Fundamentals of analysis and design - Analysis and design of bridge and tunnel origin - Expansion joints - Protection of roofs and supports and organization of drainage works over bridges and inside tunnels - Analysis and design of supports and foundations.								

References:
- *Hilal, M., "Design of Reinforced Concrete Halls", Cairo University, 1998*

STE 306	Specifications, Quantities and Contracts							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Compulsory	PWE 001
Methods of Quantitates Calculation - Analysis of the various structural items included in the construction projects - Cost elements - Tables of quantities and price categories - Inventory methods of quantities of items - Utilization of inventory tables, abstracts and quantity lists - Calculation of quantities of items – Calculation of quantities of different types of piles - General and special documents and writing contracts - Technical specifications (writing - elements - specifications).								

References:
- *Datta, B.N., " Estimating and Costing in Civil Engineering: Theory & Practice Including Specifications and Valuation", Sangam Books Ltd, 27 revised edition, 2002*

PWE 315	Engineering and Applied Geodesy							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	PWE 211

Fundamental concepts, definitions and basic aims of geodesy. Representation of the Earth's surface: physical and mathematical figures of the Earth, geodetic reference systems, frames and co-ordinates, reference ellipsoids and geodetic datums, maps. Basic types of geodetic reference systems, computational procedures, co-ordinate transformation methods. Geodetic coordinates, transformation parameters and direct and inverse problem. Elements of map projections, examples and applications - GNSS systems - Error sources.

References:

- *Smith, James.R. Introduction to Geodesy: The History and Concepts of Modern Geodesy, John Wiley & Sons. Inc., 1997, ISBN: 0-471-16660-X*
- *Torge W., Muller J.Geodesy. DE GRUYTER, 2012.*

ARE 302	Urban and Regional Planning							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	105 Cr

Development studies, planning and settlement - the structural plan and the city plan: the elements and sequence of the process of preparing the general plan, the regional framework, natural, economic, demographic and social studies, the legislative framework - the current situation: the urban structure, land uses, determinants, problems, and potentials, goals and objectives, planning alternatives, evaluation And selection, means of implementation and follow-up, settlement studies, specialized studies of different areas and elements of the city - study of concepts of urban improvement and upgrading and community development in theory and practice.

References:

- *Ching F. D . K, building construction illustrated, CBS publishers& distributors, India, 2008.*
- *LYONS, Arthur, Materials for architects and Builders, Oxford: Elsevier, 2007.*
- *McGRATH, B., GARDNER, J., Cinemetrics - Architectural Drawing Today, John Wiley & Sons - England - 2007.*
- *NIKOLAS, Davies & JOKINIEMI, Erkki, Dictionary of Architecture and Building construction, 1st Edition. 2008*

PWE 312	Theory of Errors and Global Positioning with Satellites (GPS)						Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	PWE 211

Surveying measurements and errors. Propagation of errors in surveying observations. Dealing with linear surveying models. Least squares adjustment-parametric technique. Least-squares adjustment-conditional technique. Least-squares adjustment -adjustment of level nets - adjustment of horizontal surveys.

Global Navigation Satellite System signal description. GNSS error sources and biases; atmospheric delays. Observation equations and Mathematical models for static point and relative positioning. Kinematic single point and differential post mission and real time positioning, Precise Point Positing, navigation and location.

References:

- ***Leick, A., GPS Satellite Surveying. John Wiley and Sons, 2004***
- ***Hoffmann-Wellenhof, B., Lichtenegger, H. & Collins, GPS Theory and Practice. Springer, 2001***
- ***C. D. Ghilani and P. R. Wolf, Adjustment Computations: Spatial Data Analysis, Fourth Edition. © 2006 John Wiley & Sons, Inc. ISBN: 978-0-471-69728-2***

PWE 313	Photogrammetry and Remote Sensing							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	PWE 212

Remote sensing using optical, infrared and microwave radiation. Geometries; radiometric corrections, including calibration and atmospheric correction; geometric corrections, and land cover classification algorithms- LiDAR data acquisition, information extraction from LiDAR data and error analysis. LiDAR and photogrammetric data integration, DTM and DEM creation from LiDAR. Basic principles of RADAR.

References:

- *Curran, Paul J., (1985); Principles of Remote Sensing, Longman, London & New York.*
- *Sabins, F. F,Jr., (1997): Remote Sensing: Principles and Interpretation,3rd ed., W.H. Freeman, New York.*
- *Joseph, G., 2003: Fundamentals of Remote Sensing, Universities Press, Hyderabad.*
- *Jensen, J.R., (2004); Remote Sensing of the Environment: An Earth Resource Perspective, Pearson Education*

PWE 314	Tunnels and Mines Surveying							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	PWE 211

Classification of tunnels, preliminary studies that include: economic and geological aspects and their impact on tunnel construction, factors affecting tunnel construction, analysis of tunnel loads and subsurface structures, rock pressure, technical aspects and different methods of tunnel construction. The methods used for tunneling in hard rock include Medium and weak, under rivers and lakes and related problems (such as avalanches - how to make props to avoid avalanches - groundwater leakage problems). Triangulations, subsurface polygons, subsurface polygon linking to a triangular grid, errors and probability theory, computer applications in surveying survey data and mining mapping, surveying applications in the preparation of mines and quarries for optimal use of raw material deposits.

References:

- *Engineering Surveying Technology, by T J M Kennie and GPetrie (editors), Blackie and Sons Ltd, 1990.*
- *C. D. Ghilani and P. R. Wolf, Adjustment Computations: Spatial Data Analysis, Fourth Edition. © 2006 John Wiley & Sons, Inc. ISBN: 978-0-471-69728-2*

PWE 416	Physical Geodesy							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	PWE 315

Introduction to geodesy, its principles, tasks and applications. The gravity field and the geoid in science and engineering. Gravity anomaly and boundary value problems, the normal field and gravimetric measurements. Gravity reductions, isostasy. Geoid determination, Stokes's formula. Vertical positioning and height datums and systems.

References:

- *Torge W., Muller J.Geodesy. DE GRUYTER,2012.*
- *HOFMANN-WELLENHOF, B. -- MORITZ, H. Physical geodesy. Vieděň : Springer Verlag, 2005. ISBN 3-211-23584-1*

PWE 422	Regional and Urban Transport Planning							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	PWE 222

This course discusses the evolution and role of urban and rural public transportation modes, systems and services. Various kinds of public transportation system like bus, bus rapid transit (BRT),tram, light rapid transit (LRT or fast tram), railway rapid transit will be discussed. Technological characteristics are described, along with their impacts on capacity, service quality, and cost. Current practice and new methods for data collection and analysis, performance monitoring, route and network design, frequency determination, and vehicle and crew scheduling are covered.

References:

- ***Meyer, Michael D. Transportation planning handbook. Wiley (2016)***
- ***Ceder, Avishai.* Public Transit Planning and Operation: Theory, Modeling and Practice. *Burlington, MA: Elsevier, 2007***
- ***Vuchic, Vukan R. Urban transit systems and technology. John Wiley & Sons, 2007.***
- ***Vuchic, Vukan.* Urban Transit: Operations, Planning and Economics. *New York, NY: Wiley, 2005***
- ***Transit Capacity and Quality of Service Manual, 3rd Edition, Transportation Research Board, 2013.***

PWE 423	Intelligent Transport Systems							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	PWE 222

The purpose of this subject is to introduce students to the basic elements of intelligent transportation systems (ITS), focusing on technological, systems and institutional aspects. Topics include advanced traveler information systems; transportation network operations; commercial vehicle operations and intermodal freight; public transportation applications; ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation institutions, ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS and sustainable mobility, travel demand management, electronic toll collection, and ITS and road-pricing.

References:

- ***Sussman, Joseph.* Perspectives on Intelligent Transportation Systems (ITS).** ***New York, NY: Springer, 2005. ISBN: 0387232575***
- ***Nelson, Donna C. "Intelligent transportation primer." Institute of Transportation Engineers, Washington, DC (2000)***
- ***Shladover, S. E. (2002). Introducing intelligent transportation systems: Paradigm for 21st century transportation. TR News, (218).***
- ***Chen, B. M. R. S. K. (2002). Advanced traveler information systems. Boston, MA: Artech House, 2002.***

PWE 424	**Cargo transportation, freight and container systems**						**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.		**Elective**	**PWE 222**

Introduction - the historical development of cargo transportation - multimodal transport - logistical planning for the transport of goods - international laws and norms in freight transport and port management - standard dimensions of containers - types of containers - container terminal operating systems and equipment - methods of planning container containers - raising the efficiency of container terminals - ship movement - Logistical planning for the ports - Communication systems inside the ports - Raising the efficiency and maintenance of the infrastructure inside the ports.

References:

- ***Kemme, N. (2013). Design and operation of automated container storage systems. Contributions to management science. Physica, Heidelberg.***
- ***Kim, Kap Hwan and Günther, Hans-Otto (2007). Container Terminals and Cargo Systems: Design, Operations Management, and Logistics Control Issues. Springer (381 pages)***

PWE 425	**Modern Trends of Designing and Evaluating Asphalt Mixtures and Pavement Maintenance Management**							**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.		**Elective**	**PWE 202**

Introduction - Super pave bitumen grade selection - Super pave asphalt mixtures design - Special asphalt mixtures - Environmental friendly asphalt mixtures - Asphalt mixing plants - Maintenance management systems - Asphalt and concrete paving defects - Pavement performance evaluation - Pavement reinforcement - Asphalt road maintenance work And concrete - maintenance of dirt and gravel roads.

References:

- ***E. Ray and Prithvi S. Kandhal and Freddy L. Roberts and Y. Richard Kim and Dah-Yinn Lee and Thomas W. Kennedy Brown, "Hot Mix Asphalt Materials, Mixture Design, and Construction", NCAT, 3rd edition, 2009***

PWE 431	Water Desalination Systems							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	PWE 331

Water sources and quantities, types of water and its specifications, different methods of desalination and economic calculations, metal removal method, thermal methods, electrical method, reverse osmosis method, design of reverse osmosis units, inauguration and operation of reverse osmosis stations - waste water disposal.

References:

- *Metcalf & Eddy, " Wastewater Engineering(Treatment, Disposal& Reuse)", Fourth Edition, Mc Graw-Hill Book Co., 2003*

PWE 432	Industrial Wastewater Treatment							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	PWE 332

Introduction to the characteristics of industrial wastewater and the sequence of treatment processes for sewage fluids - physical processes: refineries, fast and slow mixing, filtration, gas transmission including ventilation processes, separation of membranes - chemical processes: sedimentation, chemical precipitation, oxidation, sterilization, ion exchange - processes Biology: removal of organic matter with biological oxidation, finding design determinants, stabilization lakes, biofuels, anaerobic degradation

References:

Metcalf & Eddy, " Wastewater Engineering(Treatment, Disposal& Reuse)", Fourth Edition, Mc Graw-Hill Book Co., 2003

PWE 433	Biological Treatment							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	PWE 332

Introduction - Physical, chemical and biological properties of wastewater - Objectives of biological treatment - The role of microorganisms in treatment processes - The foundations, theories, and different methods of biological treatment of wastewater - Biological treatment of polluted water, Economics of biological treatment methods.

References:

Metcalf & Eddy, " Wastewater Engineering (Treatment, Disposal& Reuse)", Fourth Edition, Mc Graw-Hill Book Co., 2003

PWE 442	Geographic Information Systems and Their Applications in Infrastructure Projects							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	105 Cr

Introduction to Geospatial Information Systems- vector data, raster data model, map projections, geodetic datums, co-ordinate systems, georeferencing, database design and management, query language, vector data analysis, raster data analysis- Dealing with remote sensing images.

References:

- *Elements of Photogrammetry with Application in GIS, by Paul R Wolf, Bon A DeWitt, and Benjamin EWilkinson, 4th ed, McGraw-Hill Education, 2014.*
- *Michael J. de Smith,Michael F. Goodchild,Paul A. Longley. Geospatial Analysis: A Comprehensive Guide to Principles, Techniques and Software Tools,2015*

PWE 443	Computer Applications in Engineering Projects							Prerequisites
3 Cr	Lecture	2	Tutorial		Lab.	2	Elective	144 Cr

Linear programming, engineering problem formulation, general method, dualism, sensitivity analysis, transport and distribution issues, specialization issues, numerical programming, computer applications - basic concepts for estimating and testing hypotheses with a focus on the importance of uncertain models and their impact on engineering designs. Working with some specialization software.

References:

- *Hugh Jack, Engineering Design, Planning, and Management, 1st ed., 2016*

STE 302	Structural Analysis (2)							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	STE 101

Introduction - Calculation of Formations: Compliant Formation Method - Presumptive Occupation Method - Quantum Method - Static Analysis of Unselected Structures: Three Moments Equivalence Method - Tilt and Tangent Slope Method.

References:

- *Igor Karnovsky & Olga Lebed, "Advanced methods of structural analysis", 2010*

STE 303	Reinforced Concrete (2)							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	STE 102

Introduction - Designing sectors under the influence of non-axial forces - Designing columns and reinforcing steel details - Cross beams - Design of hollow tiles and reinforcing iron details, hall design

References:

- *El-Behairy, Shaker, "Handbook of Concrete Structures", 1996*

PWE 411	Geology of Rocks and Groundwater Reservoirs						Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	PWE 121

Rocks and ores and methods of identification - The engineering classification of rocks - The natural and engineering properties of rocks - Geological structures: faults, folds, separations, slides - Geological survey - Geological maps - Geological studies accompanying the design of projects (reservoirs - tunnels - new cities) - permeability and water flow in Soil - Types of underground water tanks - Types of wells and their hydraulic properties.

References:

- *Braja Das, "Principles of Geotechnical Engineering", 2011*

PWE 324	Airport Planning and Design							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	

Airport planning - Aircraft characteristics - Air traffic management - Airfield geometric design - Structural design of airport pavements - Airport lighting, marking, and signing - Airport drainage systems - Special topics in airport planning and design.

References:

- *E. Ray and Prithvi S. Kandhal and Freddy L. Roberts and Y. Richard Kim and Dah-Yinn Lee and Thomas W. Kennedy Brown, "Hot Mix Asphalt Materials, Mixture Design, and Construction", NCAT, 3rd edition, 2009*

PWE 412	Structural Design of Rigid Pavement							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	

General design consideration (traffic, subgrade, climate, design life, reliability, other factors). Concrete pavement type selection and design features - Subgrade characterization. Drainage considerations - Base selection and design - Concrete slab thickness design - Joint Design. Shoulder considerations - Construction activities. Special design considerations for reinforced concrete pavements.

References:

- *E. Ray and Prithvi S. Kandhal and Freddy L. Roberts and Y. Richard Kim and Dah-Yinn Lee and Thomas W. Kennedy Brown, "Hot Mix Asphalt Materials, Mixture Design, and Construction", NCAT, 3rd edition, 2009*

PWE 413	Pavement Maintenance and Rehabilitation							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.		Elective	

Introduction to pavement maintenance - Pavement distresses - Pavement evaluation as part of an overall pavement management process - Pavement evaluation using condition survey - Structural evaluation by non-destructive pavement testing - Maintenance and rehabilitation techniques - Overlay Design.

References:

- *E. Ray and Prithvi S. Kandhal and Freddy L. Roberts and Y. Richard Kim and Dah-Yinn Lee and Thomas W. Kennedy Brown, "Hot Mix Asphalt Materials, Mixture Design, and Construction", NCAT, 3rd edition, 2009*

Chapter Seven:

A B. Sc. Program in Chemical and Environmental Engineering (CEE) with Credit Hours System

1. Introduction

Chemical and Environmental Engineering, (**CEE**), is a branch of engineering that concerns itself with protecting people from the effects of negative environmental effects, including pollution. It is also concerned with improving environmental quality. The work of a chemical and environmental engineer includes improving the quality of recycling, waste disposal, public health and water and air pollution control in the context of environmental management issues. Chemical and Environmental engineers make use of the principles of engineering specifically heat transfer, mass transfer, momentum transfer and application of engineering thermodynamics, soil science, biology and chemistry in order to create solutions to the many environmental problems facing mankind.A key responsibility of chemical and environmental engineering is to work to prevent the release of harmful chemical and biological contaminants in the air, water and soil. In order to accomplish this, chemical and environmental engineers need to be well versed in chemistry and biology. Another key function of chemical and environmental engineers is the detection of pollutants and the tracking of them back to their source.

Chemical and environmental Engineering is a key issue for sustainable engineering. The sustainability means living well within the ecological limits of a finite planet. So engineers must looking to the interactions between technical, ecological, social and economic systems to avoid shifting problems from one area to the other. More than ever, engineers need to find holistic and effective solutions to protect our vital life support systems and, at the same time, meet the needs of a growing human population.

Graduates of the dual major in Chemical & Environmental engineering are accredited chemical engineers who have additional skills to help them tackle current and future environmental challenges. In addition to core chemical engineering courses, Chemical & Environmental engineering students study specialized courses which develop knowledge and expertise in environmental systems thinking and modeling, environmental regulation and sustainable management of water, energy and waste.. Job opportunities in this field are diverse, including process engineering, industrial ecology, waste recovery, environmental modeling, impact assessment, water supply and treatment, climate policy, energy systems, environmental regulation and sustainability. Our graduates will be employed across sectors, including industry, government and consulting firms.

2. Basic Information

2.1 Program Vision

Providing a scholarly environment that supports and fosters academic excellence.

2.2 Program Mission

Prepare graduates for professional careers in chemical and environmental engineering and/or graduate study through a program of recognized excellence in teaching and research.

2.3 Program Objectives

A. Contribute to raising the professional competence and forming a generation of distinguished engineers and qualified researchers in the field of chemical and environmental engineering.

B. Prepare graduates for professional careers and a lifetime of learning.

C. Assist the graduates ability for help in the sustainable development of the nation.
D. Develop a sense of citizenship, support team spirit, respect time and act as a way of life and progress.
E. Participate in achieving the development plan, putting science at its service to develop the society scientifically and culturally, and providing environmental services to new urban communities.
F. Developing human capabilities to meet the needs of new societies, including chemical and environmental engineers.

2.4 Program Graduate Attribute:

A. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations;
B. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation;
C. Behave professionally and adhere to engineering ethics and standards;
D. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance;
E. Recognize his/her role in promoting the engineering field and contribute in the development of the profession and the community;
F. Value the importance of the environment, both physical and natural, and work to promote sustainability principles;
G. Use techniques, skills and modern engineering tools necessary for engineering practice;
H. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies;
I. Communicate effectively using different modes, tools and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner;
J. Demonstrate leadership qualities, business administration and entrepreneurial skills;

2.5 Graduate Competencies According to NARS 2018

According to NARS 2018, a graduate must be able to:

A1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.
A2. Develop and conduct appropriate experimentation and/or simulation, analyze, and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.
A3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

A4. Utilize contemporary technologies, codes of practice, and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

A5. Practice research techniques and methods of investigation as an inherent part of learning.

A6. Plan, supervise, and monitor implementation of engineering projects, taking into consideration other trades requirements.

A7. Function efficiently as an individual and as a member of multi-disciplinary and multicultural teams.

A8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools .

A9. Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10. Acquire and apply new knowledge; and practice self, lifelong and other learning strategies

In addition to the competencies of most engineering programs, the engineering CEE program has some special competencies, which are as follows:

B1. Design a practical chemical engineering system, component or process utilizing a full range of chemical engineering principles and techniques including: Mass and Energy Balance, Thermodynamics, Mass Transfer, Heat Transfer, Momentum Transfer, Kinetics of Chemical Reactions, Reactor Design, Instrumentation and Control of Chemical Processes, and Process and Plant Design.

B2. Engage in the recent technological changes and emerging fields relevant to chemical engineering to respond to the challenging role and responsibilities of a professional chemical engineer.

B3. Apply numerical modeling methods and/or computational techniques appropriate to chemical engineering.

B4. Adopt suitable national and international standards and codes to: design, operate, inspect and maintain chemical engineering systems.

3. Course Coding System

The following figure shows courses coding system according to reference framework NARS 2018, where the course code is composed of three letters and three digits. The letters indicate the course specialization department. The first digit indicates the year 0, 1, 2, 3, or 4. The second digit between 1 and 9 displays the discipline in the major. The third digit is the course sequence in each discipline. The following must be considered:-

1. The letters indicate the majors in which the degree is given but some of these represent university requirements, college requirements, or specialized courses.
2. Course descriptions refer to the semester in which this course is usually given, but these dates are subject to change, as not all courses are taught every year, and before the start of each semester, college affairs show students the courses tables that will be taught in this semester, their teaching times and those in charge of teaching

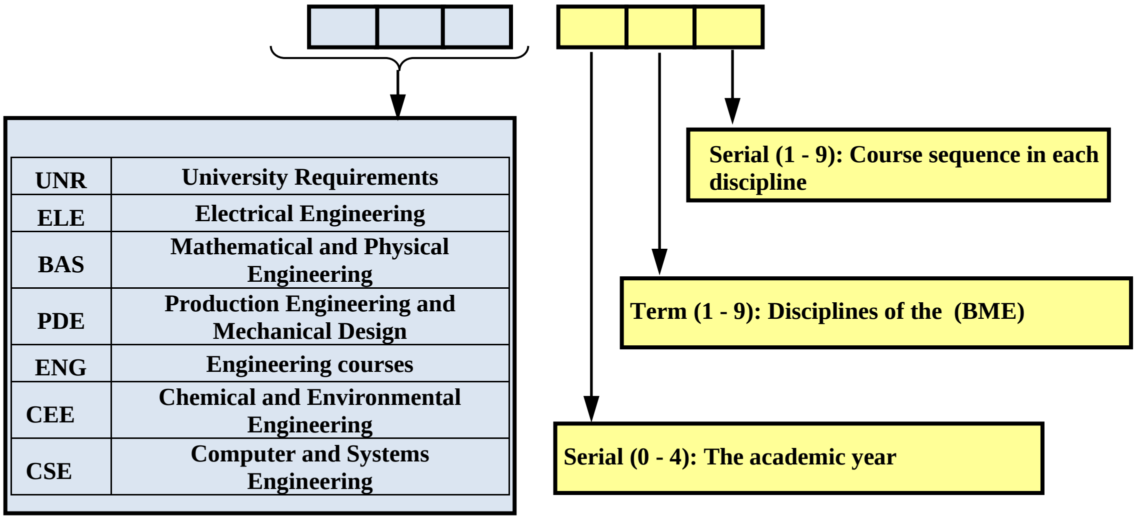


Figure (1): Courses coding system

4. The Program Plan Description

The study plan of the CEE Program at the College of Engineering, Mansoura University involves different requirements for the university, the college, and the department, as well as courses which satisfy these requirements. Also, the study plan includes the credit units for all courses and the distribution of these credit units on the Five studying levels (Years).

To prepare the student for the above targeted Educational Objectives, a set of program outcomes, that describes what students are expected to know and is able to do by the time of graduation, have been adopted. The student must successfully pass a number of courses totaling 160 credit hours in order to obtain a bachelor's degree in chemical and environmental engineering from the Faculty of Engineering, Mansoura University.

4.1. The University Requirements

The main purpose of university education is not only to prepare students for successful careers but also to provide them with the knowledge and skills necessary to develop a rational and successful personal identity. In addition, Mansoura University assists students in gaining an appreciation of the natural and cultural environments in which they live and their roles in society and community services. The university's requirements for bachelor's programs consist of 13 credit hours (8.12% of the total 160 credit hours), which are met by completing six (6) courses. Tables (1), shows the courses credit units, Total SWL and marks distribution for the university.

Table (1): The University Requirements (13 Credit)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	semester Works	Lab	Final
UNR061	English (1)	2	5	20	30	--	50
UNR062	English (2)	2	5	20	30	--	50
UNR171	History of Engineering and Technology	1	2	20	30	--	50
UNR281	Law and Human Rights	2	4	20	30	--	50
UNR241	Communication and Presentation Skills	2	5	20	30	--	50
UNR461	Ethics and Morals of The Profession	2	4	20	30	--	50
UNR471	Marketing	2	4	20	30	--	50
Total		**13**	**29**				

4.2. The College Requirements

Table (2) indicate the college requirements which contain basic science courses and basic engineering science courses.

Table (2): The College Requirements (45 Credit)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	semester Works	Lab	Final
BAS011	Mathematics (1)	3	8	20	30	--	50
BAS021	Mechanics (1)	3	8	20	30	--	50
BAS012	Mathematics (2)	3	8	20	30	--	50
BAS022	Mechanics (2)	3	8	20	30	--	50
BAS031	Physics (1)	3	9	20	20	10	50
BAS032	Physics (2)	3	9	20	20	10	50
BAS041	Engineering Chemistry	3	9	20	20	10	50
PDE051	Production Engineering	3	8	20	20	10	50
PDE052	Engineering Drawing	3	10	20	30	--	50
ENG111	Technical Reports Writing	2	6	20	30	--	50
BAS113	Mathematics (3)	3	8	20	30	--	50
BAS114	Mathematics (4)	3	8	20	30	--	50
BAS115	Statistics and Probability Theory	2	6	20	30	--	50
ELE151	Electrical Power and Machines	3	8	20	30	--	50
BAS215	Mathematics (5)	3	8	20	30	--	50
ENG412	Project Management	2	6	20	30	--	50
Total		**45**	**127**				

4.3. The Program Requirements (Core Courses)

Table (3) shows the courses distribution according to the specializations in CEE which include:

- Basic courses in chemical engineering
- Transport Phenomena and Separation processes
- Modeling and design operations courses
- Elective Courses
- Training and graduation projects

Table (3): CEE Requirements (Core Courses) Based on Disciplines

Code	Course Name	Credit	Total SWL	Marks Distribution				Groups Name
				Mid Term	semester Works	Lab	Final	
CSE042	Introduction to Computer Systems	3	9	20	20	10	50	Basic Chemical Engineering Courses (1)
CEE111	Organic Chemistry	3	10	20	30	10	50	
CEE112	Physical Chemistry	3	9	20	30	--	50	
CEE113	Introduction to Chemical Engineering	3	9	20	30	--	50	
CEE114	Material Science	3	8	20	30	--	50	
CEE115	Chemical Engineering Thermodynamics	3	10	20	20	10	50	
CEE216	Chemical Engineering Process safety	3	9	20	30	--	50	
CEE317	Chemical Industries	3	8	20	30	--	50	
CEE221	Momentum Transfer	3	11	20	20	10	50	Transport Phenomena& Separation processes (2)
CEE222	Heat Transfer	3	10	20	20	10	50	
CEE223	Mass Transfer	3	10	20	20	10	50	
CEE224	Common Mechanical Operation	3	9	20	30	--	50	
CEE325	Separation Processes	3	9	20	30	--	50	
CEE331	Computer Application in Chemical	3	9	20	20	10	50	Processes Design & Modelling (3)
CEE332	Modeling and simulation in Chemical	3	10	20	50	10	50	
CEE333	Kinetics and Reactor Design	3	9	20	30	--	50	
CEE334	Corrosion Engineering	3	7	20	30	--	50	
CEE435	Process Control in Chem.	3	7	20	30	--	50	
CEE436	Petrochemical Engineering	3	7	20	30	--	50	
CEE437	Plant Design and Economics	3	7	20	30	--	50	
CEE141	Environmental Chemistry	3	8	20	30	--	50	Environmental Engineering (4&5)
CEE142	Environmental Impact Assessment	2	6	20	30	--	50	
CEE243	Water and wastewater Treatment Engineering.	3	10	20	20	10	50	
CEE244	Environmental Risk Assessment	2	7	20	30	--	50	
CEE245	Solid and Hazard Waste Management	3	9	20	30	--	50	
CEE346	Clean Production	2	5	20	30	--	50	
CEE347	Air Pollution Control	3	9	20	30	--	50	
CEE348	Environmental Performance	2	4	20	30	--	50	
CEE361	Elective (1)	3	9	20	30	--	50	Elective Courses (6 and 7)
CEE362	Elective (2)	3	9	20	30	--	50	
CEE463	Elective (3)	3	9	20	30	--	50	

CEE464	Elective (4)	3	9	20	30	--	50	
CEE291	Training (1)	2	25	--	50	--	50	Training & project (9)
CEE392	Training (2)	2	25	--	50	--	50	
CEE493	Senior Project (1)	3	17	--	50	--	50	
CEE494	Senior Project (2)	3	17	--	50	--	50	
Total		**102**	**355**					

4.4. Elective Courses

Tables (4) and (5) shows a list of elective courses that a student can choose for elective courses.

Table (4): List of Elective Courses (1 and 2)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	semester Works	Lab	Final
CEE371	Water Desalinations	3	9	20	30	--	50
CEE372	Energy Technology	3	9	20	30	--	50
CEE373	Petroleum Engineering	3	9	20	30	--	50
CEE374	Catalysts and Catalytic Processes	3	9	20	30	--	50

Table (5): List of Elective Courses (3 and 4)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	semester Works	Lab	Final
CEE475	Biochemical Engineering	3	9	20	20	--	50
CEE476	Natural Gas Engineering	3	9	20	30	--	50
CEE477	Design of Heat Exchanger	3	9	20	30	--	50
CEE478	Polymer Engineering	3	9	20	30	--	50

4.5. Mapping of Courses to Competencies

Program competencies are enlisted in the first row of the table (by their code number: a1, a2…etc.), then the course titles or codes are enlisted in first column, and an "x" mark is inserted where the respective course contributes to the achievement of the program competencies.

Level	Course Code	Course Title	Graduate Competencies According to NARS 2018													
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4
000	UNR061	English Language (1)								√						
	BAS011	Mathematics (1)	√													
	BAS021	Mechanics (1)	√													
	BAS031	Physics (1)	√	√												
	BAS041	Engineering Chemistry	√	√												
	PDE052	Engineering Drawing	√		√											
	UNR062	English Language (2)								√						
	BAS012	Mathematics (2)	√													
	BAS022	Mechanics (2)	√													
	BAS032	Physics (2)	√	√												
	CSE042	Introduction to Computer Systems	√				√									
	PDE051	Production Engineering	√	√		√										
100	UNR171	History of Engineering and Technology				√	√			√		√				
	BAS113	Mathematics (3)	√													
	BAS115	Probability Theory and Statics	√	√				√								
	CEE111	Organic Chemistry	√	√												
	CEE112	Physical Chemistry	√	√												
	CEE141	Environmental Chem.	√	√												
	CEE142	Environmental Impact Assessment	√			√										
	BAS114	Mathematics (4)	√													
	ENG111	Technical Report					√			√						

		Writing														
	ELE151	Electric Power and Machines	√	√												
	CEE113	Introduction to Chemical Eng.	√	√	√											
	CEE114	Material Science	√													
	CEE115	Chemical Eng. Thermodynamics	√	√			√									
200	UNR241	Communication and Presentation Skills						√	√	√	√	√				
	UNR281	Law and Human Rights	√				√		√	√		√				
	BAS215	Mathematics (5)	√	√												
	CEE221	Momentum Transfer	√	√			√									
	CEE243	Water and wastewater Treatment Engineering	√	√	√	√										
	CEE244	Environmental Risk Assessment	√			√	√									
	CEE216	Chemical Eng. Process Safety	√			√	√									
	CEE222	Heat Transfer	√	√			√									
	CEE223	Mass Transfer	√	√			√									
	CEE224	Common Mechanical Operation	√								√	√		√		
	CEE245	Solid and Hazard Waste Management	√			√						√				
	CEE291	Training (1)	√	√		√	√	√	√	√	√	√		√		
300	CEE325	Separation Processes	√								√			√		
	CEE331	Computer Application in Chemical Eng.	√								√	√		√	√	
	CEE346	Clean Production	√				√							√		
	CEE347	Air Pollution Control	√			√	√							√		
	CEE348	Environmental Performance Evaluation	√			√	√									
	CEE361	Elective (1)	√		√								√			

	CEE317	Chemical Industries	√		√						√			√		
	CEE332	Modeling and simulation in Chemical Eng.	√		√						√	√			√	
	CEE333	Kinetics and Reactor Design	√		√								√			
	CEE334	Corrosion Engineering	√		√								√			√
	CEE362	Elective (2)	√		√								√			
	CEE392	Training (2)	√	√		√	√	√	√	√	√	√		√		
400	UNR461	Ethics and Morals of the Profession	√			√	√		√	√	√	√				
	UNR471	Marketing	√	√		√	√	√	√	√	√	√				
	CEE435	Process Control in Chemical Engineering	√		√						√	√	√			
	CEE463	Elective (3)	√		√		√				√	√	√	√		
	CEE493	Senior Project (1)	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	ENG412	Project Management	√	√	√	√	√	√	√	√	√					
	CEE436	Petrochemical Engineering	√		√	√							√			√
	CEE437	Plant Design and Economics	√		√								√			√
	CEE464	Elective (4)	√		√		√				√	√	√	√		
	CEE494	Senior Project (2)	√	√	√	√	√	√	√	√	√	√	√	√	√	√

4.5.1. LEVEL 000

First Semester

Code	Course Name	Hours/Week					Prerequisites	Marks Distribution			
		Credit	Lecture	Tutorial	Lab.	Free work		Mid Term	Semester Work	Lab	Final
UNR061	English (1)	2	1	2	--	2	-------	20	30	--	50
BAS011	Mathematics (1)	3	2	2	--	4	-------	20	30	--	50
BAS021	Mechanics (1)	3	2	2	--	4	-------	20	30	--	50
BAS031	Physics (1)	3	2	1	1.5	4.5	-------	20	20	10	50
BAS041	Engineering Chemistry	3	2	1	1.5	4.5	-------	20	20	10	50
PDE052	Engineering Drawing	3	2	2	--	6	-------	20	30	--	50
Total		**17**	**11**	**10**	**3**	**25**					
Total Contact hours = 24 hrs/week Total SWL = 49 hrs/week											

Second Semester

Code	Course Name	Hours/Week					Prerequisites	Marks Distribution			
		Credit	Lecture	Tutorial	Lab.	Free work		Mid Term	Semester Work	Lab	Final
UNR062	English (2)	2	1	2	--	2	UNR061	20	30	--	50
BAS012	Mathematics (2)	3	2	2	--	4	BAS011	20	30	--	50
BAS022	Mechanics (2)	3	2	2	--	4	BAS021	20	30	--	50
BAS032	Physics (1)	3	2	1	1.5	4.5	---------	20	20	10	50
CSE042	Intro. to Comp. Systems	3	2	1	1.5	4.5		20	20	10	50
PDE051	Production Engineering	3	2	--	3	3	----------	20	30	--	50
Total		**17**	**11**	**8**	**6**	**22**					
Total Contact hours = 25 hrs/week Total SWL = 47 hrs/week											

4.5.2. LEVEL 100

Third Semester

Code	Course Name	Hours/Week					Prerequisites	Marks Distribution			
		Credit	Lecture	Tutorial	Lab.	Free work		Mid Term	Semester Work	Lab	Final
UNR171	History of Eng. and Technology	1	1	--	--	1	----------	20	30	--	50
BAS113	Mathematics (3)	3	2	2	--	5	BAS012	20	30	--	50
BAS115	Statistics and Probability Theory	2	1	2	--	3	BAS012	20	30	--	50
CEE111	Organic Chemistry	3	2	--	3	4		20	30	--	50
CEE112	Physical Chemistry	3	2	2	--	5	BAS041	20	30	--	50
CEE141	Environmental Chem.	3	2	2	--	4	---	20	30	--	50
CEE142	Environmental Impact Assessment	2	2	--	--	2	--	20	30	--	50
Total		**17**	**12**	**8**	**3**	**24**					
Total Contact hours = 23 hrs/week Total SWL = 47 hrs/week											

Fourth Semester

Code	Course Name	Hours/Week					Prerequisites	Marks Distribution			
		Credit	Lecture	Tutorial	Lab.	Free work		Mid Term	Semester Work	Lab	Final
BAS114	Mathematics (4)	3	2	2	--	5	BAS113	20	30	--	50
ENG111	Technical Reports Writing	2	1	2	--	4	UNR062	20	30	--	50
ELE151	Electrical Power and Machines	3	2	2	--	4	-------	20	30	--	50
CEE113	Introduction to Chemical Eng.	3	2	2	--	5	-------	20	30	--	50
CEE114	Material Science	3	2	2	--	4	CEE 111	20	30	--	50
CEE115	Chemical Eng. Thermodynamics	3	2	--	3	4	CEE 112	20	20	10	50
Total		**17**	**12**	**8**	**3**	**26**					
Total Contact hours = 23 hrs/week Total SWL = 49 hrs/week											

4.5.3. LEVEL 200

Fifth Semester

Code	Course Name	Hours/Week					Prerequisites	Marks Distribution			
		Credit	Lecture	Tutorial	Lab.	Free work		Mid Term	Semester Work	Lab	Final
UNR241	Communication and Presentation Skills	2	1	2	--	3	------------	20	30	--	50
UNR281	Law and Human Rights	2	2	--	--	2	------	20	30	--	50
BAS215	Mathematics (5)	3	2	2	--	5	BAS113	20	30	--	50
CEE221	Momentum Transfer	3	2	--	3	3	----	20	20	10	50
CEE243	Water and wastewater Treatment Engineering	3	2	--	3	4	CEE141	20	20	10	50
CEE244	Environmental Risk Assessment	2	2	--	--	4	-----	20	30	--	50
Total		**15**	**11**	**4**	**6**	**21**					
Total Contact hours = 21 hrs/week Total SWL = 42 hrs/week											

Sixth Semester

Code	Course Name	Hours/Week					Prerequisites	Marks Distribution			
		Credit	Lecture	Tutorial	Lab.	Free work		Mid Term	Semester Work	Lab	Final
CEE216	Chemical Eng. Process Safety	3	2	2	--	4	----	20	30	--	50
CEE222	Heat Transfer	3	2	--	3	4	CEE115	20	20	10	50
CEE223	Mass Transfer	3	2	--	3	4	CEE221	20	20	10	50
CEE224	Common Mechanical Operation	3	2	2	--	5	----	20	30	--	50
CEE245	Solid and Hazard Waste Management	3	2	2	--	4	CEE141	20	30	--	50
CEE291	Training (1)	2	--	--	--	--	In summer		50		50
Total		**17**	**10**	**6**	**6**	**21**					
Total Contact hours = 22 hrs/week Total SWL = 43 hrs/week											

4.5.4. LEVEL 300

Seventh Semester

Code	Course Name	Hours/Week					Prerequisites	Marks Distribution			
		Credit	Lecture	Tutorial	Lab.	Free work		Mid Term	Semester Work	Lab	Final
CEE325	Separation Processes	3	2	2	--	5	CEE221	20	30	--	50
CEE331	Computer Application in Chemical Eng.	2	2	--	3	4	---	20	30	10	50
CEE346	Clean Production	2	2	--	--	4	----	20	30	--	50
CEE347	Air Pollution Control	3	2	2	--	5	----	20	20	--	50
CEE348	Environmental Performance Evaluation	2	2	--	--	4	----	20	30	--	50
CEE361	Elective (1)	3	2	2	--	5	CEE223	20	30	--	50
Total		**15**	**12**	**6**	**3**	**27**					
Total Contact hours = 21 hrs/week Total SWL = 48 hrs/week											

Eighth Semester

Code	Course Name	Hours/Week					Prerequisites	Marks Distribution			
		Credit	Lecture	Tutorial	Lab.	Free work		Mid Term	Semester Work	Lab	Final
CEE317	Chemical Industries	3	3	--	--	5	----	20	30	--	50
CEE332	Modeling and simulation in Chemical Eng.	3	2	--	3	4	CEE331	20	20	10	50
CEE333	Kinetics and Reactor Design	3	2	2	--	5	CEE223	20	30	--	50
CEE334	Corrosion Engineering	3	2	2	--	5	----	20	30	--	50
CEE362	Elective (2)	3	2	2	--	5	CEE223	20	30	--	50
CEE392	Training (2)	2	--	--	--	--	In summer		50		50
Total		**17**	**11**	**6**	**3**	**24**					
Total Contact hours = 20 hrs/week Total SWL = 44 hrs/week											

4.5.5. LEVEL 400

Ninth Semester

Code	Course Name	Hours/Week					Prerequisites	Marks Distribution			
		Credit	Lecture	Tutorial	Lab.	Free work		Mid Term	Semester Work	Lab	Final
UNR461	Ethics and Morals of The Profession	2	2	--	--	4	----	20	30	--	50
UNR471	Marketing	2	2	--	--	4	-------	20	30	--	50
CEE435	Process Control in Chemical Engineering	3	3	--	--	5	CEE332	20	30	--	50
CEE463	Elective (3)	3	2	2	--	5	CEE361	20	30	--	50
CEE493	Senior Project (1)	3	1	--	6	3	CEE331, CEE332 CEE333	--	50	--	50
Total		**13**	**10**	**2**	**6**	**21**					
Total Contact hours = 18 hrs/week Total SWL = 39 hrs/week											

Tenth Semester

Code	Course Name	Hours/Week					Prerequisites	Marks Distribution			
		Credit	Lecture	Tutorial	Lab.	Free work		Mid Term	Semester Work	Lab	Final
ENG412	Project Management	2	2	--	--	4	Pass 90 Cr.	20	30	--	50
CEE436	Petrochemical Engineering	3	3	--	--	5	--------	20	30	--	50
CEE437	Plant Design and Economics	3	2	2	--	5	CEE333	20	30	--	50
CEE464	Elective (4)	3	2	2	--	5	CEE362	20	30	--	50
CEE494	Senior Project (2)	3	1	--	6	3	CEE493	--	50	--	50
Total		**14**	**10**	**4**	**6**	**22**					
Total Contact hours = 20 hrs/week Total SWL = 42 hrs/week											

4.5.6. Courses Dependency

Figures (2) illustrates the prerequisites requirement for CEE program courses.

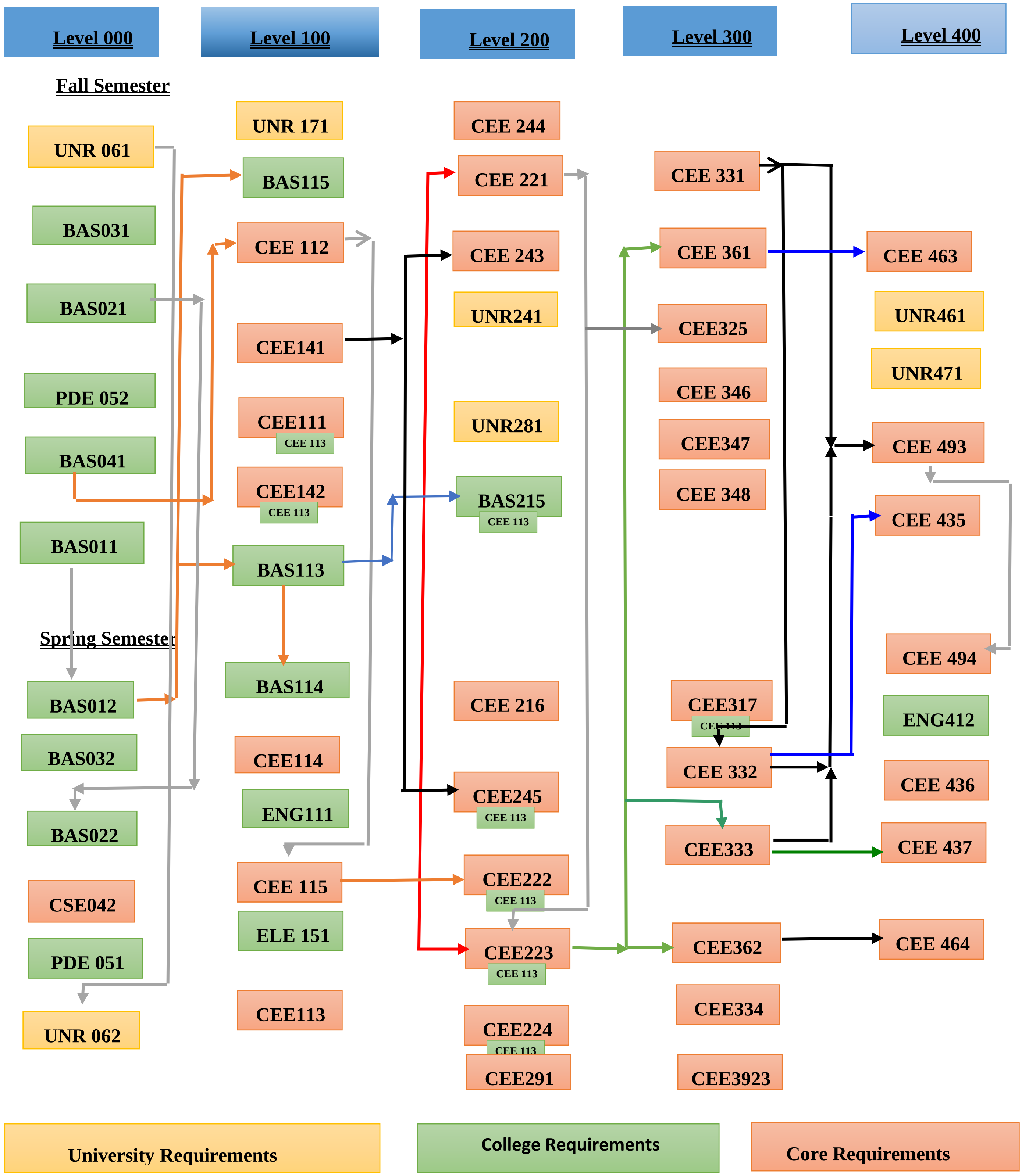


Figure (2) Courses Dependency for CEE Program

5. CEE Program Courses Syllabi

5.1. University Requirements:

UNR061	English (1)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---
Main skills of the English language - listening to short and long conversations - reading scientific passages - writing reports, summaries, and scientific articles - speaking and presenting new ideas									
References: - Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011									

UNR062	English (2)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	UNR061
Analysis and interpretation of engineering issues - summarizing engineering issues - preparation for language tests.									
References: - Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011									

UNR171	History of Engineering and Technology								Prerequisites
1 Cr	Lecture	1	Tutorial	--	Lab.	--	Semester	2nd	---
Engineering history: Art, Science, Engineering and technology - Role of engineering and technology in development and establishment of civilizations -Technology and environment - Examples on development of engineering activity.									
References: - Roger S. Kirby, Engineering in History, Dover Publications Inc. New York, United States, 1990, ISBN10 0486264122									

UNR281	Law and Human Rights								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	2ed	---
Systems and laws of institutions - Introduction to Accounting - Labor legislation and laws governing engineering professions - Industrial security legislation and environment - Historical philosophical origins of human rights - international sources of human rights - national sources of human rights - global bodies based on the protection of human rights.									

UNR241	Communication and Presentation Skills								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---
Communication skills- Presentation planning and preparation - Delivery skills such as eye contact, voice control, gestures, body language and appearance - Presenter's characteristics - Using visuals - Presentation structure - Elevator Pitch									
References: - Joan van Emden, Lucinda Becker, Presentation Skills for Students, 3rd Edition, Red Globe Press, 2016 - M. Wa Mutua, S. Mwaniki, P. Kyalo, B. Sugut, Communication Skills: A University									

Book, Succex Publishers, 2016
- Ian Tuhovsky, Wendell Wadsworth, Communication Skills Training, Ian Tuhovsky, 2015
- Tabitha Wambui, Alice W. Hibui, Elizaeth Gathuthi, "Communication skills " Vol.1, Students' coursebook, LAP LAMBERT Academic Publishing, 2012

UNR461	Ethics and Morals of The Profession								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	1st	---

General principles of professional ethics - Commitments to society - Responsibilities of the engineer - Detection of violations - Behavior - Case studies and general issues.

References:
- Lizabeth A. Stephan, David R. Bowman, William J. Park, Benjamin L. Sill, Matthew W. Ohland, "Thinking like an engineer", Published by Pearson 2018.
- Harris, C. E., Jr., Pritchard, M. S., & Rabins, M. J. Engineering Ethics. Second edition. Belmont, CA: Wadsworth, 2000

UNR471	Marketing								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	1st	---

Principles of biomedical products marketing - Marketing research - Biomedical customers buying behavior - Marketing mix - Plotting marketing strategy - Building marketing plan - Pinpointing the target market - Marketing on the world wide web - Branding strategy - Developing new products - Advertising and promotions - Costing and pricing strategies - Case studies on biomedical products marketing

References:
Principles of Marketing, University of Minnesota Libraries Publishing, 2015, ISBN 13: 9781946135193

5.2. Collage Requirements:

BAS011	Mathematics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Calculus: Function (definition - theorems) - Basic functions - limits - Continuity - Derivation - definition - theorems - types - higher orders - Applications on derivatives - partial derivatives - indefinite integral - theories and properties of integration.
Algebra: Binomial theorem (with any exponent and applications) - Partial Fractions - Theory of Equations - Matrices - System of linear equations - Gauss elimination method.

References:
- Akhtar & Ahsan, Textbook of Differential Calculus, second edition, 2009, PHI Learning Private Limited.
- Alan Jeffrey, Matrix operations for Engineers and Scientists, 2010, Springer Science & Business Media.

BAS021	Mechanics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Newton's laws - Types of forces، coplanar forces، Rectangular components of vector (1D, 2D, Space), Forces in space - Equilibrium of a particle - Conditions, Free-body diagram - Moment - Couple moment - Resultant of a system of forces and couples as a force and couple system - General procedure for reducing force and couple systems - Equilibrium of a rigid body - Conditions of equilibrium of a rigid-body، free body diagrams – friction

References:

- R.C. Hibbeler, "Engineering Mechanics: Statics and Dynamics, 14th Edition", Pearson Prentice Hall, New Jersey, 2016.
- J. L. Meriam, L. G. Kriage, and J. N. Botton, "Engineering Mechanics: Statics, 8th Edition", John Wiley & Sons, New York, 2016.

BAS012	Mathematics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	**BAS011**

Integral Calculus: Definite integral - Methods of integration - Applicationson definite integral (plane area - volume of revaluation - length of a plane curve - area of surfaces of revolution) - improper integral.

Analytic Geometry: Equations of second degree - Equation of pair of straight lines - Translation of axes - Conic sections - parabola - ellipse - hyperbola) Equation of plane - Equation of sphere.

References:

- Jumarie, G., Fractional Differential Calculus for Non-Differentiable Functions: Mechanics, Geometry, Stochastics, Information Theory. 2013: LAP Lambert Academic Publishing.
- Hestenes, D. and G. Sobczyk, Clifford algebra to geometric calculus: a unified language for mathematics and physics. Vol. 5. 2012: Springer Science & Business Media.
- Grossman, S.I., Multivariable calculus, linear algebra, and differential equations. 2014: Academic Press.

BAS022	Mechanics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	**BAS021**

Kinematics of a particle: curvilinear motion - Normal and tangential components. - Newton's laws - motion of projectiles - Work and energy of a particle - applications of friction.

References:

- R.C. Hibbeler, "Engineering Mechanics: Statics, 11th Edition", Pearson Prentice Hall, 2006.
- F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg, "Vector Mechanics for Engineering, Statics and Dynamics, 9th Edition", McGraw-Hill, New York, 2010.

BAS031	Physics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Material properties: Physical quantities - Standard units and dimensions - Mechanical properties for materials - Fluid properties - Periodic motion - Mechanical waves - Sound waves

- Waves in elastic media.

Heat and thermodynamics: Temperature measurements and thermometers - Thermal expansion - Specific and latent heat - Heat transfer - Gas motion theory - First law of thermodynamics - Entropy and second law of thermodynamics.

References:

- Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 6th Edition, Thomson Brooks/Cole 2014.
- Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.

BAS032	**Physics (2)**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Electricity and Magnetism: Electric charge - Electric force - Electric field- Column's law- Electric flux- Gauss law- Electric potential- Electric capacitance and Dielectrics - Ohm's law and simple circuits- Magnetic field - Baiot and Savart laws.

Optics and Modern physics: Nature of light and laws of geometric optics - Interference - Diffraction - polarization - optical fiber - laser - photoelectric effects - principle of quantum theory - special theory of relativity.

References:

- Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 9th Edition, Thomson Brooks/Cole 2014.,
- Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.

BAS041	**Engineering Chemistry**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Equations of state-chemical thermodynamics - Material and energy balance in chemical processes- properties of solutions - Basic principles in electrochemistry and it's applications- selected topics in chemical industry.

References:

- Brown, L. T, LeMay H. E. Jr; Bursten, B. E.; Murphy, C.J., and Woodward, P.; " Chemistry The Central Science", Pearson International Edition (11th edn), Pearson Printice Hall, (2009).

PDE051	**Production Engineering**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	2ed	---

Introduction to the following processes (Casting- Forging- Metal filing - Machining- Forming- Woodworking)

References:

- Hitomi, Katsundo. Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics. Routledge, 2017.

PDE052	**Engineering Drawing**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Two-dimensional drawings - Free-hand sketching - Sectional views - Auxiliary views and conventions - Computer-aided drawing (CAD) of 2D and 3D figures.

References:
- Mcgraw-hill Mint, "Mechanical Drawing Board & CAD Techniques", Student Edition,2011

ENG111	**Technical Reports Writing**								**Prerequisites**
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	2^{ed}	UNR062
Technical writing defenition - audience analysis - technical writing styles - technical document characteristics - automated document organization - official and unofficial document types - structure of different types of technical documents.									

References:
- G. J. Alred, W. E. Oliu, The Handbook of Technical Writing, 12th Edition, Bedford/St. Martin's; 2018
- K. Hyland, Teaching and researching writing. 3rd edition Routledge academic publisher, 2016
- M. Markel, Technical Communication, 11th edition, MacMillan, 2015.

BAS113	**Mathematics (3)**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1^{st}	**BAS012**
Applications of partial differentiation - Maximum values of functions in more than one variable and applications - First order differential equations - Second order differential equations - Laplace transform and its applications - Analytical geometry in space.									

References:
- D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.
- S. A. Wirkus, and R. J. Swifi, "A Course of Ordinary Differential Equations", Taylor & Francis Group, LLC, 2015.

BAS114	**Mathematics (4)**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2^{ed}	**BAS113**
Fourier series - Fourier transform - Complex numbers - Functions of a complex variable - Complex integration - Residue theorem - Direction derivatives - Double integrals - Triple integrals - Line integrals - Surface integrals.									

References:
- J. Brown, and R. Churchill, "Complex Variables and Applications", 9th Edition, McGraw-Hill, 2013.
- D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.

BAS115	**Statistics and Probability Theory**								**Prerequisites**
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1^{st}	**BAS012**
Measures of tendency and dispersion - Probability distributions - Sampling theorem - tests of hypothesis - non-parametric tests - regression and correlation - time series.									

References:
- Mary C. Meyer, Probability and Mathematical Statistics: Theory, Applications, and Practice in RSBN-10: 1611975778, SIAM (June 24, 2019)

ELE151	Electrical Power and Machines							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester 2ed	---

Power: Electrical power systems - three phase systems - Theory and models of transformers - Transmission line models - Voltage and frequency control - effective and ineffective power - Optimal work of power systems.
Machines: The theory of operation ، The construction of the Direct Current motors. The speed، torque، and current characteristics - applications of the DC motors. The theory of operation and construction of stepper motors - Permanent-magnet DC motor and Low-inertia DC Motors. The theory of operation، construction of three phase induction motors.

References:

- Nilsson, J.W. and S.A. Riedel, Electric circuits. 2015: Pearson Upper Saddle River, NJ.
- Slade, P.G., Electrical contacts: principles and applications. 2017: CRC press.

BAS215	Mathematics (5)							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester 1st	BAS113

Numerical solution of linear and non-linear systems of equations - Iterative methods - Curve fitting: Least square of (Straight lines, Polynomials), Linearization of nonlinear relationship. Interpolation and polynomial approximation -finite difference operators - Numerical integration and differentiation.

References:

- Mazumder, Numerical Methods for Partial Differential Equations,Finite Difference and Finite Volume Methods, science direct ,2016.
- Sheldon Rose, A First course in probability, Eighth edition, 2010, Pearson Prentice Hall.

ENG412	Project Management							Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester 1st	---

Fundamentals of biomedical project management - Integration management - Scope management - Time management - Cost management - Quality management - Human resources management - Communication management - Risk management - Procurement management - Biomedical projects case studies

References:

- Kerzner, H. and H.R. Kerzner, Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons, 2017.
- Kalpakjian, S., K. Vijai Sekar, and S.R. Schmid, Manufacturing Engineering and technology. Pearson, 2014.
- Nigel J. Smith, "Engineering Project Management", 3rd Edition, Wiley-Blackwell, ***2008.***

5.3. CEE Program Requirements

5.3.1. CEE Program Compulsory courses

CSE042	Introduction to Computer Systems							Prerequisites
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester 2ed	---

Introduction to the design and operation of digital computers: types of data and its representation and number systems - the basic components of the computer and the organization of the computer and the ways of transfer of information- programming with Visual Basic - Introduction to information networks

Introduction to Programming: Program Structure and Command Types - Presentation of key commands - simple software development Training Fundamentals: Dealing with Common Operating Systems (Windows – Linux) - Software Development and Desktop Software
References: - Peter Van Roy, Seif Haridi, "Concepts, Techniques, and Models of Computer Programming" The MIT Press (February 20, 2012)

CEE111	Organic Chemistry								Prerequisites
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	1st	---
Introduction to organic compounds composition . organic reactions and its mechanism - types of carbon bonds - electronic theory of valence - Aromatic hydrocarbons - resonance and electronic displacement - paraffin, Olefins aldehydes ketones, carboxylic acids, alcohols, phenols - radical isomerism methods of analysis of organic compounds using (U.V), chromatographic analysis and magnetic resonance - enzymes - catalysts biochemistry for carbohydrates , proteins , fats and oils - kinetics of biochemical reactions.									
References: - Wade ، Jr. L. G, "Organic Chemistry". 6th edn. Prentice Hall, (2006).									

CEE112	Physical Chemistry								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	**BAS041**
Concept of equationsof state and its application in case of ideal gas and deviation from ideality - phases equilibrium and its diagram - ideal solution and its deviations from ideality - general properties of solution - fugacity - activity of ideal solution - activity coefficient - additional properties - dynamic equilibrium and its application in physical and chemical changes: equilibrium calculations of gas and liquid -Reaction Kinetics.									
References: - Mortimer R.G. ، "Physical Chemistry", Elsevier ، 3rd Ed. (2008), ISBN-13: 978-0123706171									

CEE113	Introduction to Chemical Engineering								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---
Basics of mass balance: processes and systems variable: mass, volume, flow rates, chemical composition, pressure - Mass balance models of continuous and discontinues. **Basics of energy balance**: forms of energy -energy balance for non-interactive systems - changes in the temperature and pressure - energy balance for interactive systems - heat of reaction - heat of formation - heat of combustion.									
References: - David M. Himmelblau James B. Riggs Basic Principles and Calculations in Chemical Engineering, Prentice Hall, 7th ed 2003, ISBN-10: 0131406345									

CEE141	Environmental Chemistry								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	**CEE011**

Basic concepts from colloidal chemistry: methods of formations, colloidal dispersions in liquid, colloidal dispersion in air - basic concepts from biochemistry: enzymes and cofactors, biochemistry of carbohydrates and proteins, biochemistry of fats and oils, general biochemical pathways - Volumetric analysis, gravimetric analysis, turbidimetry, colorimetry, photometry, atomic absorption, emission methods, dispersion and scattering, fluorimetry, electrochemical methods, polarography, chromatography, nuclear magnetic resonance (nmr), X-ray analysis - Study of some environmental indicator and their significance and methods of determination: turbidity, color, pH, acidity, alkalinity, hardness, chlorine, chlorides, dissolved oxygen, biological oxygen demand (BOD), chemical oxygen demand (COD), nitrogen, solids, iron and manganese, fluorides, sulphates, phosphorus and phosphate – Grease – Volatile acids – Gas analysis – Trace inorganic.

References:

- Paul L. Bishop, "Pollution prevention: Fundamentals and Practice” Waveland Pr Inc., 2004,

CEE142	Environmental Impact Assessment								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	1st	--

Basic concept and principles - The legislative framework of EIA - Costs and benefits of EIA - The EIA process - Linking EIA to other environmental management tools.

References:

- Edinburgh David Tyldesley, A handbook on environmental Impact Assessment, 2005 2nd Edition, Natural Heritage Management.

CEE114	Material science								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	**CEE111**

Organic polymer : long chain molecules - types of plastic materials - mechanical properties of polymer, cross - linking- electrical properties - formation and growth of crystals - equilibrium curve of iron and carbon - Alloys - Ceramics: Crystaline structure of ceramic materials - Ion electrical conductivity of ceramic materials - Electrical insulating properties - Thermal properties - Application of composite materials - Nano-martial : Concept of nanomaterials - properties associated with the bulk partials fundamental, carbon Nano tubes.

References:

- Callister ، Jr. W.D, "Materials Science & Engineering", 7th ed., (2007) John Wiley & Sons.

CEE115	Chemical Engineering Thermodynamics								Prerequisites
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	2ed	**CEE112**

Concept of internal energy and the first law of thermodynamics - concept of entropy and the second law of thermodynamics - The free energy and chemical equilibrium - spontaneous chemical reaction - thermodynamics functions and the first law of thermodynamics- the thermodynamics analysis of chemical reactions- power and refrigeration cycles- steam cycles - Gas power cycles - gas turbine cycles - The Carnot Principles - The Carnot Cycle- The Reversed Carnot Cycle.

References:

- J.M. Smithjavascript:void(0), Hendrick Van Ness, Michael Abbott, Introduction to Chemical Engineering Thermodynamics, Mcgraw-Hill Chemical Engineering Series, 7th Edition, 2010.

CEE221	**Momentum Transfer**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	1st	---

Static fluid - general molecular equation of transfer phenomena (momentum temperature , mass) - the viscosity of the fluid - flow patterns - Reynolds s number - the overall mass balance and continuity equation - the overall energy balance - the overall momentum balance in thin layers flow - design equation for thin layers - flow and turbulent flow in tubes -flow of compressible gases - fluid past solid body and through fluidized bed - measurement of the rate of fluid flow - pumps instruments of agitation and mixing of fluid and the power required - non-Newton liquid flow . the differentiated form for equation of momentum transfer - the dimensional analysis in momentum transfer phenomenon.

References:

- F. A. Holland &Dr R. Bragg, Fluid Flow for Chemical Engineers, Second edition, 1995

CEE243	**Water and Wastewater Treatment Engineering**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	1st	**CEE141**

Introduction for potable water supply treatment process – Physical processes: screening, mixing, sedimentation, membrane separation – Chemical process: coagulation, chemical precipitation, disinfection, ion exchange – Desalination processes: membrane separation, evaporation, reverse osmosis, ion exchange – Development of process design parameters.
Principles of biological oxidation: organics removal mechanisms, the mechanisms of organic removal by bio-oxidation, sludge-quantity considerations, nitrification and denitrification, development of process design parameters – Biological wastewater-treatment processes: lagoons and stabilization basins, aerated lagoons, activated sludge processes, trickling filtration, rotating biological contactors, anaerobic decomposition – Adsorption: theory of adsorption, properties of activated carbon, the PACT process – Ion exchange – Chemical oxidation– Sludge handling and disposal – Miscellaneous treatment processes: land treatment, deep-well disposal, membrane processes, phosphorous removal, filtration.

References:

- Metcalf & Eddy Wastewater Engineering: Treatment, Disposal and Reuse., 4th Edition , 2010.

CEE244	**Environmental Risk Assessment**								**Prerequisites**
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	2nd	---

Introduction to Risk Management and Environment - Linking Risk Analysis and Risk Management - Structuring a Decision Problem - Benefit-Cost Analysis - Technological Risk Assessment - Strategies for Dealing with Extreme Events - Decision Making for Extreme Events in Organizations - Environmental Impact Assessment - Participants in environmental management and Approaches to environmental management - Pollution Management - Waste Management - Emerging environmental issues.

References:

- Vlasta Molak Fundamentals of Risk Analysis and Risk Management, CRC Press; 1st edition, 1996

CEE245	Solid and Hazard Waste Management								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	CEE141

Solid waste: type, quantities, trends, environmental stress –collection of solid waste, Sources and assembly of solid waste - soft waste treatment - Material and energy recovery- Methods of sorting solid waste components for re-use them. Pretreatment of Solid waste - Treatment of Solid Waste - Final disposal: sanitary landfills, incineration, underground disposal, deep shallow water disposal, environmental stress, pollution issues (for all the four options)– Elimination (reduction) of solid wastes: change in production lines and life style, substitution/ reduction of package material, process/ product modification - Legislation relative to solid waste.

Characterization and rules regulation hazards waste - reduction hazardous waste volume and recovery useful materials - Hazardous waste system paths - selection appropriate physics, chemical and biological treatment: installation and hardening - Thermal processes - Chemical and thermodynamics incineration of hazardous - Operation of burial - Check of method of pollution treatment and analysis

References:

- LaGrega, Michael D., Phillip.L. Buckingham, and J.C. Evans. Environmental Recourse Management. Hazardous Waste Management. 2nd Edition.,.Wave Land Press, Inc. 2010.

CEE216	Chemical Engineering Process safety								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2nd	---

Introduction to processes safety and health - The safety of laboratories and inspection - Chemical, Mechanical and Electrical risks - Toxicology - Fire and explosions - Protection from risks - Emergency and Evacuation Plans - Application of hazard evaluation techniques - Personal protection equipment.

References:

- Crowl. D.A, Louvar. J.F,"Chemical Process Safety: Fundamentals with applications", Prentice Hall, (2002).

CEE222	Heat Transfer								Prerequisites
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	2nd	CEE115

Steady state heat transfer: mechanisms of heat transfer - heat transfer by conduction - heat transfer by conductivity in case of steady state - forced conviction heat transfer through tubes - forced convocation heat transfer outside bodies according to its shape - heat transfer by natural convection - boiling and condensation - heat exchangers - principle of radiation heat transfer - heat transfer in non-Newtonian fluid - special heat transfer coefficients - dimensional analysis and its application in heat transfer.Unsteady-state heat transfer: derivation of basic equation - heat transfer by conduction in case of unsteady geometrical shape.

References:

- Cengel. Y. A, "Heat Transfer", 2ed. , McGraw- Hill (2003)

CEE223	Mass Transfer								Prerequisites
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	2nd	**CEE221**

Fix law of molecule diffusion - Molecular diffusion in gas - Molecular dispersion in liquids - Dispersion in biological solution and gel molecular dispersion in solid materials - Unsteady state dispersion - Mass transfer coefficient - Mass transfer coefficient in different geometrical shapes - mass transfer in colloidal having small volumes - diffusion of gases through solid bodies and capillary tubes - Mass transfer between two phases and overall mass transfer coefficient - Dimension analysis in mass transfer process.

References:

- Christil J Geankolpis Transport Processes and Unit Operations, 2nd ed. Printice hall international, inc.,2006, ISBN 0-13-045253-X

CEE224	Common mechanical operation								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2nd	---

Classification of natural mechanical separation operations -Crushing and grinding - Fluid movement through a solid bed - Fluidization - settling sedimentation - centrifugation processes - Separation of suspended solids from gases - Mixing.

References:

Christil J Geankolpis Transport Processes and Unit Operations, 2nd ed. Printice hall international, inc.,2006, ISBN 0-13-045253-X

CEE291	Training (1)							Prerequisites
2 Cr	Lecture	--	Tutorial	--	Lab.	--	Semester	Summer for six weeks

Training on industrial establishments relevant to the program.

CEE325	Separation Processes								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	CEE221

Mass transfer operation between two phases and types of the unit operations which apply the mass transfer phenomenon- Separation processes between two content phases and in equilibrium for one stage and multistage which includes: adsorption - distillation - absorption - separation by membranes for gases, liquids, reverse osmosis solutions and application in water purification - crystallization - drying - Extraction.

References:

- Christien Geankopliis ، Pamela R. Toliver, "Transport processes and separation process principles", 4th Ed Pearson, (2003).

CEE346	Clean Production								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	1st	---

Application of industrial ecology to design for environment (DFE) of processes and pollution loads — Introduction of methodology for Life Cycle Assessment (LCA) of manufactured products — Analysis of several DFE and LCA case studies — Term project required on use of DFE/LCA on a specific product/process: product design complete with materials and process selection, energy consumption, waste loadings, LCA of an existing industrial or consumer product using a commercially established method.

References:

- Marc J. Rogoff, Solid Waste Recycling and Processing, ISBN: 978-1-4557-3192-3, 2nd edn, Copyright © 2014 Elsevier Inc.

CEE347	Air Pollution Control								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Air pollution from factories of extraction nickel from its ovens - pollution of air from factories and smelters of aluminum - air pollution from copper smelters - diffusion of air pollutant and dispersion - the basic theory of diffusion and dispersion of air pollutants - assess the effect of stationary sources of pollution on air quality - the basic principles of air pollutant control - command and control devices of air pollutant - methods of removal , book dust and fine size particles.

References:

- Vallero, Daniel A,"Fundamentals Of Air Pollution" 5th edition. Amsterdam ; Boston : Elsevier. 2014 ISBN:9780124046023

CEE348	Environmental Performance Evaluation								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	1st	---

Measurement of environmental performance: basic definitions, incentives and benefits, measures and indicators - Environmental performance indicators: international standard iso 14031, other international initiatives -Eco-efficiency: concept, driving forces and benefits, eco-efficiency indicators.

References:

- Philipp Weib and Jörg Bentlage, Environmental Management Systems and Certification, Printed by Nina Tryckeri, Uppsala 2006. ISBN 91-975526-3-1

CEE331	Computer Application in Chemical Engineering								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	1st	---

Measurement of environmental performance: basic definitions, incentives and benefits, measures and indicators –Environmental performance indicators: international standard iso 14031, other international initiatives –Eco-efficiency: concept, driving forces and benefits, eco-efficiency indicators.

References:

- Arun Datta, Process Engineering and Design Using Visual Basic®, Second Edition, 2013 , CRC Press

CEE317	Chemical Industries								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2ed	---

Industrial processes and flowchart including operation procedures and raw materials to option the final product for some organic and inorganic industries.

References:

- Shreev, R.N. & Brink, J.A. : Chemical Process Industries, 5th Edition, McGraw Hill, 1987.

CEE332	Modeling and Simulation Process								Prerequisites
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	2nd	**CEE331**

Important of modeling and simulation in chemical engineering systems and supported calculations by using computer - A high level of programming and ready software package tools.Introduction to water quality modeling - Reaction kinetics - Steady state solution - Response time - Feed forward systems of reactors - Modeling of the environment: Rivers and streams - BOD and oxygen saturation - Gas transfer and oxygen re-aeration.

References:

- Luyben W.L, "Process Modeling Simulation & Control". 2nd Ed. McGraw-Hill, (1996).

CEE333	Kinetics and Reactor Design								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2nd	**CEE223**

This course aims to establish fundamental knowledge for the students in chemical engineering through interpret and analyse chemical reaction kinetics data; apply reaction kinetics principles in chemical reaction engineering; identify and formulate problems in chemical reaction engineering and find appropriate solutions; specify size the most common industrial chemical reactors to achieve production goals for processes involving homogeneous or heterogenous reaction systems.

References:

- Fogler, H.S., “Elements of Chemical Reaction Engineering”, 4th Ed., Prentice Hall, Englewood Cliffs, New Jersey, 2006.

CEE392	Training (2)							Prerequisites
2 Cr	Lecture	--	Tutorial	--	Lab.	--	Semester	Summer for six weeks

Training on industrial establishments relevant to the program.

CEE334	Corrosion Engineering								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2nd	-----

Electrolyte and electrolytic transfer processes - Elyctrolytic conductivity Ostwald law of dilution - oxidation states - oxidation and reduction reactions - Equlibrium state of oxidation and reduction reactions - Voltaic cell - The eletromotive force for cells at standard conditions - The free energy and oxidation - reduction reactions - Nernest equation and its appliction for prediction the spontaneous prosesses and the electromotive force at normal conditions - Cocentration cells - Batteries and fuel celles - Electrolysis and nonspont. Oxidtion- reduction rections - The features of electrochemical corrosion: Polarization, application of thermodynamic principles on the corrrosion phenomena - Corrostion protection: Using suitable materials , change the nature of the medium , using the corrostion inhibitors, proper design, cathode protection , paints.

References:

- Pierre R. Roberge   Handbook of Corrosion Engineering McGraw-Hill Companies, Inc. 2000

CEE435	Process Control in Chemical Engineering								Prerequisites
3 Cr	Lecture	3	Tutorial	--	Lab.	--	Semester	1st	CEE332

Introduction to control systems - Dynamic modeling - Block diagram analysis, signal flow diagram - Transient response analysis: First and second order system - Routh stability criteria - Static error coefficients - Steady state error - Root Locus - Frequency response analysis - Nyquist stability (Polar Plots) - Stability analysis - Closed loop frequency response.

References:

- E. Seborg, T.F. Edgar, D.A. Mellichamp, Process Dynamics and Control. John Wiley, second edition, 2003.

CEE436	Petrochemical Engineering								Prerequisites
3 Cr	Lecture	3	Tutorial	--	Lab.	--	Semester	1st	---

The course cover the uses petroleum and its derivatives as raw materials to produce chemicals (e.g. ethylene, propylene, benzene, toluene), solvents, adhesives, detergents, plastics, polymers and fibers, lubricants, fertilizers, agrochemicals and *e*valuate the economical and marketing aspects of the petrochemical industry.

References:

- Uttam Ray Chaudhuri," Fundamentals of Petroleum and Petrochemical, Engineering", CRC Press, 2011

CEE493	Senior Project(1)								Prerequisites
3 Cr	Lecture	1	Tutorial	--	Lab	6	Semester	1st	CEE331, CEE332, CEE333

Problem formulation - Assignment of solutions - Data Collection - Application of appropriate project work.

References:

- To be determined by the supervisor according to the project topics

CEE437	Plant Design and Economics								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2nd	CEE333

Fixed cost accounting - Cost estimation profits - Investment cost - taxes - Insurance - Depreciation profitability - Investment alternatives and substation - optimum design - Design strategies - Determination of volume of apparatus and equipment and its cost.
Plant design process - optimum design and strategic design : proper design economically - design appropriate operationally - genial and practical considerations of design - design methodology - computer aided design.

References:

- Coulson & Richardson's. Chemical Engineering, volume 6, Fourth edition, R. K. Sinnott "Chemical Engineering Design", Elsevier Butterworth-Heinemann (2005).

CEE494	Senior Project(2)								Prerequisites
3 Cr	Lecture	1	Tutorial	--	Lab	6	Semester	2nd	CEE494
Completing the appropriate project work - Discuss and analyze the results - Writing the final reports.									
References: - To be determined by the supervisor according to the project topics									

5.3.2. CEE Program Elective courses

CEE371	Water Desalinations								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	--	---
Introduction to water resources & Desalination processes - Thermal Technologies: Single and Multi-Stage Flash (MSF) Technology - Process calculations and MSF performance parameters - Single and Multi-Effect Distillation (MED) Technology - Process calculations and MED performance parameters -Membrane Technologies: Osmosis and Reverse Osmosis (RO) - RO system performance parameters, Energy Recovery and pretreatment - Electro dialysis - Solar – Desalination Systems - Future desalination Technologies - Desalination problems (scaling, fouling, corrosion), and their mitigation.									
References: - Cipollina A., Micale G., Rizzuti L.: “Seawater Desalination: Conventional and Renewable Energy Processes”, Springer (2009)									

CEE372	Energy Technology								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	--	---
The course cover the efficiencies of both new and established energy generation and conversion methods− electricity generation by fossil fuels−nuclear, solar, wind and hydropower- Bioenergy and biogas- alternative energy technologies. The environmental consequences of energy choices on local, national and global scales, including toxic emissions, greenhouse gases and resource depletion are also discussed and integrated throughout the course.									
References: - Schaeffer, John.. Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living 30th ed.). Gaiam. 2007									

CEE373	Petroleum Engineering								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	--	---
This course presents a comprehensive introduction to petroleum refining technology and economics. The focus is on transportation fuels refineries, an overview of crude oil supply and petroleum product demand, a description of refinery process technology such as crude oil distillation, heavy oil conversion options, hydrotreating, and catalytic reforming.									
References: - James H. Gary, Glenn E. Handwerk, Mark J. Kaiser, Petroleum Refining: Technology and Economics, Fifth Edition 5th Edition, CRC press, 2007.									

CEE374	Catalysts and Catalytic Processes								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	--	---

This course starts with basics of catalysis and goes deeper into various aspects of catalytic preparation and characterization techniques. The course gives an introduction into catalysis and its relation to sustainable chemistry and focus on heterogeneous and homogeneous catalysis. Discusses what catalysis is and why catalytic processes are favourable over stoichiometric reactions. The basic concepts of catalysis are introduced based on examples from heterogeneous and homogeneous catalytic reactions.

References:

- Fogler, H.S., "Elements of Chemical Reaction Engineering", 4th Ed., Prentice Hall, Englewood Cliffs, New Jersey, 2006.

CEE475	Biochemical Engineering								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	--	---

Biological processes engineering - The final treatment for biological products – removal of microbial cell and other solid materials – Disintegration of cells- Methods of extraction and concentration – purification re-solidity and drying of biological mixtures – Thermodynamics characteristics of biological processes – mass transfer phenomena and design of biological reactors -Physical properties of biological reaction- biomass as source of protein organic and amino acids – the production and purification of enzymes.

References:

- Michael L. Shuler and Fikret Kargi Bioprocess Engineering Basic Concepts 2ed Ed. Prentice Hall PTR. 2002. ISBN 0-13-081908-5.

CEE476	Natural Gas Engineering								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	--	---

This course is designed to cover the Properties of natural gases, hydrate formation. Estimation of gas reserves. Gas well testing. Estimation of gas deliverability. Gas flow measurement. Natural gas deliverability. Natural gas transmission, design of gathering systems. Field treating and processing of natural gas.

References:

- W.C. Lyons ، G.J. Plisga ، ''Standard HandBook of Petroleum& Natural Gas Engineering''. Elsevier ، Second Edition ، (2005)

CEE477	Design of Heat Exchanger								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	--	CEE477

This course cover an description and applications of different heat exchangers in process industries. Design of double pipe heat exchanger (including extended surfaces). Detailed design procedures for shell and tube heat exchanger for single phase flow. Detailed design procedures for air coolers. Selection criteria for heat exchangers. Descriptive discussion of condensers, evaporators and reboilers, novel heat exchangers and other types of heat exchangers.

References:

- Kuppan Thulukkanam "Heat Exchanger Design Handbook", Dekker Mechanical Engineering, 2nd Edn Print ISBN-10: 1439842124

CEE478	Polymer Engineering								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	--	---

This course gives an overview of engineering analysis and design techniques for synthetic polymers. Enhanced the materials properties such as chemical, electrical, physical, and mechanical. Emphasis is placed on how the various synthetic methods are used to control structural features such as molecular weight, branching, crosslinking, and crystallinity.

References:

- R.J. Young & P.A. Lovell. Introduction to Polymers, 3rd Ed. CRC Press, 2011.

Chapter Eight:

A B. Sc. Program in Renewable and Sustainable Energy Engineering (RSE) with Credit Hours System

1. Introduction to the Program

Sustainable development is the main and nominal goal of the whole world, regional and international, countries and institutions. It is not forgotten that energy is the main engine and the active component of all growth and development. It is the basic element of all sectors of the economy and the companion of human life. So, energy has become a very valuable resource in the current era. Now most of the energy, used in the world as a whole, is conventional and unsustainable, as well as polluting the environment and causing harmful emissions. Since sustainable development is primarily based on protecting the environment, ensuring optimal use and fair distribution of resources between the current and subsequent generations, such conventional energy does not allow sustainable development. Sustainable development is the main and nominal goal of the whole world, regional and international countries and institutions. It is known that energy is the main engine of development. So, the search for new and renewable sources of energy has begun. These renewable energy resources must preserve the environment and ensure its sustainability, achieve fair distribution between successive generations, provide new jobs, meet the growing demand for energy, and thus achieve sustainable development. So many countries began to make great steps towards establishing and developing renewable energy sources especially the solar and wind energy. There is a growing effort towards measuring energy efficiency in systems, products and buildings to ensure minimizing that operating costs while maximizing the environmental and financial savings.

Renewable energy engineering is the link between the engineering branches involved in the design, installation, operation and maintenance of renewable energy systems. These branches include electrical engineering, mechanical engineering, architecture, environmental engineering, materials engineering and other engineering sciences. The specialization revolves around the methods and systems used to generate and distribute energy from sustainable and renewable sources. These methods and systems include persons, materials, information, equipment, sustainable energy sources and their applications in these environments. The renewable and sustainable energy engineering program is one of the important scenarios for achieving the "Egypt 2030" vision for energy planning, which includes maximizing the participation of renewable energy in the energy mix to around 40% until 2035. It prepares students to work in companies and institutions that contribute to sustainable solutions or actively integrate sustainability into their business strategies. It develops their scientific, mental and practical skills in ways to achieve sustainable development through renewable energy technology.

The Renewable and Sustainable Energy Engineering Program enables the students of the program to acquire the skills needed to design, implement and operate renewable energy systems such as solar, wind and other renewable energy applications. The program includes theoretical study of renewable energy engineering and practical applications in laboratories equipped and dedicated to this purpose in addition to field visits to projects in progress in order to prepare students for practical life. Moreover, the program includes field practical training periods during the years of study in projects under implementation, in cooperation with specialized companies in the labor market, which qualifies the students professionally to practice their work professionally in the labor market.

One aspect of excellence in the program is to enhance the student's ability to deal with complex systems based on multiple engineering disciplines at the same time and to visualize the appropriate system that combines the elements of the complex energy systems. The program also focuses on learning through case studies and multiple projects aimed at solving specific application problems in different energy fields, which is another element of excellence.
The program is designed to generate modern engineers able to apply their engineering knowledge in the practical applications of sustainable and renewable energy engineering.

2. Basic Information

2.1. Program Vision:

To achieve leadership between renewable energy programs and sustainable energy engineering at the local and regional level by providing a scientific environment that supports and enhances academic excellence.

2.2. Program Mission:

Preparing a distinguished graduate who has acquired the principles and skills of renewable and sustainable energy engineering in order to serve society and develop the environment.

2.3. Program Aims:

The Renewable and Sustainable Energy Engineering program is committed to providing high-quality education in accordance with the most distinguished educational standards for its students in the field of renewable and sustainable energy engineering. Faculty members and students should participate as productive individuals in the society and contributors with the highest levels of expertise in the energy field.

The program aims are summarized as follows:

A. Prepare graduates who are able to use, develop and apply technical and administrative skills in dealing with electrical energy systems in general and especially in renewable and sustainable energy systems.

B. Develop the performance of graduates with distinctive skills and advanced concepts of renewable energy fundamentals.

C. Keep up with developments in technology and developing effective communication skills.

D. Preparing a graduate who will be able to develop knowledge and skills through self-learning

E. Collaborate with colleagues and others in solving problems through teamwork as team members or as leaders.

F. Qualify to pursue postgraduate studies and scientific research through the development of creative thinking and the ability to analyze problems and systematic thinking to solve them.

G. Establish the professional and ethical values of graduates as leaders in different areas of the energy sector.

H. Enable graduates to work not only in local markets but also in regional markets (especially in Arab and African regions) and international markets.

I. Promote and incorporate sustainability concepts in all program courses as well as embody a culture of sustainability for staff, students and graduates.

J. Create and strengthen a collaborative partnership with stakeholders in the field of skills, knowledge generation and application.

2.4. Specifications of the Program Graduate:

The academic program for renewable and sustainable energy engineering is keen to graduate distinguished and qualified engineers for the labor market. The program graduate will be able to:

A. Link renewable energy sciences with other engineering sciences

B. Deal efficiently with modern technological methods used in generating and converting alternative energies

C. Employ theories, information, data and ideas that achieve energy and raw materials rationalization and take decisions that guarantee good management and quality performance

D. Model and design integrated energy systems in which different disciplines overlap

E. Design, implement, operate and maintain renewable energy stations and conduct specialized research and studies in the energy field

F. Deal with problems during the performance of tasks, communication skills and ensure the performance of equipment efficiently.

2.5. Graduate Competencies in Accordance with the National Academic Standards

According to NARS 2018, a graduate must be able to:

A1. **Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.**

A2. **Develop and conduct appropriate experimentation and/or simulation, analyze, and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.**

A3. **Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.**

A4. **Utilize contemporary technologies, codes of practice, and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.**

A5. **Practice research techniques and methods of investigation as an inherent part of learning..**

A6. **Plan, supervise, and monitor implementation of engineering projects, taking into consideration other trades requirements.**

A7. **Function efficiently as an individual and as a member of multi-disciplinary and multicultural teams.**

A8. **Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.**

A9. **Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.**

A10. **Acquire and apply new knowledge; and practice self, lifelong and other learning strategies**

In addition to the competencies of most engineering programs, the engineering RSE program has some special competencies, which are as follows:

D1. **Select, model and analyze renewable energy systems applicable to the specific discipline by applying the concepts of: Thermodynamics, Heat Transfer, Fluid Mechanics, Control Theory and Systems, Mechanical Design and Analysis, Dynamics and Vibrations, Generation, Transmission and Distribution of renewable energy systems**

D2. **Design, model and analyze an electrical/electronic/mechanical/digital system or component for renewable energy application; and identify the tools required to optimize this design.**

D3. **Estimate and measure the performance of an electrical/electronic/mechanical/digital system and circuit under specific input excitation, and evaluate its suitability for a renewable energy application.**

D4. **Adopt suitable national and international standards and codes to: design, build, operate, inspect and maintain electrical/electronic/mechanical/digital equipment, systems and services..**

D5. **Select conventional mechanical and electrical equipment according to the required performance of the renewable energy systems.**

3. Course Coding System

Courses are coded according to the following figure (Fig. 1). The course is related to the scientific department that offers it. The first part of the course code is the code of the scientific department. The second part consists of three numbers, the first of which represents the level, while the second number represents the exact specialization number within the scientific department, and the third number reflects a series of courses in the specialization of the same level. Not all of these letters indicate the majors in which the degree is given, some of which represent university requirements, engineering requirements, or specialized courses.

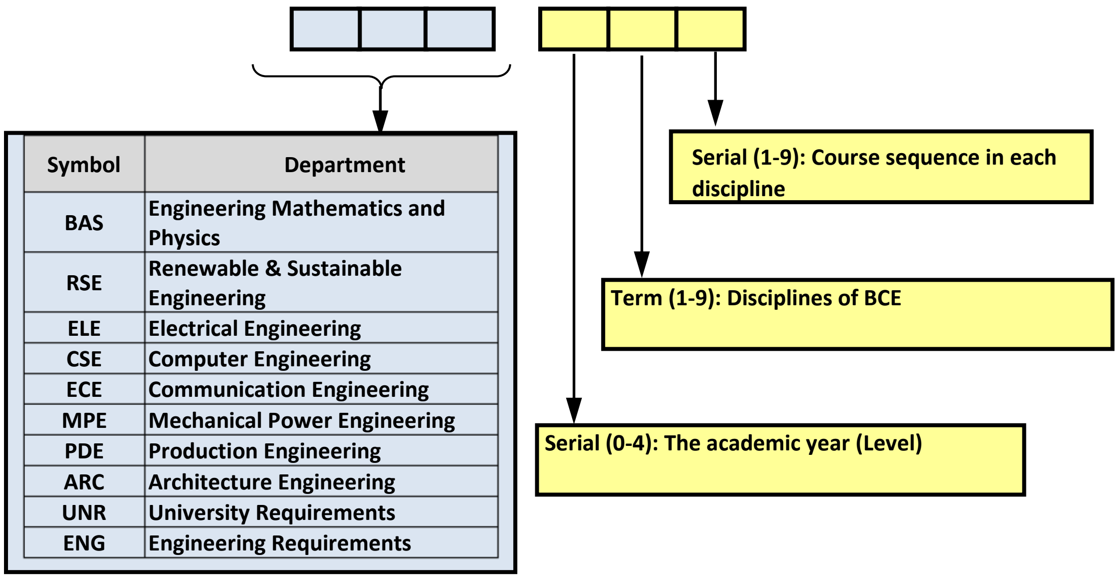


Fig. 1. Course Coding System

Table 1: Scientific Departments and Course Codes

Code	Department
UNR	University Courses
BAS	Engineering Mathematics and Physics
CSE	Computers & Control Systems
ECE	Electronics & Communication Engineering
ELE	Electrical Engineering
MPE	Mechanical Power Engineering
PDE	Production & Mechanical Design Engineering
RSE	Renewable & Sustainable Engineering
ENG	Engineering Faculty Courses

Course code refers to the semester in which this course is usually taught. These dates are subject to change, as not all courses are taught every year. Before the start of each semester, college affairs present a table of courses that will be taught in this semester and their teaching dates and those who are teaching them.

4. Structure and Contents of the RSE Program

The structure of the renewable and sustainable energy engineering program consists of 160 credit hours distributed as follows:

4.1 University Requirements:

The main purpose of university education is not only to prepare students for successful careers but also to provide them with the knowledge and skills necessary to develop a rational and successful personal identity. In addition, Mansoura University assists students in gaining an appreciation of the natural and cultural environments in which they live and their roles in society and community services. The university's requirements for bachelor's programs consist of 13 credit hours (8.12% of the total 160 credit hours), which are met by completing six (6) courses that are reflected in table 2

Table 2: University Requirements: 13 credits (8.12% of 160 credits)

Code	Course name	Credit Hr.
UNR061	English language	2
UNR281	Law and Human Rights	2
UNR241	Communication and Presentation Skills	2
UNR461	Ethics and Morals of the Profession	2
UNR364	Environmental impact Assessment	2
CSE042	Introduction to Computer Systems	3

4.2 Faculty Requirements:

The faculty requirements provide students with the knowledge and skills necessary to develop a successful engineer. Common college requirements are applied in all credit hour programs. The standard requirement of faculty courses includes basic knowledge courses for all engineering graduates such as mathematics, physics, mechanics, engineering drawing, design, manufacturing, and chemistry. The faculty requirements for the Renewable and Sustainable Energy Engineering program consist of 44 credit hours (27.5% of the total 160 credit hours), which are completed by completing sixteen (16) mandatory courses, as listed in Table 3.

Table 3: Faculty Requirements: 44 Credits (27.5 % of 160 credits)

Code	Course name	Credit Hr.
BAS011	Mathematics (1)	3
BAS021	Mechanics (1)	3
BAS031	Physics (1)	3
BAS041	Engineering Chemistry	3
PDE05١	Engineering Drawing	3
BAS012	Mathematics (2)	3
BAS022	Mechanics (2)	3
BAS032	Physics (2)	3
PDE052	Production Engineering	3
BAS113	Mathematics (3)	3

BAS114	Mathematics (4)	3
ENG111	Technical Reports Writing	2
BAS115	Statistics and Probability Theory	2
ELE141	Electrochemical Properties of Materials	2
ECE211	Electronic Circuits and Integrated Systems	3
ENG412	Project management	2

4.3 Major and Minor Requirements for RSEE

The major and minor requirements in the renewable and sustainable energy engineering program consist of 103 credit hours (64.38% of a total of 160 credit hours), which are fulfilled by completing 30 compulsory courses equivalent to 85 credit hours, 4 elective courses equivalent to 12 credit hours and field training and graduation projects equivalent to 6 credit hours as shown in the following tables.

Table 4: Major and Minor Requirements (85 credits plus 12 credits elective courses)

Code	Course name	Credit Hr.
ELE111	Electric circuits	3
MPE121	Fluid Mechanics	3
MPE111	Thermodynamics	3
RSE101	Measurement and Instrumentation	3
ELE112	Basics of power systems	3
RSE102	Computer applications in energy	2
RSE103	Introduction to engineering design	3
ELE221	Electric Machines (1)	3
MPE222	Hydraulic Machines	3
CSE253	Automatic Control Systems	3
RSE204	Introduction to energy conversion	2
PDE232	Materials Strength & Stresses Analysis	3
MPE212	Solar energy thermal applications	3
MPE213	Heat transfer	3
RSE205	Modeling of dynamic systems	3
ELE231	Photovoltaic Systems	3
MPE314	Mechanical power stations	3
ELE322	Electric machines (2)	3
MPE323	Automatic control equipment	3
MPE313	Refrigeration and Air Conditioning	3
RSE308	Introduction to Wind Energy	3
RSE309	Energy Storage systems	3
ELE333	Power electronics and applications	3
RSE311	Energy Policies and Economics	2
ARC311	Smart Buildings	2
RSE413	Design of energy systems	3
ELE413	Power System Analysis	3

RSE415	Introduction to Biomass Energy	2
ELE414	Power System control	3
ELE415	Power system protection	3

Table 4 (continue): Elective Courses (12 Credits)

Code	Course name	Credit Hr.
ELE324	Electrical Traction	3
ELE334	Applications of PLC/SCADA in power system	3
ELE314	Hybrid Energy Systems	3
MPE315	Elective Course (1) in Mechanical Engineering	3
ELE325	Electrical Motor Drives	3
ELE335	Low Voltage Distribution	3
ELE315	Smart grid technologies	3
MPE316	Elective Course (2) in Mechanical Engineering	3
ELE421	Electrical vehicle technology	3
PWE411	Wastewater treatment technologies	3
ELE418	Utilization of Electrical Energy	3
ELE416	Energy Auditing and Conservation	3
MPE411	Elective Course (3) in Mechanical Engineering	3
ELE422	Energy systems and electrical vehicles	3
ELE419	Illumination Technology	3
ELE417	Energy markets	3
MPE412	Elective Course (4) in Mechanical Engineering	3

4.4 Project and Practical and Field Training

Table 5: Projects and Practical Training (6 credits)

Code	Course name	Credit Hr.
RSE206	Training (1) in energy engineering	--
RSE312	Training (2) in energy engineering	--
RSE416	Project (1) in Energy Engineering	3
RSE417	Project (2) in Energy Engineering	3

Mapping of Courses to Competencies

Program competencies are enlisted in the first row of the table (by their code number: a1, a2……etc), then the course titles or codes are enlisted in first column, and an "x" mark is inserted where the respective course contributes to the achievement of the program competencies.

Course Title	Code	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	D1	D2	D3	D4	D5
Mathematics (1)	BAS011	x														
Mechanics (1)	BAS021	x														
Physics (1)	BAS031	x	x													
Engineering Chemistry	BAS041	x	x													
Engineering Drawing	PDE051	x														
English Language	UNR061								x							
Mathematics (2)	BAS012	x														
Mechanics (2)	BAS022	x														
Physics (2)	BAS032	x	x													
Introduction to Computer Systems	CSE042	x				x										
Production Engineering	PDE052	x	x													
Mathematics3	BAS 113	x														
Probability Theory and Statistics	BAS115	x	x													
Electrochemical properties of materials	ELE141	x		x												
Electric Circuits	ELE111	x		x	x											
Fluid Mechanics	MPE121											x				
Thermodynamics	MPE111											x				
Mathematics (4)	BAS 114	x	x													
Technical Report Writing	ENG111					x			x							
Introduction to Engineering Design	RSE103	x			x											
Computer applications in energy	RSE102	x	x		x											
Basics of Electrical power systems	ELE112												x			
Measurement and Instrumentation	RSE101															x
Electronic circuits and integrated systems	ECE211	x	x						x							
Electric Machines (1)	ELE221												x			
Hydraulic Machines	MPE222											x				
Automatic Control Systems	CSE253											x			x	
Introduction to Energy Conversion	RSE204											x	x			
Communication and Presentation Skills	UNR214								x	x						
Materials Strength &	PDE232															x

Stresses Analysis																
Solar energy thermal applications	MPE212											x				x
Heat Transfer	MPE213											x				
Modeling of dynamic systems	RSE205											x	x			
Photovoltaic Systems	ELE231											x		x		
Law and Human Rights	UNR 281		x				x	x								
Training (1) in energy engineering	RSE206											x	x		x	x
Mechanical Power Stations	MPE314											x		x		x
Electric Machines (2)	ELE322												x	x		
Automatic control equipment	MPE323													x		x
Refrigeration and Air Conditioning Systems	MPE313											x				x
Elective course (1)	Elective											x	x		x	
Environmental impact Assessment	UNR364		x			x			x	x	x					
Introduction to wind energy	RSE308											x	x			
Energy storage systems	RSE309											x	x	x	x	
Power electronics and applications	ELE333											x				x
Elective course (2)	Elective											x	x		x	
Energy Policies and Economics	RSE311											x	x		x	x
Smart buildings	ARC311												x			x
Training (2) in energy engineering	RSE312											x	x	x	x	x
Elective course (3)	Elective											x	x	x	x	x
Design of energy systems	RSE413											x	x		x	
Power system analysis	ELE413												x		x	
Project management	ENG412				x	x			x	x						
Introduction to Biomass Energy	RSE415											x	x			
Project (1) in Energy Engineering	RSE416											x	x	x	x	x
Power System control	ELE414											x		x	x	x
Power system protection	ELE415												x		x	
Ethics and Morals of the Profession	UNR461					x	x			x	x					
Elective course (4)	Elective											x	x		x	
Project (2) in Energy Engineering	RSE417											x	x	x	x	x

Level 000

First semester

Course Coding		No. of Hrs/week						Course grades					Prerequisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
BAS011	Mathematics (1)	3	2	2		4	8	20	30	--	50	100	
BAS021	Mechanics (1)	3	2	2		4	8	20	30	--	50	100	
BAS031	Physics (1)	3	2	1	1.5	4.5	9	20	20	10	50	100	
BAS041	Engineering Chemistry	3	2	1	1.5	4.5	9	20	20	10	50	100	
PDE051	Engineering Drawing	3	2	2		6	10	20	30	--	50	100	
UNR061	English Language	2	1	2		2	5	20	30	--	50	100	
Total		17	11	10	3	25	49					600	
Total Contact hours = 24 hrs/week Total SWL = 49 hrs/week													

Second semester

Course Coding		No. of Hrs/week						Course grades					Prerequisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
BAS012	Mathematics (2)	3	2	2	--	4	8	20	30	--	50	100	BAS011
BAS022	Mechanics (2)	3	2	2	--	4	8	20	30	--	50	100	BAS021
BAS032	Physics (2)	3	2	1	1.5	4.5	9	20	20	10	50	100	-----------------
CSE042	Introduction to Computer Systems	3	2	1	1.5	4.5	9	20	20	10	50	100	-----------------
PDE052	Production Engineering	3	2	--	3	3	8	20	20	10	50	100	-----------------
Total		15	10	6	6	20	42					500	
Total Contact hours = 22 hrs/week Total SWL = 42 hrs/week													

Level 100: Third Semester

Course Coding		No. of Hrs/week						Course grades					Prerequisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
BAS 113	Mathematics3	3	2	2	--	4	8	20	30	--	50	100	BAS012
BAS115	Probability Theory and Statistics	2	1	2	--	2	5	20	30	--	50	100	BAS012
ELE141	Electrochemical properties of materials	2	2	--	--	5	7	20	30	--	50	100	BAS041
ELE111	Electric Circuits	3	2	2	--	4	8	20	30		50	100	
MPE121	Fluid Mechanics	3	2	1	1	4	8	20	20	10	50	100	BAS031
MPE111	Thermodynamics	3	2	2	--	4	8	20	30	--	50	100	
Total		16	11	9	1	23	44					600	
Total Contact hours = 21hrs/week Total SWL = 44 hrs/week													

Fourth Semester

Course Coding		No. of Hrs/week						Course grades					Prerequisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
BAS 114	Mathematics (4)	3	2	2	--	4	8	20	30	--	50	100	BAS113
ENG111	Technical Report Writing	2	1	2	--	3	6	20	30	--	50	100	UNR 061
RSE103	Introduction to Engineering Design	3	2	2	--	4	8	20	30	--	50	100	----
RSE102	Computer applications in energy	2	1	1	1.5	2.5	6	20	20	10	50	100	CSE051
ELE112	Basics of Electrical power systems	3	2	2	--	5	9	20	30	--	50	100	ELE111
RSE101	Measurement and Instrumentation	3	2	1	1.5	4.5	9	20	20	10	50	100	--------
Total		16	10	10	3	23	46					600	
Total Contact hours = 23 hrs/week Total SWL = 46 hrs/week													

Level 200: Fifth Semester

Course Coding		No. of Hrs/week						Course grades					Prerequisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
ECE211	Electronic circuits and integrated systems	3	2	2	--	5	9	20	30	--	50	100	-------
ELE221	Electric Machines (1)	3	2	1	1.5	4.5	9	20	20	10	50	100	ELE111
MPE222	Hydraulic Machines	3	2	2	--	5	9	20	30	-	50	100	MPE121
CSE253	Automatic Control Systems	3	2	2	--	4	8	20	30	-	50	100	
RSE204	Introduction to Energy Conversion	2	2	-	--	4	6	20	30	-	50	100	
UNR2٤١	Communication and Presentation Skills	2	1	2	--	1	4	20	30	--	50	100	-------
Total		16	11	9	1.5	23.5	45					600	
Total Contact hours = 21.5 hrs/week Total SWL = 45 hrs/week													

Sixth Semester

Course Coding		No. of Hrs/week						Course grades					Prerequisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
PDE232	Materials Strength & Stresses Analysis	3	2	1	1	4	8	20	20	10	50	100	----------
MPE212	Solar energy thermal applications	3	2	1	1.5	3.5	8	20	20	10	50	100	RSE204
MPE213	Heat Transfer	3	2	2	-	4	8	20	30	-	50	100	---------
RSE205	Modeling of dynamic systems	3	2	-	3	3	8	20	20	10	50	100	
ELE231	Photovoltaic Systems	3	2	1	1.5	4.5	9	20	20	10	50	100	
UNR 281	Law and Human Rights	2	2	٠	٠	2	4	20	30	-	50	100	----------
RSE206	Training (1) in energy engineering	-	-	-	-	3	3	-	-	-	-	-	------
Total		17	12	5	7	24	48					600	
Total Contact hours = 24 hrs/week Total SWL = 48 hrs/week													

Level 300: Seventh semester

Course Coding		No. of Hrs/week						Course grades					Prerequisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
MPE314	Mechanical Power Stations	3	2	2	--	5	9	20	30	--	50	100	MPE111
ELE322	Electric Machines (2)	3	2	1	1.5	4.5	9	20	20	10	50	100	ELE221
MPE323	Automatic control equipment	3	2	2	--	5	9	20	30	-	50	100	MPE121
MPE313	Refrigeration and Air Conditioning Systems	3	2	2	--	4	8	20	30	-	50	100	MPE213
Elective	Elective course (1)	3	2	1	1.5	4.5	9	20	20	10	50	100	-------
UNR364	Environmental impact Assessment	2	2	-	--	3	5	20	30	--	50	100	------
Total		17	12	8	3	26	49					600	
Total Contact hours = 23 hrs/week Total SWL = 49 hrs/week													

Eighth Semester

Course Coding		No. of Hrs/week						Course grades					Prerequisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
RSE308	Introduction to wind energy	3	2	1	1.5	3.5	8	20	20	10	50	100	MPE121
RSE309	Energy storage systems	3	2	2	--	4	8	20	30	-	50	100	RSE204
ELE333	Power electronics and applications	3	2	1	1.5	3.5	8	20	20	10	50	100	ECE211
Elective	Elective course (2)	3	2	1	1.5	3.5	8	20	20	10	50	100	Depends on course
RSE311	Energy Policies and Economics	2	2	-	--	3	5	20	30	-	50	100	
ARC311	Smart buildings	2	2		--	3	5	20	30	--	50	100	
RSE312	Training (2) in energy engineering	-	-	-	-	8	8	-	-	-	-	-	-----
Total		16	12	5	4.5	28.5	50					600	
Total Contact hours = 21.5 hrs/week Total SWL = 50 hrs/week													

Level 400: Ninth semester

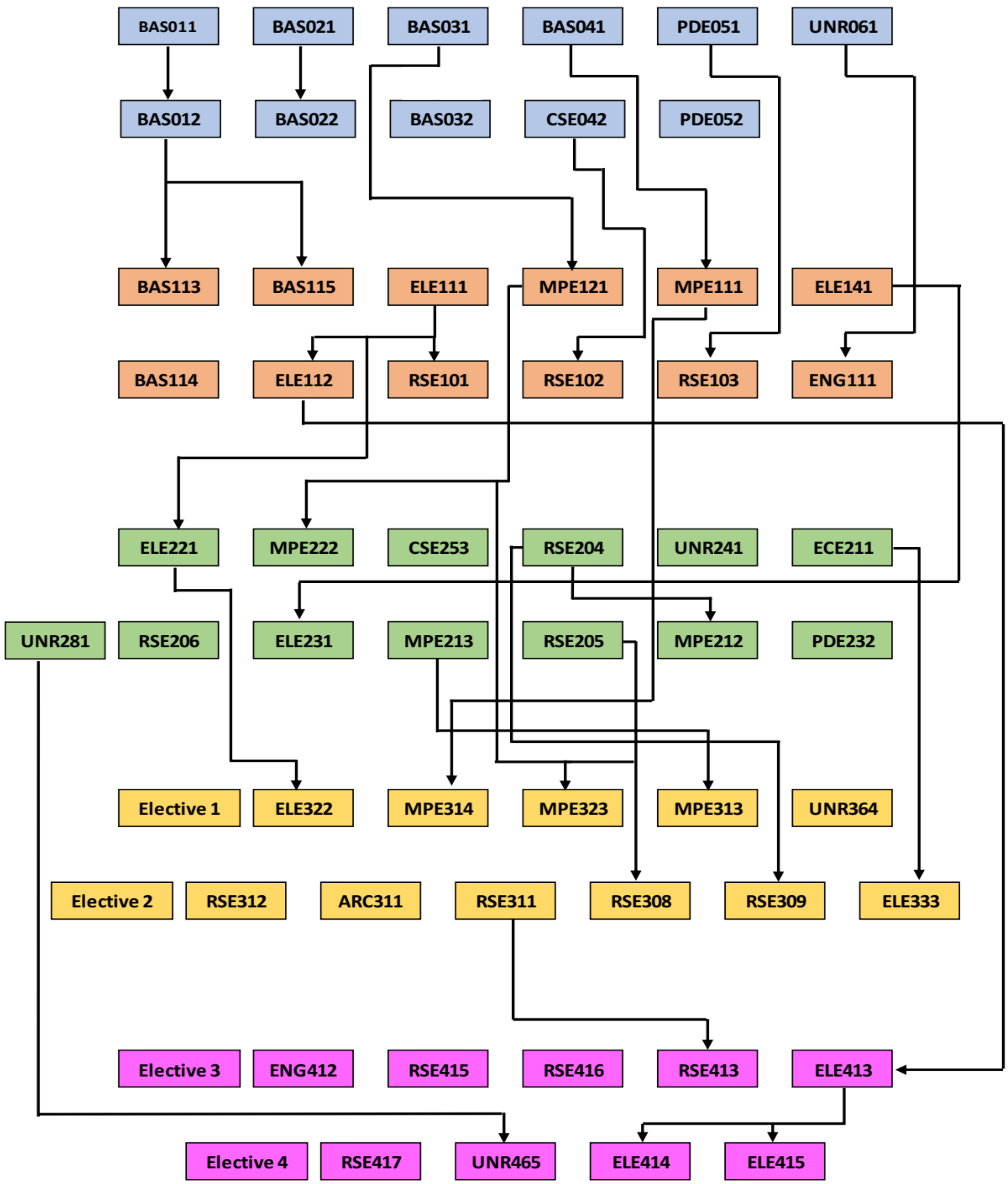
Course Coding		No. of Hrs/week						Course grades					Prerequisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
Elective	Elective course (3)	3	2	1	1.5	4.5	9	20	20	10	50	100	Depends on course
RSE413	Design of energy systems	3	2	1	1.5	4.5	9	20	20	10	50	100	RSE311
ELE413	Power system analysis	3	2	2	--	5	9	20	30	-	50	100	ELE112
ENG412	Project management	2	2	-	--	4	6	20	30	-	50	100	-------
RSE415	Introduction to Biomass Energy	2	2	-	--	6	8	20	30	-	50	100	
RSE416	Project (1) in Energy Engineering	3	1	2	3	2	8	20	20	10	50	100	Level 400
Total		16	11	6	6	26	49					600	
Total Contact hours = 21.5 hrs/week Total SWL = 50 hrs/week													

Tenth Semester

Course Coding		No. of Hrs/week						Course grades					Prerequisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
ELE414	Power System control	3	2	2	--	5	9	20	30	--	50	100	ELE413
ELE415	Power system protection	3	2	1	1.5	4.5	9	20	20	10	50	100	ELE413
UNR461	Ethics and Morals of the Profession	2	2	2	--	2	6	20	30	-	50	100	UNR281
Elective	Elective course (4)	3	2	1	1.5	4.5	9	20	20	10	50	100	Depends on course
RSE417	Project (2) in Energy Engineering	3	1	2	3	6	12	20	20	10	50	100	Level 400
Total		14	9	8	6	22	45					500	
Total Contact hours = 23 hrs/week Total SWL = 45 hrs/week													

Renewable and Sustainable Energy Engineering (RSEED) Program

Schematic Graph for Courses and prerequisite courses



Syllabus of Renewable and Sustainable Program Courses

- Level 000

A. First Term

BAS011	Mathematics 1								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	1 st	

Calculus: Function (definition - theorems) - Basic functions - limits - Continuity - Derivation - definition - theorems - types - higher orders - Applications on derivatives - partial dervatives - indefinite integral - theories and properties of integration.

Algebra: Binomial theorem (with any exponent and applications) - Partial Fractions - Theory of Equations - Matrices - System of linear equations - Gauss elimination method.

References:

1. 1.Akhtar & Ahsan, Textbook of Differential Calculus, second edition, 2009, PHI Learning Private Limited
2. Alan Jeffrey, Matrix operations for Engineers and Scientists, 2010, Springer Science & Business Media.

BAS021	Mechanics 1								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	1 st	

Equilibrium of a particle: Two-Dimensional - Force vectors in three dimensions - Equilibrium of a particle in three dimension – System of forces and moments – Moment of a force about point - Moment of a couple – Equivalent systems of forces and couples – Reduction of systems of forces and couples - Equilibrium of Rigid body in two dimension - Center of gravity and centroid– Frames and Machines: Analysis of frames – Dismembering connected parts of the frame - Analysis of Machines - Friction: Types of friction, Theory of dry friction – Static friction and Impending motion – kinetic friction – Types of problems involving dry friction.

References:

1. R.C. Hibbeler, "Engineering Mechanics: Statics and Dynamics, 14th Edition", Pearson Prentice Hall, New Jersey, 2016.
2. J. L. Meriam, L. G. Kriage, and J. N. Botton, "Engineering Mechanics: Statics, 8th Edition", John Wiley & Sons, New York, 2016.

BAS031	Physics 1							Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1 st	

Properties of matter: physical quantities – dimensions and units– oscillatory motion – mechanical properties of material – fluid characteristics – viscosity – surface tension – acoustic waves – waves across elastic bodies.

Heat and thermodynamics: heat transfer – kinetic theory of gases – first law of thermodynamics – entropy and second law of thermodynamics – temperature scales and thermometers – heat expansion.

References:

1. Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 6th Edition, Thomson Brooks/Cole 2014.
2. Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.

BAS041	Engineering Chemistry								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1 st	

Equations of state-chemical thermodynamics - Material and energy balance in chemical processes-properties of solutions - Basic principles in electrochemistry and its applications – Introduction to chemical engineering: basic operations and plastics, fertilizers, dyes and petrochemical industries.

References:

1. Brown, L. T, LeMay H. E. Jr; Bursten, B. E.; Murphy, C.J., and Woodward, P.; " Chemistry The Central Science", Pearson International Edition (11th edn), Pearson Printice Hall, (2009).

BAS051	Engineering Drawing								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1 st	--

Introduction - Techniques and skills of engineering drawing – Free hand sketching - Engineering processes - Vertical projection - Simple objects projections - The intersection of geometric objects - Drawing geometric objects and isometric drawing - Dimensional writing rules – Generating the missing projections - Engineering sections - Introduction to computer aided drawing.

References:

1. Mcgraw-hill Mint, "Mechanical Drawing Board & CAD Techniques", Student Edition,2011

UNR061	English Language								Prerequisites
2 Cr.	Lecture	1	Tutorial	2	Lab.	--	Semester	1 st	--

Analysis and explanation of technical texts – abbreviating texts at different levels of conciseness – continuation of preparation for standard language tests.

References:

1. Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011

- **Level 000 term 2**

BAS012	Mathematics 2								Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	2 nd	BAS011

Integral Calculus: Definite integral - Methods of integration – Applications on definite

integral (plane area - volume of revaluation - length of a plane curve - area of surfaces of revolution) - improper integral.

Analytic Geometry: Equations of second degree - Equation of pair of straight lines - Translation of axes - Conic sections - parabola - ellipse - hyperbola) Equation of plane - Equation of sphere.

References:

- Jumarie, G., Fractional Differential Calculus for Non-Differentiable Functions: Mechanics, Geometry, Stochastics, Information Theory. 2013: LAP Lambert Academic Publishing.
- Hestenes, D. and G. Sobczyk, Clifford algebra to geometric calculus: a unified language for mathematics and physics. Vol. 5. 2012: Springer Science & Business Media.
- Grossman, S.I., Multivariable calculus, linear algebra, and differential equations. 2014: Academic Press.

BAS022	Mechanics 2								Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	2 nd	BAS021

Introduction to dynamics – Kinematics of a particle: curvilinear Motion – Rectangular components – Motion of projectiles – Normal and Tangential components – cylindrical components - Kinetics of a Particle: Force and Acceleration; The Equation of Motion in: Rectangular Coordinates, Normal and Tangential Coordinates, Cylindrical Coordinates. Work and Energy; Principle of a Work and Energy, Conservative Forces and Potential Energy, Conservation of Energy, Power and Efficiency. Linear

Impulse and Momentum: Conservation of Linear Momentum for a System of Particles, Impact.

References:
- R.C. Hibbeler, "Engineering Mechanics: Statics, 11th Edition", Pearson Prentice Hall, 2006.
- F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg, "Vector Mechanics for Engineering, Statics and Dynamics, 9th Edition", McGraw-Hill, New York, 2010.

BAS032	**Physics 2**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester	**2 nd**	---

Electricity and magnetism: the shipment and material - electric field - Coulomb's law - Flood electrophoresis - Law Gauss - voltage - capacitors and insulating materials - current and resistance and potential electric power - Ohm's law and simple circuits - magnetic field - Biot and Savart law - magnetic flux and the law of Gauss - Faraday's law - magnetic induction. Light: light engineering - the wave nature of light and the principle of HOI - interference and diffraction - polarization of light - optical fiber - Atomic physics: atomic structure - Bohr theory - the principles of quantum theory - Laser - PV phenomenon - the theory of relativity

References:
- Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 9th Edition, Thomson Brooks/Cole 2014.,
- Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.

CSE042	**Introduction to Computer Systems**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester	**2 nd**	---

Introduction to the design and operation of a digital computer: data types, representation and number systems – basic computer components and organization – data transfer input/output as well as between components and registers – data processing – machine language – relation between SW and HW – operating systems – compilers – introduction to data network.

References:
- Peter Van Roy, Seif Haridi, "Concepts, Techniques, and Models of Computer Programming" The MIT Press (February 20, 2012)

PDE052	Production Engineering								Prerequisites
3 Cr.	Lecture	2	Tutorial	--	Lab.	3	Semester	2 nd	---
Introduction to Engineering Materials - Steel and Cast Iron Furnaces - Methods of Metal Forming (Casting - Welding - Forging - Rolling - Extrusion - Drawing - Bending - Stamping) - Machining Methods (Turning - shaping - Milling - Drilling - Grinding) - Simple Measuring Instruments - Production quality and industrial safety - practical training in various workshops.									
References: - Hitomi, Katsundo. Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics. Routledge, 2017.									

- **Level 100**

  A. **First Term**

BAS113	Mathematics (3)								Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	1 st	BAS012
Applications of partial differentiation - Maximum values of functions in more than one variable and applications - First order differential equations - Second order differential equations - Laplace transform and its applications - Analytical geometry in space.									
References: - D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007. - S. A. Wirkus, and R. J. Swifi, "A Course of Ordinary Differential Equations", Taylor & Francis Group, LLC, 2015.									

BAS115	Statistics and Probability Theory								Prerequisites
2 Cr.	Lecture	1	Tutorial	2	Lab.	--	Semester	1 st	BAS012
Probability- Total probability Theorem - Measures of tendency and dispersion - Probability distributions - Sampling theorem - tests of hypothesis - non-parametric tests - regression and correlation - time series.									
References: - Mary C. Meyer, Probability and Mathematical Statistics: Theory, Applications, and Practice in RSBN-10: 1611975778, SIAM (June 24, 2019)									

ELE111	Electric Circuits								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**--**	Semester	**1 st**	

Electric circuit elements - basic laws of electrical circuits - Kirchhoff's laws - methods of electric circuits analysis- Thevenin's theory - Norton theory – superposition theory - conversion of sources - maximum power transfer – basic concepts for AC circuits – analysis of AC circuits- power and power factor – resonance circuits - three-phase AC circuits.

References:

1. Slade, P.G., Electrical contacts: principles and applications. 2017: CRC press.
2. Nilsson, J.W. and S.A. Riedel, Electric circuits. 2015: Pearson Upper Saddle River, NJ
3. Dunn, P.F., Measurement and data analysis for engineering and science. 2014: CRC press

MPE121	Fluid Mechanics								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**--**	Semester	**1 st**	BAS031

Introduction to fluid dynamics - Physical laws in the field of fluid mechanics – Conservation equations – Mass, momentum and energy conservation equations - Analysis of some engineering applications using control volume analysis – Deducing Navier-Stokes equations and their applications - Marginal layer theory - Using von Karmen's equations to solve boundary layer problems - An introduction to turbulent flow.

References

- Som, S. K., Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Private Limited, 2010

MPE111	Thermodynamics								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**--**	Semester	**1 st**	---

Basic concepts of thermodynamic – Energy concepts – Thermodynamic properties of pure substance – First law – Second law – Entropy – Thermodynamic equilibrium – Thermodynamic properties of Mixtures and solutions – Thermodynamics of chemical reactions.

References

- Yunus A. Cengel, Introduction To Thermodynamics and Heat Transfer, McGraw-Hill Science/ Engineering/ Math, 2nd Ed., 2007.

ELE141	Electrochemical properties of materials								Prerequisites
2 Cr.	Lecture	2	Tutorial	--	Lab.	--	Semester	1 st	BAS041

Introduction to electrical properties of materials - Introduction to electrochemistry - Thermodynamic equilibrium - Kinetically and mass transport controlled electrochemical processes - Electrochemical techniques - Surface confined electrochemical processes – Electro polymerizing - Homogeneous and heterogeneous electrocatalysis - Electrochemical processes coupled to chemical steps - Comparisons of batteries, fuel cells and supercapacitors - Electrochemical processes of particular relevance to energy conversion - Simulations of electrochemical systems.

References

- Cristoloveanu, S. and S. Li, Electrical characterization of silicon-on-insulator materials and devices. Springer Science & Business Media, 2013
- Seanor, D.A., Electrical properties of polymers. Elsevier, 2013
- E. R. Leite, "Nanostructured Materials for Electrochemical Energy Production and Storage", Springer-Verlag New York Inc., 2009

B. Second Term

BAS114	Mathematics (4)								Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	2 nd	BAS113

Fourier series - Fourier transform - Complex numbers - Functions of a complex variable - Complex integration - Residue theorem - Direction derivatives - Double integrals - Triple integrals - Line integrals - Surface integrals

References:

- J. Brown, and R. Churchill, "Complex Variables and Applications", 9th Edition, McGraw-Hill, 2013.

D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.

RSE101	Measurement and Instrumentation								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2 nd	ELE111

Configurations and descriptions of measuring instruments - Characteristics of instruments and measurement systems - Errors analysis - Basics and concepts of electrical measurements - Principle and types of analog and digital voltmeters and ammeters - Measurement devices for AC&DC power and power factor in single and 3-phase system - Measuring frequency - Pressure measurements - Flow measurements - Temperature measurements - Instrument transformers - Force, torque, and shaft power measurements - Instruments for measurement of frequency and phase D.C & A.C bridges - Measuring resistance and inductive reluctance– Grounding techniques - Resistive, capacitive and inductive transducers – Piezoelectric, optical and digital transducers.

References

1. Kirkham, H., Measurement and Instrumentation. 2018, Pacific Northwest National Lab.(PNNL), Richland, WA (United States).
2. Morris, A.S. and R. Langari, Measurement and instrumentation: theory and application. 2012: Academic Press.
3. Hauschild, W. and E. Lemke, High-voltage test and measuring techniques. 2014: Springer.
4. Sawhney, A. K., Sawhney, P. "A Course in Mechanical Measurements and Instrumentation", Dhanpat Rai&Co., Delhi, 1998.

ELE112	**Basics of Electrical Power Systems**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**--**	Semester	**2 nd**	ELE111

Introduction to electric power systems - definition of active and reactive power - transmission lines components (resistance- inductance –capacitance) - characteristics and performance of transmission lines - components of overhead lines - mechanical design of overhead transmission lines - underground cables – corona discharge: reasons and impacts and.

References

1. Sadhu, P.K. and S. Das, Elements of Power Systems. 2015: CRC Press.
2. Weedy, B.M., et al., Electric power systems. 2012: John Wiley & Sons.
3. Allan, R.N., Reliability evaluation of power systems. 2013: Springer Science & Business Media.

RSE102	**Computer applications in energy**								**Prerequisites**
2 Cr.	Lecture	**1**	Tutorial	**1**	Lab.	**1.5**	Semester	**2 nd**	CSE051

Introduction to Matlab - Applications on programming with Matlab: Solving linear equations (uniqueness condition and ill-conditioned systems), solving nonlinear systems of equations– drawing curves – simulation using computer programs - processing in and out files - Models of power system components - Applications of simulation and modeling methods in electrical power systems - design and handling of graphical user interfaces -

References

1. Shortliffe, E.H. and J.J. Cimino, Biomedical informatics: computer applications in health care and biomedicine, Springer Science & Business Media, 2013.
2. López, C.P., Introduction to MATLAB, in MATLAB Numerical Calculations, Springer, 2014
3. R. Pathak, A. Pathak and H. Mahala, Computer Applications To Power Systems Book, Satya Prakashan, New Delhi, Delhi, 2016

RSE103	Introduction to engineering design								Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	2 nd	
Design Process, Technical Sketching and Drawing, Measurement and Statistics, Modeling Skills, Geometry of Design, : Reverse Engineering, Documentation, Advanced Computer Modeling, Design Team, Design Challenges, Consumer Product Design Innovation, Marketing									
References: - Introduction to Engineering Design by Andrew Samuel, John Weir. • ISBN: 0750642823 • Publisher: Elsevier Science & Techn.									

ENG111	Technical Report Writing								Prerequisites
2 Cr.	Lecture	1	Tutorial	2	Lab.	--	Semester	2 nd	UNR061
Introduction to technical writing - elements of writing strategy - planning technical reports – writing a technical report: using illustrations, organizing and numbering, writing reference lists and appendices. Formal reports: categories and structure - Applications in report writing: laboratory report, field report, periodic reports, proposals, theses - Ethical considerations and plagiarism - writing a CV.									
References: - G. J. Alred, W. E. Oliu, The Handbook of Technical Writing, 12th Edition, Bedford/St. Martin's; 2018 - K. Hyland, Teaching and researching writing. 3rd edition Routledge academic publisher, 2016 - -M. Markel, Technical Communication, 11th edition, MacMillan, 2015.									

Level 200

C. First Semester

ECE211	Electronic circuits and integrated systems								Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	1 st	
Different types of P-N junction and its Characteristics - Bipolar junction transistor (BJT) and its Characteristics - BJT small-signal analysis - Field-effect transistor (FET) and its Characteristics - Photonic devices and its Characteristics - Operational Amplifiers and its applications - Cascade Amplifier – Filters - Principles operation of diode circuits and rectifiers - Single phase half and full wave rectifier circuits operation under switching mode action.									
References - Dunn, P.F., Measurement and data analysis for engineering and science. 2014: CRC press. - Landsberg, P.T., Basic properties of semiconductors. 2016: Elsevier. - Bimbhra, P. and S. Kaur, Power electronics. Vol. 2. 2012: Khanna publishers.									

ELE221	Electric Machines (1)								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester	**1 st**	ELE111

Power Transformers: Construction and theory of operation, equivalent circuit, determining transformer's constants through practical experiments, electrical performance of the transformer, operation of transformers in parallel.

DC Machines: Construction and theory of operation - power flow and losses. DC Generators: equivalent circuit, characteristics of DC generators, types of excitation, magnetization curve, armature reaction, parallel operation, types and applications of DC generators. DC motors: equivalent circuit, performance and characteristics, DC motor starting, speed and braking control, efficiency, types and applications of DC motors

References

1.Mayergoyz, I.D. and P. McAvoy, Fundamentals of Electric Power Engineering. Vol. 3. 2015: World Scientific.
2.Laughton, M.A. and M.G. Say, Electrical engineer's reference book. 2013: Elsevier.
3.Conradi, A., D. Schmidt, and C. Deeg. Contribution to the analysis of end winding inductances of induction machines—I. IEEE International Conference o Electrical Machines (ICEM), 2016 .

MPE222	Hydraulic Machines								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**--**	Semester	**1 st**	MPE121

Basic theory of turbo-machines- Dimensional analysis and similitude of turbo-machines-Cascade mechanics - Pumps-Turbines -Fans, blowers and compressors- Volumetric machines -Theory of cavitation in centrifugal pumps.

References

- Som, S. K., Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Private Limited, 2010

CSE253	Automatic Control Systems								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**--**	Semester	**1 st**	

Fundamentals of Control - Mathematical Description of linear systems using Laplace transform – Modeling of electromechanical systems – State variables – Time and frequency domain system response – Stability of linear systems – Root locus – Introduction to PID controllers – Analysis using adequate SW - Stationary behavior of closed loop control - Frequency transformed methods - Control design - Optimum control - State-Space-Methods.

RSE204	Introduction to Energy Conversion								Prerequisites
2 Cr.	Lecture	**2**	Tutorial	**--**	Lab.	**--**	Semester	**1 st**	

Energy conversion matrix – New and renewable energies (solar, wind, biofuels, hydro-power), Production of electrical energy using: fossil fuel, nuclear fuel – direct thermo-electric generators - Peltier cooling, Production of electrical energy using: fossil fuel, nuclear fuel - energy conversion through photovoltaic cells and fuel cells .

References

1. D. Yogi Goswami, F. Kreith, Energy Conversion, 2nd Edition, CRC Press, 2017
2. B. Gupta , A Text book of Energy Conversion System, Dhanpat Rai Publishing Company Ltd, January 2008
3. Archie W Culp, “ Principles of Energy Conversion”, McGraw – Hill, Singapore, 1991.

UNR241	Communication and Presentation Skills								Prerequisites
2 Cr.	Lecture	**2**	Tutorial	**--**	Lab.	**--**	Semester	**1 st**	----

Communication Skills: Introduction to communication - communication process - communication skills - verbal and nonverbal communication -interpersonal communication - small group communication - online communication - workplace communication.

Presentation Skills: Overview of oral presentations - preparing and creating a presentation - presentation software - attending a presentation - presentation writing skills.

References:

- Joan van Emden, Lucinda Becker, Presentation Skills for Students, 3rd Edition, Red Globe Press, 2016
- M. Wa Mutua, S. Mwaniki, P. Kyalo, B. Sugut, Communication Skills: A University Book, Succex Publishers, 2016
- Ian Tuhovsky, Wendell Wadsworth, Communication Skills Training, Ian Tuhovsky, 2015
- Tabitha Wambui, Alice W. Hibui, Elizaeth Gathuthi, "Communication skills " Vol.1, Students' coursebook, LAP LAMBERT Academic Publishing, 2012

B Second Term

PDE232	Materials Strength & Stresses Analysis								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1**	Semester	**2 nd**	----

Review of statics -The concept and relationship between stress and strain. -Normal stresses, statically indeterminate systems-Bearing stresses, factor of safety and stress concentration-Thermal stresses and statically indeterminate problems-Shearing stress and strain & Direct shearing stress-Bending of beams-Stresses in beams -Beam deflections-Combined stresses-Principal stresses - Maximum shearing stress - (MOHR'S circle)-Combined normal loads & Eccentricity loads - Columns - Pressure vessels - Mechanical properties of materials and materials testing

References:

- Richard G Budynas, Advanced Strength and Applied Stress Analysis, McGraw-Hill Education, 2nd Ed., 1998.

MPE212	Solar energy thermal applications								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester	**2 nd**	RSE204

Fundamentals of thermal radiation and heat exchangers – Fundamentals of solar thermal energy systems, including system performance, concentrating versus non-concentrating systems, thermal fluids, markets for solar thermal energy, and applications in a range of relevant fields, such as district heating and cooling, industrial process heating, solar desalination, and materials processing.

References

- John A. Duffie, Solar Engineering of Thermal Processes, 4th Edition ,2013 by John Wiley & Sons

MPE212	Heat Transfer								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**--**	Semester	**2 nd**	---

Principles of heat transfer -Conduction heat transfer -One, two, three-dimensional Heat Transfer-Numerical heat transfer, two-dimensional steady heat conduction -Fins - Transient heat conduction equations- External forced convection -Internal forced convection -Natural convection.

References

- Incropera, F.P., and Dewitt, D.P., Fundamentals of Heat and Mass Transfer, John Wiley & Sons, 6th Ed., 2006.

RSE205	**Modeling of dynamic systems**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial		Lab.	**3**	Semester	**2 nd**	

Applications of models in engineering. Electro-mechanical transducers, mechanisms, electronics, fluid and thermal systems, compressible flow, chemical processes, diffusion, and wave transmission. Model reduction. Difference and differential equations, transfer functions. The concepts poles, zeros, frequency function, stability and causality. State-space models. Introduction to nonlinear systems. Linearisation and stationary solutions. Disturbances and disturbance models. Modeling of dynamic systems using parametric and nonparametric methods.

References

1. Karnopp, Rosenberg and Margolis, System Dynamics: Modeling and Simulation of Mechatronic Systems, 4th Edition, Wiley, 2005.

ELE231	**Photovoltaic Systems**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester	**2 nd**	

Solar cell fundamentals - solar cell characteristics - classification of solar cells - of photovoltaic array - solar cell fabrication technology - stand-alone solar PV System - grid connected-solar PV System - hybrid solar PV system - large scale PV systems.

References

1. Wenham, S.R., Green, M.A., Watt, M.E., Corkish, R. and Sproul, A., Applied photovoltaics. Routledge, 2013.
2. Sick, F., Photovoltaics in buildings: a design handbook for architects and engineers. Routledge publishers, 2014.
3. Femia, N., Petrone, G., Spagnuolo, G. and Vitelli, M., Power electronics and control techniques for maximum energy harvesting in photovoltaic systems. CRC press, 2012.

UNR281	**Law and Human Rights**								**Prerequisites**
2 Cr.	Lecture	**2**	Tutorial	--	Lab.	--	Semester	**2 nd**	---

Definition and importance of human rights - Historical and philosophical origins of human rights - Historical establishment of human rights - jurisprudence schools for the establishment of those rights and the provisions of their international agreements - international and regional international organizations based on the protection of human rights - Egyptian constitution's position on human rights and legal protection for them at the national and international level - Universal organs based on the protection of human rights (United Nations organs) - national protection of human rights - human rights in Islamic law.

References:

RSE206	Training (1) in energy engineering							Prerequisites
0 Cr.	Lecture	--	Tutorial	--	Lab.	--	Semester	2 nd	---
Students are required to carry out professional training in specialized training centers or industrial facilities under supervision of program stuff members									

- **Level 300**

A. First Term:

MPE314	Mechanical power stations								Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	1 st	MPE111
Engineering economy for power plants -Environmental aspects of power generation-Innovation technologies in the field of power plants-Basics of nuclear power plants- Steam and gas power stations – Diesel stations – Water systems in power plants.									
References 1- Nag, P. K., Power Plant Engineering, Tata McGraw-Hill Education, 2002									

ELE322	Electric Machines (2)								Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	1 st	ELE221
Basic Concepts of Rotating Electric Machine: Physical concepts of torque production- electromagnetic interaction torque- reluctance torque- constructional features of rotating electrical machine . Synchronous Generators: construction, the internal generated voltage- equivalent circuit, performance parameters of the machine - equations of power and torque,. Synchronous Motors: Steady state motor operation- effect of excitation on motor starting, Three phase Induction Motors: Construction- equivalent circuits- power and torque- torque/speed characteristic- motor starting- speed control of the moto, Single-phase Induction Motor: equivalent circuit- motor starting- speed control of the motor									
References 1. Pyrhonen, J., T. Jokinen, and V. Hrabovcova, Design of rotating electrical machines. 2013: John Wiley & Sons. 2. Lipo, T.A., Introduction to AC machine design. Vol. 63. 2017: John Wiley & Sons. 3. Hindmarsh, J., Electrical machines & their applications. Vol. 1. 2014: Elsevier.									

MPE323	Automatic control equipment								Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	1 st	MPE121

Fundamentals of pneumatic - Air Generation and distribution- Pneumatic components- Design Procedure of Pneumatic control system- Examples and applications of pneumatic and Electro pneumatic Systems- Fundamentals of Hydraulic control system - Hydraulic Fluid- Hydraulic Components- Design Procedure of Hydraulic control system – Applications – Electro-mechanical control (stepper motor – servomotor – electric relay)

References

- Norman S. Nise, Control Systems Engineering, Wiley, 7th Ed., 2015.

MPE313	Refrigeration and Air Conditioning Systems								Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	1 st	MPE213

Gas Refrigeration cycles - Vapor compression cycle- Working fluids - Multi pressure cycles – Compressor-Condenser-Expansion devices Evaporators - Complete vapor compression refrigeration system - Psychometric chart and air conditioning processes - Vapor absorption cycle - Applications in air conditioning- Designing considerations - Load estimation - Air transport and distribution -Design of air conditioning apparatus - Control units - Non-conventional cooling systems.

References

Arora, C., P., Refrigeration and Air Conditioning, McGraw-Hill, 2009

UNR364	Environmental Impact Assessment								Prerequisites
3 Cr.	Lecture	2	Tutorial	--	Lab.	--	Semester	1 st	---

Basic concept and principles of Environmental impact Assessment of energy sources (EIA) - Methodology for EIA: Problem formulation, Hazard identification, release assessment, risk estimation, risk management. The legislative framework of EIA - Costs and benefits of EIA - Linking EIA to other environmental management tools.

References

- Glasson, J. and Therivel, R., 2013. Introduction to environmental impact assessment. Routledge.
- Therivel, R., Wilson, E., Heaney, D. and Thompson, S., 2013. Strategic environmental assessment. Routledge.
- Wathern, P. ed., 2013. Environmental impact assessment: theory and practice. Routledge.

B. Second Term:

RSE308	Introduction to Wind Energy								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester	**2 nd**	MPE121

Basics of wind energy - forces influencing wind and power in the wind - wind measurement techniques and instrumentation - theory of aerodynamics: basic equation, continuity, momentum and energy equations, application of momentum equation calculation of drag on two-dimensional body - WTG used in wind turbine: d.c. generator- induction generator - synchronous generators. Interface converters structure of WTGs.

References

1. Heier, S., 2014. Grid integration of wind energy: onshore and offshore conversion systems. John Wiley & Sons.
2. Houpis, C.H. and Garcia-Sanz, M., 2012. Wind energy systems: control engineering design. CRC press.
3. 3. Ali, M.H., 2016. Wind energy systems: solutions for power quality and stabilization. CRC Press

RSE309	Energy Storage systems								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**--**	Semester	**2 nd**	RSE204

Types of energy storage technologies - need for energy storage - Appreciation of energy storage in grid and vehicular applications - Vehicle energy demand and the use of storage - Battery systems – characteristics of different batteries, behavior at different rates, charging profiles - Battery management systems - Supercapacitor modules and packs - Superconducting Magnetic Energy Storage SMES - Mechanical systems - Pumped hydro storage - Thermal storage systems - Thermal storage materials - practical flywheels.

References

1. Kaldellis, J.K. ed., 2010. Stand-alone and hybrid wind energy systems: technology, energy storage and applications. Elsevier.
2. Hirose, K., 2010. Handbook of hydrogen storage: new materials for future energy storage. John Wiley & Sons.
3. Dincer, I. and Rosen, M., 2002. Thermal energy storage: systems and applications. John Wiley & Sons.

ELE333	Power Electronics and Applications								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester	**2 nd**	ECE211

Principles of switch mode power conversion – dc/dc converters and power supplies – dc/ac inverters for utility interfacing - harmonic reduction techniques for inverters - resonant converters – Cycloconverters - Power electronics for renewable and utility applications.

References

1. Bimbhra, P.S. and Kaur, S., 2012. Power electronics (Vol. 2). Khanna publishers.
2. Akagi, H., Watanabe, E.H. and Aredes, M., 2017. Instantaneous power theory and applications to power conditioning . John Wiley & Sons.
3. Rashid, M.H. ed., 2017. Power electronics handbook. Butterworth-Heinemann.
4. Femia, N., et al., Power electronics and control techniques for maximum energy harvesting in photovoltaic systems. 2012: CRC press.

RSE311	**Energy Policies and Economics**								**Prerequisites**
2 Cr.	Lecture	**2**	Tutorial	**--**	Lab.	**--**	Semester	**2 nd**	
The state of energy and the symbiosis between energy, policy, technology, and the economy - Uncertainty and impact: environmental, political, cultural – Electricity Markets - Electricity production: Policy and Economics - Alternative Energy for transportation – technical and policy challenges of incorporating renewables - The policy of energy efficiency									

ARC311	**Smart Buildings**								**Prerequisites**
2 Cr.	Lecture	**2**	Tutorial	**--**	Lab.	**--**	Semester	**2 nd**	
Introduction to smart buildings: definitions. A brief history of smart technologies in ancient architecture. Building envelope and components. Effect of the surrounding environment on the building's envelope. Heating, ventilation, air conditioning, lighting, security and other systems. Improve indoor air quality through smart processes, sensors, actuators, microchips, data collection and management according to business functions and services using sensors, reducing energy use, and reducing the environmental impact of buildings and groups of building.									

RSE312	**Training (2) in energy engineering**								**Prerequisites**
0 Cr.	Lecture	**--**	Tutorial	**--**	Lab.	**--**	Semester	**2 nd**	---
Students are required to carry out professional training in specialized training centers or industrial facilities under supervision of program stuff members									

- **Level 400**

A. First Term

RSE413	Design of energy systems								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester	**1 st**	RSE311

Types of Energy Systems, Load forecasting - Reliability and availability - Generation planning – Optimization - Equipment Selection - Technical and financial study – Cost Estimation and energy market - Integrated Product Development, Teamwork, Analysis, Testing, Trade Studies, Modeling, Optimization, Equipment Selection, Cost Estimating, Engineering Economics, Product marketing and Communications

References

- D. Newnan, T. Eschenbach, J. Lavelle, Engineering Economic Analysis 13th Edition, Oxford University Press; 2017.
- G. Mulukutla, Power System Analysis and Design, 5th Edition, Cenage Learning; 2012.
- Y.Jaluria, Design and optimization of thermal systems, 2nd edi0tion McGraw Hill, 2007.
- K. Deb, Optimization for engineering design - algorithms and examples, Prentice Hall, 1995.

ELE413	Power System Analysis								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**--**	Semester	**1 st**	ELE112

Electrical loads characteristics - power system modeling - per unit calculations - symmetrical faults - symmetrical components - unsymmetrical faults - power flow analysis - Gauss method - Gauss-sidle method -Newton-Raphson method - economic operation of power systems

References

- D. Newnan, T. Eschenbach, J. Lavelle, Engineering Economic Analysis 13th Edition, Oxford University Press; 2017.
- G. Mulukutla, Power System Analysis and Design, 5th Edition, Cenage Learning; 2012.
- Y.Jaluria, Design and optimization of thermal systems, 2nd edi0tion McGraw Hill, 2007.
- K. Deb, Optimization for engineering design - algorithms and examples, Prentice Hall, 1995.

ENG412	Project Management								Prerequisites
2 Cr.	Lecture	**2**	Tutorial	**--**	Lab.	**--**	Semester	**1 st**	---

Management of Engineering projects - Implementation of Engineering projects - Engineering Contracts - Project Planning - Project Control and scheduling - Engineering economics - Risk analysis - Project life cycle - Laws and ethics.

References:

- Kerzner, H. and H.R. Kerzner, Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons, 2017.

- Kalpakjian, S., K. Vijai Sekar, and S.R. Schmid, Manufacturing Engineering and technology. Pearson, 2014.
- Nigel J. Smith, "Engineering Project Management", 3rd Edition, Wiley-Blackwell, 2008.

RSE415	Introduction to Biomass Energy								Prerequisites
2 Cr.	Lecture	**2**	Tutorial	**--**	Lab.	**--**	Semester	**1 st**	

Fundamentals of thermochemistry - Introduction to biomass and bioenergy - theory of bioenergy and biofuels production processes - practical production of bioenergy and biofuels - characterization techniques - technologies and bioprocesses for the production of biofuels - biogas for electricity generation – control systems in biogas generation- design and control of bioenergy and biofuel generation - modeling, optimization of biogas and biofuel processes - technical, economic and environmental issues.

References :

- Clark, J.H. and F. Deswarte, Introduction to chemicals from biomass. John Wiley & Sons, 2015
- Lee, J.W., Advanced biofuels and bioproducts, Springer Science & Business Medi, 2012.
- Aresta, M., A. Dibenedetto, and F. Dumeignil, Biorefinery: from biomass to chemicals and fuels. Walter de Gruyter, 2012

RSE416	Project (1) in Energy Engineering								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**--**	Lab.	**3**	Semester	**1 st**	Level 400

Problem formulation - Assignment of solutions - Data Collection - Application of appropriate project work - Discuss and analyze the results - Writing the final reports.

B. Second Term

ELE414	Power System control								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**--**	Semester	**2 nd**	ELE413

Load centers and operating economics – power system classification and methods of operation – power and frequency control – generators and load modeling – voltage and frequency controllers - Basics of using automatic control of generators in isolated and interconnected grids - FACTs in organizing network's voltage – monitoring and control of electrical power systems.

References

- Grigsby, L.L., Power system stability and control. CRC press. 2016.
- Sastry, S., Nonlinear systems: analysis, stability, and control (Vol. 10). Springer Science & Business Media. 2013.
- 3. Pai, M.A., Energy function analysis for power system stability. Springer Science & Business Media. 2012.

ELE415	Power System Protection								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2 nd	ELE413

Fundamentals of switchgear - introduction to power systems protection - circuit interrupting devices (fuse, circuit breakers) - relay principles - instrument transformers - overcurrent protection - distance protection - digital protection - rotating machines protection - transformer protection - bus-bar and feeder protection.

References

- Meliopoulis, A.S., 2017. Power system grounding and transients: an introduction. Routledge.
- Gonen, T., 2015. Electrical power transmission system engineering: analysis and design. CRC press.
- 3. Gomez-Exposito, A., Conejo, A.J. and Canizares, C., 2018. Electric energy systems: analysis and operation. CRC press.

UNR461	Ethics and Morals of the Profession								Prerequisites
2 Cr.	Lecture	2	Tutorial	--	Lab.	--	Semester	2 nd	UNR281

General principles of professional ethics - Commitments to society - Responsibilities of the engineer - Detection of violations - Behavior - Case studies and general issues.

References:

- Lizabeth A. Stephan, David R. Bowman, William J. Park, Benjamin L. Sill, Matthew W. Ohland, "Thinking like an engineer", Published by Pearson 2018.
- Harris, C. E., Jr., Pritchard, M. S., & Rabins, M. J. Engineering Ethics. Second edition. Belmont, CA: Wadsworth, 2000

RSE417	Project (2) in Energy Engineering								Prerequisites
2 Cr.	Lecture	2	Tutorial	--	Lab.	3	Semester	2 nd	Level 400

Problem formulation - Assignment of solutions - Data Collection - Application of appropriate project work - Discuss and analyze the results - Writing the final reports.

Elective Courses

A. Elective Course (1)

UNR461	Electrical Traction								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester		ELE221-ELE322

Traction systems – Train movement and energy consumption – Electric Traction - Traction systems- Speed-time curves and mechanics of train movement- Electric Traction motors- Control of traction motors; Electric braking methods- Regeneration- Electric Vehicles - Types of electric vehicles and hybrid vehicles- motors and batteries for electric vehicles - Drive systems for electric traction.

References:

- L W. Gant, Elements of Electric Traction, BCR publishing 2009
- Gonzalo Abad, Power Electronics and Electric Drives for Traction Applications 1st Edition, wiley 2016

ELE334	**Applications of PLC/SCADA in power system**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester		ELE333

PLC Fundamentals - (Block diagram of PLC's), Applications and Types of Transformers, Selection of PLC components (Power supply, CPU, I/Os List, Communication bus Various ranges available in PLC's), I/O list selection, Types of Inputs & outputs / Source Sink Concepts, Parallel Operation of Transformers, Wiring of the I/O devices, Architectural Evolution of PLC. SCADA system application (Oil GAS / factory /Metro/ Solar Power Plant /Steel Plant), Calculation SCADA tag, Selection of Software basis of SCADA Tag, Creating Database of Tags

References :

- Bolton, William. Programmable logic controllers. Newnes, 2015.
- Mini S. Thomas, John Douglas McDonald, Power System SCADA and Smart Grids, 1st Edition, CRC Press; 2015
- Rajesh Mehra, Vikrant Vij, PLCS & SCADA Theory and Practice, university science Press, 2011

ELE314	**Hybrid Energy Systems**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester		ELE308, ELE 231

Hybrid Systems: Advantages of hybrid power systems - Importance of storage in hybrid power systems - Design of hybrid power system based on load curve - Sizing of hybrid power systems, Issues In Integration Of Renewable Energy Sources: challenges in integrating renewable sources to the grid - Impact of harmonics on power quality - Need to maintain voltage within a band and fluctuations in voltage because of renewable integration - Power inverter and converter technologies - Mechanism to synchronize power from renewable sources to the grid - Overview of challenges faced in designing power injection from offshore generation sources - Challenges in modeling intermittent nature of renewable power in a power system.

References :

- Hossain, Jahangir, Mahmud, Apel, Renewable Energy Integration: Challenges and Solutions, Series: Green Energy and Technology, springer, 2014
- Felix A. Farret, M. Godoy Simões, Integration of Alternative Sources of Energy Wiley-IEEE Press, December 2005.
- N. Mohan; T.M. Undeland; W.P. Robbins, Power Electronics, Converters, Applications and Design", John Wiley and Sons, 1995.

MPE315	Elective Course 1 in Mechanical Engineering								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester		

The elective courses are mainly term projects. The project effort and the final report consists of a description of the idea/concept/design, with reference to the relevant literature, followed by analysis and conclusions. Analysis should use material covered in class and/or related tools. Maximum number of students in project team is 10 students. Students are asked to select one of the following subjects:

1-Water treatment
2-Natural gas technology
3-Pipelines
4-Steam technology
5-Fuel cell

B. Elective Course (2)

ELE325	Electrical Motor Drives								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester		ELE324

Introduction to electrical motor drives – Dynamics of electrical drives – Selection of motor rating – dc motor drives – Induction motor drives – Synchronous motor drives – Special motors drives-Energy efficient drives

References :

- J. Pyrhonen, V. Hrabovcova, Electrical Machine Drives Control: An Introduction 1st Edition, Wiley, 2016
- S.-Ki Sul, Control of Electric Machine Drive Systems, Wiley-IEEE Press, 2011

ELE315	Smart grid technologies								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester		ELE314

Basic Elements of Electrical Power Systems- Origins of the Power Grid- Principal Characteristics of the Smart Grid- Smart Grid Terminology-Modern Grid Characteristics- Reliable- Security-Economic Operation-Efficiency-stability- Accommodates all Generation and Storage Options- Optimization-Integrated Communications- Sensing and Measurement/Advanced Metering- technology for microgrids - integration of renewable energy and energy storage.

References :

- Borlase, S., Smart grids: infrastructure, technology, and solutions. CRC press, 2016.
- Uslar, M., et al., Standardization in smart grids: introduction to IT-related methodologies, architectures and standards, Springer Science & Business Media, 2012.
- Rajakaruna, S., Shahnia, F. and Ghosh, A., Plug in electric vehicles in smart grids. Springer Verlag, Singapor, 2016.

MPE316	Elective Course (2) in Mechanical Engineering								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester		MPE315

The elective courses are mainly term projects. The project effort and the final report consists of a description of the idea/concept/design, with reference to the relevant literature, followed by analysis and conclusions. Analysis should use material covered in class and/or related tools.
Maximum number of students in project team
is 10 students. Students are asked to select one of the following subjects:
1-Computational fluid dynamics
2-Biomass
3- Hydraulic Control
4- Solar Energy
5-Two phase flow

C. Elective Course (3)

ELE421	Electrical Vehicle Technology								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester		ELE325

Introduction to electric vehicles- principle of working of electric vehicles: Design- analysis- control- calibration- operating characteristics - General Background about Hybrid Vehicles – battery technology- electric vehicles charging- smart charging – Motor basics – electric motor types - Motor operation – four quadrant operation, regeneration.

References :
- Tom Denton, Electric and Hybrid Vehicles, Institute of the Motor Industry (IMI), 2016
- Rajakaruna, S., Shahnia, F. and Ghosh, A., Plug in electric vehicles in smart grids. Springer Verlag, Singapor, 2016.
- James Larminie, John Lowry, Electric Vehicle Technology Explained, 1st Edition, Wiley; 2003

ELE418	Utilization of Electrical Energy								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester		ELE335

Electric Lighting -Lighting schemes- calculations & design – Lighting controller design- Electric Heating – Comparison with other heating methods- Resistance heating- Induction heating- electronic heating - Arc furnace- Electric welding: types, equipment and modern techniques- conditioning systems - Heating, Ventilation, and Air Conditioning (HVAC) systems: Principle of air conditioning, vapor pressure, refrigeration cycle, ecofriendly refrigerants- Electrical Circuits used in Refrigeration and Air Conditioning and Water Coolers- Electrochemical Processes – Electrolysis- Electroplating.

References :
- L. Bloch, The Science of Illumination; an Outline of the Principles of Artificial Lighting, Hard Press

Publishing, 2012
- Er. R. K. Rajput, Utilization of Electrical Power, Firewall Media, 2006
- E. O. Taylor, Utilization of Electric Energy in SI Units, Orient BlackSwan/ Universities Press, 2015

PWE411	Wastewater treatment technologies								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester		UNR364

The characteristics and flow discharge of wastewater treated effluent quality requirements, wastewater treatment techniques. Preliminary and primary treatment (equalization, screen, grit removal, flotation), sedimentation, secondary treatment including mass-transfer fundamentals of biological treatment, sludge quantities and methods of its treatment. Wastewater and sludge treatment as an energy source.

ELE416	Energy Auditing and Conservation								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester		ELE335

Basic Principles of Energy Audit definitions, types of audit, energy index, cost index ,Sankey diagrams, energy audit of process industry, thermal power station, building energy audit, Energy Efficient Motors: factors affecting efficiency, constructional details, variable duty cycle systems, motor energy audit, Power Factor: methods of improvement, sizing and location of capacitors, effect of harmonics on power factor, power factor of motor controllers, Energy Instruments: wattmeter, data loggers, thermocouples, lux meters, application of PLC's, Economic Analysis of energy conservation projects.

References :

- Marudhai Vivek, Pannerselvam Sundaramoorthy, Vijayaraj S. , Energy Audit and Conservation, Lap Lambert Academic Publishing, 2017
- Sonal Desai, Handbook of Energy Audit , McGraw Hill Education (India) Private Limited, 2015.
- Barun Kumar De, Energy Management: Audit and Conservation, Vrinda Publications P Ltd.; 2nd edition, 2014

MPE411	Elective Course (3) in Mechanical Engineering								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester		MPE316

The elective courses are mainly term projects. The project effort and the final report consists of a description of the idea/concept/design, with reference to the relevant literature, followed by analysis and conclusions. Analysis should use material covered in class and/or related tools. Maximum number of students in project team is 10 students. Students are asked to select one of the following subjects:

1-Design of heat exchangers
2-Fire fighting
3-Advanced refrigeration systems

4-Advanced energy conversion
5-Refrigeration and air conditioning control

D. Elective Course (4)

ELE422	Energy systems and electrical vehicles								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester		ELE421

Integration of renewable energy sources in charging of EV- Fundamentals of power electronics, converters, and inverters- Fundamentals of vehicle dynamics, control, performance, power management- Energy systems – fuel cells, batteries, battery management and charging systems- Vehicle Energy (Battery, Fuel Cell) and Management Systems - Electric Vehicles Integration in the Electric Power System with Intermittent Energy Sources - the Charge/Discharge infrastructure of EV- Battery charging stations, converters, controls-

References :

- Rajakaruna, S., Shahnia, F. and Ghosh, A., Plug in electric vehicles in smart grids. Springer Verlag, Singapor, 2016.
- Borlase, S., Smart grids: infrastructure, technology, and solutions. CRC press, 2016

ELE419	Illumination Technology								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester		ELE418

Electric Lighting -Lighting schemes- calculations & design – Interior lighting – industrial, Factory, residential lighting- Energy Conservation codes for lighting- lighting controls – daylight sensors and occupancy sensors- Lighting controller design.

References :

- Robert Karlicek et al., Handbook of Advanced Lighting Technology, Springer, Cham, 2017
- L. Bloch, The Science of Illumination; an Outline of the Principles of Artificial Lighting, HardPress Publishing, 2012
- R. John Koshel, Illumination Engineering, Wiley-IEEE Press, 2013

ELE417	Energy Markets								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester		ELE416

Mechanism of energy markets- comparative market systems- determination of prices under different market structures- gas, oil, coal, and electricity market architecture- electricity market design- dispatch and new build decisions- smart grid and renewable energy in electricity markets- risk and risk management in energy including demand and price volatility and use of financial derivatives- Impact of financial market trends and current and proposed policies on the energy industry.

References :

- Tom James, Energy Markets: Price Risk Management and Trading, John Wiley & Sons Pte Ltd, 2008.
- Davis W. Edwards, Energy Trading and Investing: Trading, Risk Management and Structuring Deals in the Energy Market, 1st Edition, McGraw-Hill Education; 2009.

MPE412	**Elective Course (4) in Mechanical Engineering**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester		MPE411

The elective courses are mainly term projects. The project effort and the final report consists of a description of the idea/concept/design, with reference to the relevant literature, followed by analysis and conclusions. Analysis should use material covered in class and/or related tools. Maximum number of students in project team is 10 students. Students are asked to select one of the following subjects:

1. Thermoelectric systems
2. Energy efficiency
3. Fuel systems
4. Sensors in mechanical systems
5. Heat operated refrigeration systems.

Unified Regulations for Bachelor Programs with Credit Hours System (Part II)

Faculty of Engineering – Mansoura University

2020

Chapter Nine:

A B. Sc. Program in SUSTAINABLE ARCHITECTURE Engineering with Credit Hours System

1. Introduction to the Program

With the beginning of the 21st century, the world's tendency to take care of the environment increased, especially with the increasing awareness of the relationship between the environment and architecture. Since ancient times, mankind has sought to adapt to the environment and benefit from its resources. With the increase in engineering and technical capabilities that prepare the environment, make it suitable for life and improve its quality, the term "sustainability" has appeared, which in turn refers to development strategies that take into account the requirements of the present and prepare for the future and balance between interests that serve everyone in the economic and social axes, health and development, all within the framework of providing quality of life. Appropriate and appropriate for the advancement of man and the improvement of his standard of living.

The definition of "environmental architecture" appeared, which is concerned with the physical and natural surroundings of the environment. It recommends the use of natural materials that do not harm people or creatures and wealth in general, and calls for preserving the base of natural resources and wealth for the future. Therefore, "sustainable development" has adopted a set of strategies, including the optimal orientation of the building, exploitation of natural energies and care. With planning systems and building details inside and outside the building, all of this in turn leads to improving the quality of life, including public health, and from here we can say that sustainable planning is the first steps to achieve external and internal sustainable architecture that requires better use of all skills

In fact, the architect cannot achieve the requirements of quality, efficiency and economy unless he is reasonably aware of the theories of sustainability and the compatibility of the building with the surrounding environment. And you have sufficient knowledge in the field of environment and urbanism to consider the architectural aspects in design to preserve the aesthetics and achieve the purpose for which the building was built. Therefore, the market needs an engineer with reasonable knowledge of architectural, structural, environmental and aesthetic aspects to achieve safety, adequacy and beauty of the building, in addition to the old and modern construction methods, selection of the appropriate ones for the project, as well as its economics, its implementation program and the evaluation of the implementation stages in order to achieve the concepts of sustainable development and quality of life.

The Architecture of Sustainable Urban and Interior Design program qualifies the student to obtain a new Bachelor's degree in the field of Architecture. The study is based on the credit hour system and the primary study language in the program is English. As the fields of engineering accommodate many subjects, a number of elective courses have been designed to cover all areas of engineering related to the major. The program offers a number of necessary courses (compulsory) to provide students with the essentials required to study in the program. Some of them are directly related to sustainable interior design, as well as materials related to sustainable urban design. The program also allows the student to take a number of elective courses and basic design courses.

The program links four major disciplines, which have close links and depend on a number of common core courses, and these specializations are:

- Architecture design
- Environmental engineering and sustainability
- Urban design engineering
- Interior design engineering

2. Basic Information

2.1. Program Vision:

Excellence and leadership in architecture and sustainability field at the local and regional levels, the program aspires to be a distinguished and pioneering educational program in the field of interior design and urban design education from the point of view of sustainable architecture.

2.2. Program Mission:

Preparing a distinguished graduate in the field of sustainable architecture through an advanced educational process that meet the requirement of local and regional labor and provide services to the community. By providing high-quality education in the field of specialization, whether in interior architecture or urban design architecture, which contributes to providing a graduate with skills that enable him to effectively practice the profession of interior and urban design, and to deal with real problems, and allow him to quickly integrate into the labor and provide Specialized services to the community that improve the environment.

2.3. Program Aims:

The sustainable urban and interior architecture Engineering program is committed to providing high-quality education in accordance with the most distinguished educational standards for its students in the field of urban and sustainable architecture engineering and interior design. Faculty members and students should participate as productive individuals in the society and contributors with the highest levels of expertise in the energy field.

The program aims to:

1. Prepare graduates who are able to use, develop and apply technical and administrative skills in dealing with electrical energy systems in general and especially in renewable and sustainable energy systems.
2. Develop the performance of graduates with distinctive skills and advanced concepts of renewable energy fundamentals.
3. Keep up with developments in technology and developing effective communication skills.

4. Preparing a graduate who will be able to develop knowledge and skills through self-learning
5. Collaborate with colleagues and others in solving problems through teamwork as team members or as leaders.
6. Qualify to pursue postgraduate studies and scientific research through the development of creative thinking and the ability to analyze problems and systematic thinking to solve them.
7. Establish the professional and ethical values of graduates as leaders in different areas of the energy sector.
8. Enable graduates to work not only in local markets but also in regional markets (especially in Arab and African regions) and international markets.
9. Promote and incorporate sustainability concepts in all program courses as well as embody a culture of sustainability for staff, students and graduates.
10. Create and strengthen a collaborative partnership with stakeholders in the field of skills, knowledge generation and application.

2.4. Specifications of the Program Graduate:

The academic program for urban and interior sustainable architecture engineering is keen to graduate distinguished and qualified engineers for the labor market. The program graduate will be able to:

- Link sustainable urban sciences with other engineering sciences
- Deal efficiently with modern technological methods used in urban and interior design
- Employ theories, information, data and ideas that achieve sustainable and architecture engineering and take decisions that guarantee good management and quality performance
- Model and design interior and exterior in which different disciplines overlap
- Design, implement, operate and maintain urban planning and interior design conduct with architecture to specialize research and studies in the sustainable field
- Deal with problems during the performance of tasks, communication skills and ensure the performance of equipment efficiently

2.5. Graduate Competencies in Accordance with the National Academic Standards

According to NARS 2018, a graduate must be able to:

- Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.
- Develop and conduct appropriate experimentation and/or simulation, analyze, and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.
- Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other

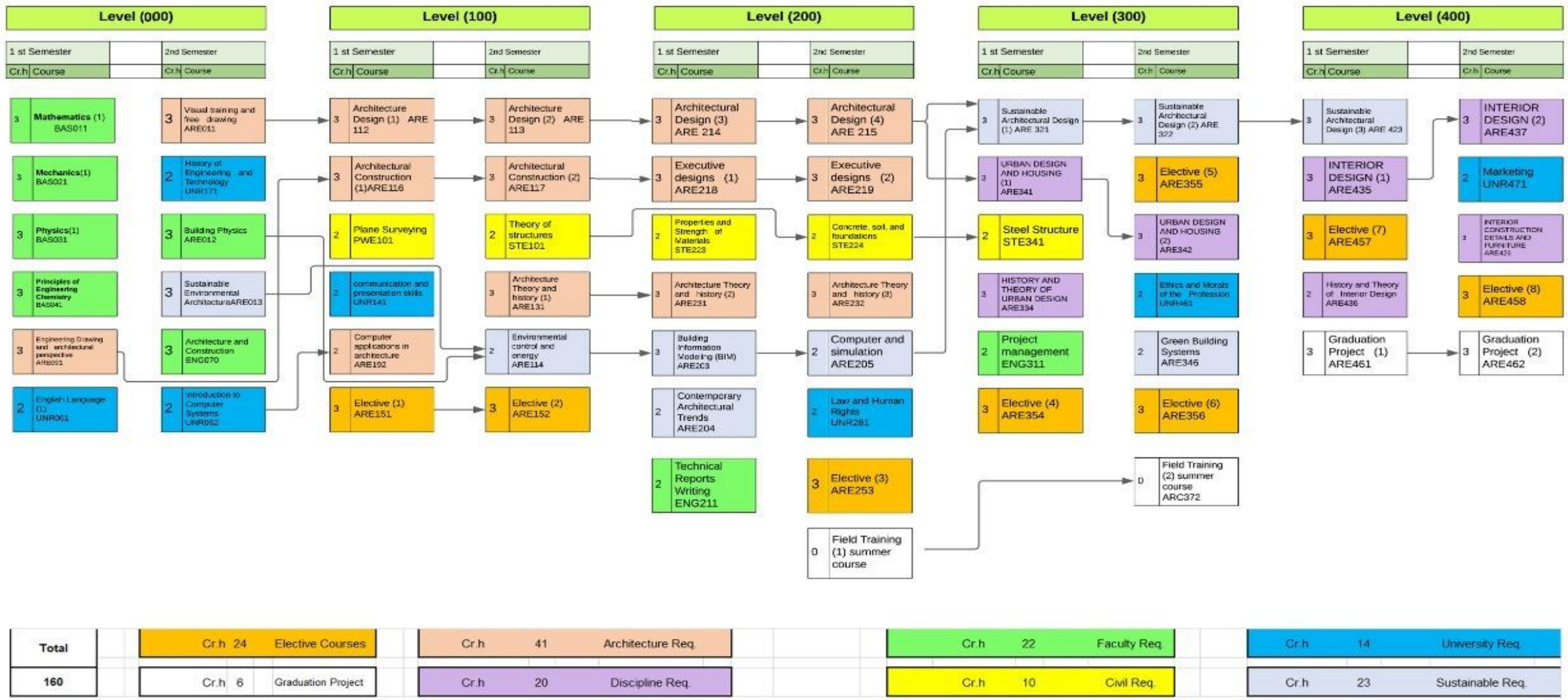
aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

- Utilize contemporary technologies, codes of practice, and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.
- Practice research techniques and methods of investigation as an inherent part of learning.
- Plan, supervise, and monitor implementation of engineering projects, taking into consideration other trades requirements.
- Function efficiently as an individual and as a member of multi-disciplinary and multicultural teams.
- Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.
- Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.
- Acquire and apply new knowledge; and practice self, lifelong and other learning strategies
- Select, model and analyze renewable energy systems applicable to the specific discipline by applying the concepts of: generation, transmission and distribution of renewable energy systems.
- Design, model and analyze an electrical/electronic/mechanical/digital system or component for renewable energy application; and identify the tools required to optimize this design.
- Estimate and measure the performance of an electrical/electronic/mechanical/digital system and circuit under specific input excitation, and evaluate its suitability for a renewable energy application.
- Adopt suitable national and international standards and codes to: design, build, operate, inspect and maintain electrical/electronic/mechanical/digital equipment, systems and services.

The Graduate's Competencies According to NARS 2018: According to the National Academic Reference Standards (NARS 2018), the engineering graduate must be able to	
1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics . 2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions . 3. Apply engineering design processes to produce cost-elective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental ,ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development 4. Utilize contemporary technologies, codes of practice and standards, quality guidelines ,health and safety requirements, environmental issues and risk management principles . 5. Practice research techniques and methods of investigation as an inherent part of learning . 6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements . 7. Function efficiently as an individual and as a member of multi-disciplinary and multicultural teams . 8. Communicate effectively-graphically, verbally and in writing-with a range of audiences using contemporary tools . 9. Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations . 10. Acquire and apply new knowledge; and practice self, lifelong and other learning Strategies.	**Level A**
The Architectural engineering requirements courses must cover the competences of the basic Architectural engineering (Level B)	**Level B**
1. Create architectural, urban and planning designs that satisfy both aesthetic and technical requirements, using adequate knowledge of: history and theory, related fine arts, local culture and heritage, technologies and human sciences. 2. Produce designs that meet building users' requirements through understanding the relationship between people and buildings, and between buildings and their environment; and the need to relate buildings and the spaces between them to human needs and scale. 3. Generate ecologically responsible, environmental conservation and rehabilitation designs; through understanding of: structural design, construction, technology and engineering problems associated with building designs. 4. Transform design concepts into buildings and integrate plans into overall planning within the constraints of: project financing, project management, cost control and methods of project delivery; while having adequate knowledge of industries, organizations, regulations and procedures involved. 5. Prepare design project briefs and documents and understand the context of the architect in the construction industry, including the architect's role in the processes of bidding, procurement of architectural services and building production.	

The Architectural engineering graduate must be able to (Level C):	**Level C**
1. Design robust architectural projects with creativity and technical mastery. 2. Demonstrate Fundamentals of building acquisition, operational costs, and of preparing construction documents and specifications of materials, components, and systems appropriate to the building. 3. Demonstrate knowledge of cultural diversity, differences and the impact of a building on community character and identity. 4. Demonstrate professional competence in developing innovative and appropriate solutions of architectural and urban problems. 5. Apply advanced lighting, acoustics, and smart systems techniques in design	

Sustainable Architecture Engineering Program (SAE) Course Map - خريطة المقررات الدراسية لبرنامج هندسة العمارة المستدامة



Level	Code	Course Name	Graduate’s Competencies According to NARS 2018																			
			Level A										Level B					Level C				
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
000	BAS011	Mathematics (1)	×																			
	BAS021	Mechanics (1)	×																			
	BAS031	Physics (1)	×	×																		
	BAS041	Engineering Chemistry	×	×																		
	PDE091	Engineering Drawing and architectural perspective	×		×																	
	UNR061	English Language (1)								×												
	ARE011	Visual training and free drawing				×			×	×			×					×				
	UNR171	History of Engineering and Technology	×																			
	ARE012	Building Physics	×	×																		
	ARE013	Sustainable Environmental Architecture - History and Theories	×		×																	
	ENG070	Architecture and Construction	×	×																		
	UNR062	Introduction to Computer Systems	×			×																
100	ARE112	Architecture Design (1)			×	×							×					×				
	ARE116	Architectural Construction (1)				×			×	×			×					×				
	PWE101	Plane Surveying				×			×				×					×				
	UNR141	communication and presentation skills		×			×						×					×				
	ARE192	Computer applications in architecture				×										×			×			
	ARE151	Elective (1)				×				×			×					×				

	ARE113	Architecture Design (2)			×								×					×				
	ARE117	Architectural Construction (2)			×											×				×		
	STE101	Theory of structures			×	×							×					×				
	ARE131	Architecture Theory and history (1)					×			×			×							×		
	ARE114	Environmental control and energy				×	×						×					×				
	ARE152	Elective (2)				×										×						
200	ARE214	Architectural Design (3)					×		×				×					×				
	ARE218	Executive designs (1)								×						×				×		
	STE223	Properties and Strength of Materials				×	×								×							
	ARE231	Architecture Theory and history (2)							×	×						×			×			
	ARE203	Building Information Modeling (BIM)				×								×				×				
	ARE204	Contemporary Architectural Trends				×								×				×				
	ENG211	Technical Reports Writing					×							×					×			
	ARE215	Architectural Design (٤)					×		×					×				×				
	ARE219	Executive designs (2)								×						×				×		
	STE224	Concrete, soil, and foundations				×		×							×			×	×			
	ARE232	Architecture Theory and history (3)										×				×				×		
	ARE205	Computer and simulation			×									×				×				
	UNR281	Law and Human Rights						×				×				×			×			
	ARE253	Elective (3)				×										×			×			
	ARE271	Training (1) summer course																				

300	ARE321	Sustainable Architectural Design (1)			×									×				×				
	ARE341	Urban Design and Housing (1)					×		×						×			×	×			
	STE341	Steel Structure							×							×			×			
	ARE334	History and Theory of Urban Design					×				×					×				×		
	UNR311	Project management				×		×							×			×	×			

	ARE354	Elective (4)				×										×			×			
	ARE322	Sustainable Architectural Design (2)							×	×	×					×	×		×	×		
	ARE342	Urban Design and Housing (2)				×										×			×			
	ARE355	Elective (5)						×	×	×						×				×		
	ARE346	Green Building Systems					×									×			×	×		
	UNR461	Ethics and Morals of the Profession				×				×					×					×		
	ARE356	Elective (6)				×										×			×			
	ARE372	Training (2) summer course																				

400	ARE423	Sustainable Architectural Design (3)							×	×	×					×	×		×			
	ARE435	Interior Design (1)			×	×										×			×			
	ARE457	Elective (7)				×										×			×			
	ARE436	History and Theory of Interior Design			×											×				×		
	ARE461	Graduation Project (1)					×	×		×	×	×			×	×	×			×	×	×
	UNR471	Marketing									×	×			×	×					×	×
	ARE437	Interior Design (2)								×							×				×	
	ARE458	Elective (8)									×	×				×	×			×		×
	ARE426	Interior Construction Details and Furniture				×										×			×			
	ARE462	Graduation Project (2)					×	×		×	×	×			×	×	×			×	×	×

3- Course Coding System

Courses are coded according to the following figure (Fig. 1). The course is related to the scientific department that offers it. The first part of the course code is the code of the scientific department. The second part consists of three numbers, the first of which represents the level, while the second number represents the exact specialization number within the scientific department, and the third number reflects a series of courses in the specialization of the same level. Not all of these letters indicate the majors in which the degree is given, some of which represent university requirements, engineering requirements, or specialized courses

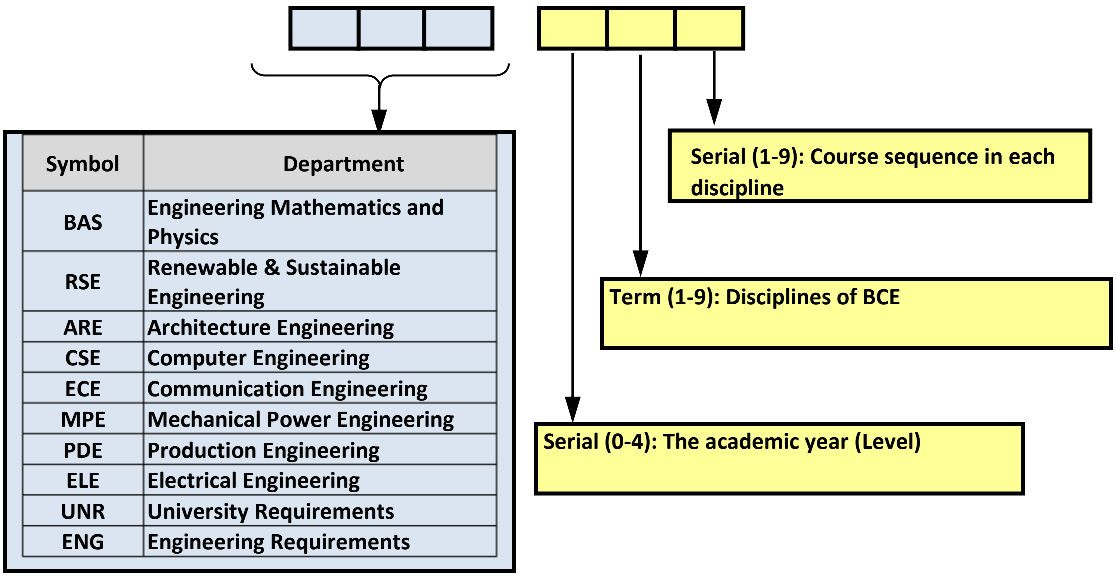


Fig. 1. Course Coding System

Table 1: Scientific Departments and Course Codes

Code	Department
UNR	University Courses
BAS	Engineering Mathematics and Physics
CSE	Computers & Control Systems
ECE	Electronics & Communication Engineering
ELE	Electrical Engineering
MPE	Mechanical Power Engineering
PDE	Production & Mechanical Design Engineering
RSE	Renewable & Sustainable Engineering
ENG	Engineering Faculty Courses

Course code refers to the semester in which this course is usually taught. These dates are subject to change, as not all courses are taught every year. Before the start of each semester, college affairs present a table of courses that will be taught in this semester and their teaching dates and those who are teaching them.

4. Structure and Contents of the USA Program

The structure of the Urban sustainable architecture engineering program consists of 160 credit hours distributed as follows:

a. **University Requirements**

The main purpose of university education is not only to prepare students for successful careers but also to provide them with the knowledge and skills necessary to develop a rational and successful personal identity. Moreover, Mansoura University assists students in gaining an appreciation of the natural and cultural environments in which they live and their roles in society and community services. University requirements in undergraduate programs consist of 14 credit hours (8.75% of the total 160 credit hours), which are fulfilled by completing seven (7) courses which are shown in Table (1).

Table 2: University Requirements: 14 credits (8.75 % of 160 credits)

Course code	Course Name	Credit Hours	Total SWL Mid Term	Marks Distribution		
				semester Works	Lab	Final Term
UNR 061	English language	2	5	20	30	50
CSA 042	Introduction to Computer Systems	2	7	20	30	50
UNR 171	History of Engineering and Technology	2	5	20	30	50
UNR 241	Communication and Presentation Skills	2	5	20	30	50
UNR 281	Law and Human Rights	2	4	20	30	50
UNR 461	Ethics and Morals of the Profession	2	8	20	30	50
UNR 471	Marketing	2	7	20	30	50

b. **Faculty Requirements**

The college requirements provide students with the knowledge and skills necessary to develop a successful engineer. The core of the college is applied to all credit hour programs. The standard requirement of the core courses in the college includes basic knowledge courses for all engineering graduates such as mathematics, physics, mechanics, engineering drawing, design, manufacturing, and chemistry. The college requirements for the Bachelor of Sustainable and Architectural Engineering program consist of 32 credit hours (20 % of the total 160 credit hours), which are completed by completing sixteen (13) mandatory courses, as listed in Table (2).

Table 3: Faculty Requirements: 32 Credits (20 % of 160 credits)

Course Code	Course Name	Credit Hours	Pre-requisite	Total SWL	Marks Distribution			
					Mid Term	semester Works	Lab	Final Term
BAS 011	Mathematics (1)	3	--	8	20	-	30	50

BAS 021	Mechanics (1)	3	--	8	20	-	30	50
BAS 031	Physics (1)	3	--	9	20	10	20	50
ENG 070	Architecture and Construction	3	--	8	20	10	20	50
BAS 041	Basics of Engineering Chemistry	3	--	9	20	10	20	50
ARE012	Building Physics	3	--	10	20	-	30	50
PWE101	Plane Surveying	2	--	8	20	-	30	50
STE101	Theory of structures	2	--	8	20	-	30	50
STE223	Properties and Strength of Materials	2	--	6	20	-	30	50
ENG 111	Technical Reports Writing	2	--	5	20	-	30	50
STE224	Concrete, soil and foundations	2	STE223	6	20	-	30	50
STE341	Steel Structure	2	STE224	7	20	-	30	50
ENG 412	Project management	2	--	8	20	-	30	50

c. Requirements for General and Specific Specialization Courses

The requirements for the general specialization and the exact major in the sustainable and architecture program for the undergraduate degree consist of 114 Credit hours (71.25% of the total 160 credit hours), which are fulfilled by completing **30** mandatory courses equivalent to **84** credit hours, **8** elective courses equivalent to **24** credit hours, Training and graduation projects equivalent to **6** credit hours as shown in Tables (3a) and (3b):

Table (3a) Compulsory Courses as a Requirement for GENERAL and SPECIFIC Specialization (64 Credit Hours = 40% from160)

Course Code	Course Name	Credit Hours	Pre-requisite	Total SWL	Marks Distribution			
					Mid Term	**semester Works**	**Lab**	Final Term
ARE091	Engineering drawing and architectural perspective	3	--	**6**	20	30	--	50
ARE 011	Visual Training and Free Drawing	3	--	**9**	20	30	-	50
ARE013	Sustainable Environmental Architecture (History and Theories)	3	--	**8**	**20**	**30**	**-**	**50**
ARE 116	Architectural Construction (1)	3	PDE052	**9**	20	30	-	50
ARE 192	Computer Application in Architecture	2	--	**7**	20	20	10	50
ARE 117	Architectural Construction (2)	3	--	**9**	20	30	-	50
ARE 131	Architecture Theory and history (1)	2	--	**7**	20	30	--	50
ARE114	Environmental control and energy	2	--	**8**	20	20	10	50
ARE 112	Architectural design (1)	3	ARE011	**9**			--	50

Course Code	Course Name	Credit Hours	Pre-requisite	Total SWL	Marks Distribution			
					Mid Term	semester Works	Lab	Final Term
ARE 113	Architectural design (2)	3	ARE112	9			--	50
ARE203	Building Information Modeling (BIM)	3	--	8	20	30	–	50
ARE204	Contemporary Architectural Trends	2	--	6	20	30	–	50
ARE 231	Architecture Theory and history (2)	3	ARE131	7	20	30	–	50
ARE 214	Architectural design (3)	3	ARE112	8	20	20	10	50
ARE 215	Architectural design (4)	3	ARE214	8	20	30	–	50
ARE 232	Architecture Theory and history (3)	3	ARE231	7	20	30	–	50
ARE 218	Executive Design (2)	3	ARE116	8	20	20	10	50
ARE 219	Executive Design (2)	3	ARE218	8	20	30	–	50
ARE 205	Computer and simulation	2	ARE203	6	20	30	–	50
ARE 321	Sustainable Architectural design (1)	2	ARE215	9	20	30	–	50
ARE 346	Green Building Systems	2	--	7	20	30	–	50
ARE 322	Sustainable Architectural design (2)	3	ARE321	9	20	30	--	50
ARE 423	Sustainable Architectural design (3)	3	ARE322	9	20	30	–	50

Table (3b) Compulsory Courses as a Requirement for SPECIFIC Specialization (44 Credit Hours = 27.5% from160)

1- Compulsory Courses as a Requirement for SPECIFIC Specialization (20 Credit Hours = 12.5% from160)

Course Code	Course Name	Credit Hours	Pre-requisite	Total SWL	Marks Distribution			
					Mid Term	semester Works	Lab	Final Term
ARE 341	Urban Design and Housing (1)	3	--	9	20	30	–	50
ARE 334	History and Theory of Urban Design	3	--	7	20	30	–	50
ARE 342	Urban Design and Housing (2)	3	ARE341	9	20	30	–	50
ARE 436	History and Theory of Interior Design	2	--	7				
ARE 435	Interior Design Architecture (1)	2	--	9	20	30	–	50
ARE 437	Interior Design Architecture (2)	3	ARE435	9	20	30	–	50
ARE 426	Interior Construction Details and Furniture	2	--	9	20	30	–	50

2- Elective Courses as Requirements for General and Specific Specialization (24 Credit Hours = 15% of 160)

Course Code	Course Name	Credit Hours	Pre-requisite	Total SWL	Marks Distribution			
					Mid Term	semester Works	Lab	Final Term
Elective course 1 – ARE 151								
a	Architecture and Sustainable Development	3		8	20	30	--	50
b	Sustainable Green Architecture	3		8	20	30	--	50
Elective course 2 – ARE 252								
a	Interior Architecture	3		8	20	30	--	50
b	Architecture, Culture and Heritage	3		8	20	30	--	50
Elective course 3 – ARE 353								
a	Architecture and Computers	3		8	20	30	--	50
b	Architecture and Behavioral Studies in Society	3		8	20	30	--	50
Elective course 4 – ARE 354								
a	Virtual Interior Architecture	3		8	20	30	--	50
b	Landscape in interior architecture	3		8	20	30	--	50
Elective course 5 – ARE 355								
a	Architectural Models	3		8	20	30	--	50
b	Urban and architectural projects	3		8	20	30	--	50
Elective course 6 – ARE 356								
a	Morphology of Architecture and Urbanism	3		8	20	30	--	50
b	Applications of Artistic Works in Interior Architecture	3		8	20	30	--	50
Elective course 7 – ARE 457								
a	Contracts Specifications and Quantities	3		8	20	30	--	50
b	Artist and Architecture Criticism	3		8	20	30	--	50
Elective course 8 – ARE 458								
a	Urban Preservation and Upgrading	3		8	20	30	--	50
b	Computer applications in interior architecture	3		8	20	30	--	50

Table (4) Project Decisions, Practical Training, and Training (6 Credit Hours = 3.75% of 160)

Course Code	Course Name	Credit Hours	Pre-requisite	Total SWL	Marks Distribution			
					Mid Term	**semester Works**	**Lab**	Final Term
ARE271	Training (1) -Sustainable Architectural Engineering	0	--	--	--	--	--	--
ARE372	Training (2)- Sustainable Architectural Engineering	0	ARE271	--	--	--	--	--
ARE461	Graduation Project (1) - Sustainable Architectural Engineering	3	120 Credit Hours	١٢	--	50	--	50
ARE462	Graduation Project (2) - Sustainable Architectural Engineering	3	Graduation Project (1)	12	--	50	--	50

Fifth: Student's Study Plan Proposal

The following tables clarify a proposal for the regular student to schedule the courses in the first and second semesters for each of the five levels of study, indicating the number of study hours prescribed as lectures, exercises and laboratories, as well as the number of credit hours and contact hours.

Table of level (000) - 1st semester

Course code	Course Name	Weekly hours						Course grades distribution					Prerequisite
		Credit Hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
BAS011	Mathematics (1)	3	2	2	--	4	8	20	30	--	50	100	--
BAS021	Mechanics (1)	3	2	2	--	4	8	20	30	--	50	100	--
BAS031	Physics (1)	3	2	1	1٫5	4٫5	9	20	20	10	50	100	--
BAS041	Engineering Chemistry	3	2	1	1٫5	4٫5	9	20	20	10	50	100	--
PDE091	Engineering Drawing and architectural perspective	3	2	2	--	6	10	20	30	--	50	100	--
UNR061	English Language (1)	2	1	2	--	2	5	20	30	--	50	100	--
	Total	**17**	**11**	**10**	**3**	**25**	**49**					**600**	
Total Contact Hours = 24 hrs./week Total SWL = 49 hrs./week													

Table of level (000) - 2nd semester

Course code	Course Name	Weekly hours						Course grades distribution					Prerequisite
		Credit Hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
ARE011	Visual training and free drawing	3	2	2	--	5	9	20	30	--	50	100	--
UNR171	History of Engineering and Technology	2	2	1	--	2	5	20	30	--	50	100	--
ARE012	Building Physics	3	2	2	2	4	10	20	20	10	50	100	--
ARE013	Sustainable Environmental Architecture - History and Theories	3	2	2	--	4	8	20	30	--	50	100	--
ENG070	Architecture and Construction	3	2	2	--	4	8	20	30	--	50	100	--
UNR06٢	Introduction to Computer Systems	2	1	2	--	4	7	20	30	--	50	100	--
	Total	**16**	**11**	**11**	**2**	**23**	**47**					**600**	
Total Contact hours = 24hrs./week Total SWL = 47 hrs./week													

Table of level (100) - 3rd semester

Course code	Course Name	Weekly hours						Course grades distribution					Prerequisite
		Credit Hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
ARE112	Architecture Design (1)	3	2	2	--	5	9	20	30	--	50	100	ARE011
ARE116	Architectural Construction (1)	3	2	2	--	5	9	20	30	--	50	100	PDE052
PWE101	Plane Surveying	2	1	1	2	4	8	20	20	10	50	100	--
UNR141	communication and presentation skills	2	2	--	--	3	5	20	30	---	50	100	--
ARE192	Computer applications in architecture	2	1	2	--	4	7	20	20	10	50	100	--
ARE151	Elective (1)	3	2	2	--	4	8	20	30	--	50	100	Table 3b
	Total	**15**	**10**	**9**	**2**	**25**	**46**					**600**	
Total Contact hours =21 hrs./week Total SWL = 46 hrs./week													

Table of level (100) - 4th semester

Course code	Course Name	Weekly hours						Course grades distribution					Prerequisite
		Credit Hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
ARE113	Architecture Design (2)	3	2	2	--	5	9	20	20	10	50	100	ARE112
ARE117	Architectural Construction (2)	3	2	2	--	5	9	20	30	--	50	100	ARE116
STE101	Theory of structures	2	1	2	1	4	8	20	30	--	50	100	--
ARE131	Architecture Theory and history (1)	3	2	2	--	3	7	20	30	--	50	100	--
ARE114	Environmental control and energy	2	1	2	1	4	8	20	20	10	50	100	--
ARE152	Elective (2)	3	2	2	--	4	8	20	30	--	50	100	Table 3b
	Total	**16**	**10**	**12**	**2**	**25**	**49**					**600**	
Total Contact hours = 24 hrs./week Total SWL = 49 hrs./week													

Table of level (200) - 5th semester

Course code	Course Name	Weekly hours						Course grades distribution					Prerequisite
		Credit Hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
ARE214	Architectural Design (3)	3	2	2	--	4	٨	20	30	--	50	100	ARE112
ARE218	Executive designs (1)	3	2	2	--	4	٨	20	30	--	50	100	ARE116
STE223	Properties and Strength of Materials	2	1	2	1	2	6	20	30	--	50	100	--
ARE231	Architecture Theory and history (2)	3	2	2	--	3	7	20	30	--	50	100	ARE131
ARE203	Building Information Modeling (BIM)	3	2	2	--	4	8	20	30	--	50	100	--
ARE204	Contemporary Architectural Trends	2	2	2	--	2	6	20	30	--	50	100	ARE151
ENG211	Technical Reports Writing	2	2	--	--	2	5	20	30	--	50	100	
	Total	**18**	**13**	**12**	**1**	**21**	**48**					**700**	
Total Contact hours =26 hrs./week Total SWL = 48 hrs./week													

Table of level (200) - 6th semester

Course code	Course Name	Weekly hours						Course grades distribution					Prerequisite
		Credit Hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
ARE215	Architectural Design (٤)	3	2	2	--	4	8	20	30	--	50	100	ARE214
ARE219	Executive designs (2)	3	2	2	--	4	8	20	30	--	50	100	ARE218
STE224	Concrete, soil, and foundations	2	1	2	1	2	6	20	30	--	50	100	STE223
ARE232	Architecture Theory and history (3)	3	2	2	--	3	7	20	30	--	50	100	ARE231
ARE205	Computer and simulation	2	1	2	--	3	6	20	30	--	50	100	ARE203
UNR281	Law and Human Rights	2	2	--	--	2	4	20	30	--	50	100	--
ARE253	Elective (3)	3	2	2	--	4	8	20	30	--	50	100	Table 3b
ARE271	Training (1) summer course		--	--	--	--	--	--	--	--	--	--	--
	Total	**18**	**12**	**12**	**1**	**22**	**47**					**700**	
Total Contact hours =25 hrs./week Total SWL =47 hrs./week													

Table of level (300) - 7th semester

Course code	Course Name	Weekly hours						Course grades distribution					Prerequisite
		Credit Hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
ARE321	Sustainable Architectural Design (1)	3	2	2	--	5	9	20	30	--	50	100	ARE215
ARE341	URBAN DESIGN AND HOUSING (1)	3	2	2	--	5	9	20	30	--	50	100	--
STE341	Steel Structure	2	1	2	--	4	7	20	30	--	50	100	STE224
ARE334	HISTORY AND THEORY OF URBAN DESIGN	3	2	2	--	3	7	20	30	--	50	100	--
UNR311	Project management	2	2	2	--	4	8	20	30	--	50	100	--
ARE354	Elective (4)	3	2	2	--	4	8	20	30	--	50	100	Table 3b
	Total	**16**	**11**	**12**	**-**	**25**	**48**					**600**	
Total Contact hours 23 hrs./week Total SWL = 48 hrs./week													

Table of level (300) - 8th semester

Course code	Course Name	Weekly hours						Course grades distribution					Prerequisite
		Credit Hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
ARE322	Sustainable Architectural Design (2)	3	2	2	--	5	9	20	30	-	50	100	ARE321
ARE342	URBAN DESIGN AND HOUSING (2)	3	2	2	--	5	9	20	30	-	50	100	ARE341
ARE355	Elective (5)	3	2	2	--	4	8	20	30	-	50	100	Table 3b
ARE346	Green Building Systems	2	2	1	--	4	7	20	30	-	50	100	ARE013
UNR461	Ethics and Morals of the Profession	2	2	2	--	4	8	20	30	-	50	100	--
ARE356	Elective (6)	3	2	2	--	4	8	20	30	-	50	100	Table 3b
ARE372	Training (2) summer course		--	--	--	--	--	--	--	--	--	--	ARE271
	Total	**16**	**12**	**11**	**-**	**26**	**49**					**600**	
Total Contact hours =23 hrs./week Total SWL = 49 hrs./week													

Table of level (400) - 9th semester

Course code	Course Name	Weekly hours						Course grades distribution					Prerequisite
		Credit Hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
ARE423	Sustainable Architectural Design (3)	3	2	2	--	5	9	20	30	--	50	100	ARE322
ARE435	INTERIOR DESIGN (1)	3	2	2	--	5	9	20	30	--	50	100	--
ARE457	Elective (7)	3	2	2	--	4	8	20	30	--	50	100	Table 3b
ARE436	History and Theory of Interior Design	2	2	1	--	4	7	20	30	--	50	100	--
ARE461	Graduation Project (1)	3	2	4	--	6	12	20	30	--	50	100	120 credit hours
	Total	**14**	**10**	**11**	**-**	**24**	**45**					**500**	

Total Contact hours =21 hrs./week   Total SWL = 45 hrs./week

Table of level (400) - 10th semester

Course code	Course Name	Weekly hours						Course grades distribution					Prerequisite
		Credit Hours	Lectures	Tutorials	Lab	Free work	SWL	Mid-term	Class work	Lab grade	Final Exam	Total	
UNR471	Marketing	2	2	1	--	4	7	20	30	--	50	100	--
ARE437	INTERIOR DESIGN (2)	3	2	2	--	5	9	20	30	--	50	100	ARE435
ARE458	Elective (8)	3	2	2	--	4	8	20	30	--	50	100	Table 3b
ARE426	INTERIOR CONSTRUCTION DETAILS AND FURNITURE	3	2	2	--	5	9	20	30	--	50	100	--
ARE462	Graduation Project (2)	3	2	4	--	6	12	20	30	--	50	100	ARE461
	Total	**14**	**10**	**١١**	**-**	**24**	**٤٥**					**500**	

Total Contact hours =21 hrs./week   Total SWL = 45 hrs./week

List of overall data about the programs.

#	Program	NC	Credits and SWL			Total Contact Hours				4 Requirements %				BS %	EC%
			CH	ECTS	SWL	Lec	Tut	Lab	TT	UR	FR	DR	PR		
1	**Sustainable Architecture Program**	**60**	**160**	**30.272**	**756.8**	**110**	**111**	**11**	**232**	**8.75**	**20**	**27.5**	**40**	**8.75**	**15**

NC	Total number of Courses	UR	University Requirement
CH	Credit Hour	FR	Faculty Requirement
ECTS	European Credit Transfer System	DR	Discipline Requirement
SWL	Student Workload	PR	Program Requirement
Lec	Lectures	BS	Basic Sciences Percentage, Credit Hours
Tut	Tutorials	EC	Elective Courses Percentage, by Credit Hours
Lab	Laboratory		
TT	Total		

Syllabus of Urban and Sustainable Architecture Program Courses

- Level (000)

- First Term

BAS011	Mathematics (1)								Prerequisites
3Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	1 st	

Calculus: Function (definition - theorems) - Basic functions - limits - Continuity - Derivation - definition - theorems - types - higher orders - Applications on derivatives - partial derivatives - indefinite integral - theories and properties of integration.

Algebra: Binomial theorem (with any exponent and applications) - Partial Fractions - Theory of Equations - Matrices - System of linear equations - Gauss elimination method.

References:

1. 1.Akhtar & Ahsan, Textbook of Differential Calculus, second edition, 2009, PHI Learning Private Limited
2. Alan Jeffrey, Matrix operations for Engineers and Scientists, 2010, Springer Science & Business Media.

BAS031	Physics (1)								Prerequisites
3Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1 st	

Properties of matter: physical quantities – dimensions and units– oscillatory motion – mechanical properties of material – fluid characteristics – viscosity – surface tension – acoustic waves – waves across elastic bodies.

Heat and thermodynamics: heat transfer – kinetic theory of gases – first law of thermodynamics – entropy and second law of thermodynamics – temperature scales and thermometers – heat expansion.

References:

1. Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 6th Edition, Thomson Brooks/Cole 2014.
2. Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.

BAS041	Engineering Chemistry								Prerequisites
3Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1 st	

Equations of state-chemical thermodynamics - Material and energy balance in chemical processes- properties of solutions - Basic principles in electrochemistry and its applications – Introduction to chemical engineering: basic operations and plastics, fertilizers, dyes and petrochemical industries.

References:

1. Brown, L. T, LeMay H. E. Jr; Bursten, B. E.; Murphy, C.J., and Woodward, P.; " Chemistry The Central Science", Pearson International Edition (11th edn), Pearson Printice Hall, (2009).

PDE052	Engineering Drawing and architectural perspective							Prerequisites
3Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1 st	--

Introduction - Techniques and skills of engineering drawing – Free hand sketching - Engineering processes - Vertical projection - Simple objects projections - The intersection of geometric objects - Drawing geometric objects and isometric drawing - Dimensional writing rules – Generating the missing projections - Engineering sections - Introduction to computer aided drawing

The aim of the course is to identify one of the most important methods of expression and the skills of the architectural designer, which is the three-dimensional drawing, as well as the identification of the mechanisms, principles and steps of the engineering perspective, starting from the expression of simple figures until the projection of the complex models with their details in addition to the methods of projecting shadows on the different interfaces and models, such as exposure to the internal perspective With different drawing methods and casting shadows on the building, both outside and inside.

References:

1. Mcgraw-hill Mint, "Mechanical Drawing Board & CAD Techniques", Student Edition,2011
2. Pozzo, Andrea,Perspective architecture and painting,Published by Dover Publications (1989)
3. *Ching, Frank (1985), Architectural Graphics – Second Edition, New York: Van Norstrand Reinhold.*

UNR061	English Language							Prerequisites
2 Cr.	Lecture	1	Tutorial	2	Lab.	--	Semester	1 st	--

Analysis and explanation of technical texts – abbreviating texts at different levels of conciseness – continuation of preparation for standard language tests.

References:

1. Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011

- **Level 000 term 2**

ARE012	visual training and free drawing								Prerequisites
3 Cr.	lecture	2	tutorials	2	lab	0	semester	2nd	

Requirements:

Content:

various drawing principles and artistic techniques. pencil and pen techniques. free drawing skills - perspective drawing and drawing architectural elements and natural views - colors theory: study color circles ,shapes , degrees and lines - use colors in drawing natural and constructed elements -colors and displays modules - formulation and experience , manual and mental skills - interior design application for buildings - basics of vision and light , studying shadow , straight lines , flying shapes , projection shading methods

References

- Francis D. K. Ching. “Architectural Graphics”, 2015.
- Ernest R. Norling. “Perspective Made Easy (Dover Art Instruction)”, 2012.

ARE071	Building physices								Prerequisites
3 Cr.	lecture	2	tutorials	2	lab	0	semester	2nd	

Content The course aims to study thermal comfort inside the structure, the meaning of thermal comfort, methods of heat transfer from outside the building to the inside, as well as exposure to the influence of climatic regions on the building and study the thermal performance of the outer envelope and the heat exchange processes between the building and the surrounding environment
As well as the most general mathematical methods that an architect needs and mathematical equations to know the physiothermal properties of building materials and the thermal behavior of the structure

-

UNR171	History of Engineering and Technology								Prerequisites
1 Cr	Lecture	1	Tutorial	--	Lab.	--	Semester	2nd	---

Engineering history: Art, Science, Engineering and technology - Role of engineering and technology in development and establishment of civilizations -Technology and environment - Examples on development of engineering activity.

References:

- *Roger S. Kirby, Engineering in History, Dover Publications Inc. New York, United States, 1990, ISBN10 0486264122*

CSE042	Introduction to Computer Systems								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2 nd	---

Introduction to the design and operation of a digital computer: data types, representation and number systems – basic computer components and organization – data transfer input/output as

well as between components and registers – data processing – machine language – relation between SW and HW – operating systems – compilers – introduction to data network.
References: - Peter Van Roy, Seif Haridi, "Concepts, Techniques, and Models of Computer Programming" The MIT Press (February 20, 2012)

ARE031	ARCHITECTURE AND CONSTRUCTION							Prerequisites
3 Cr.	**lectures**	**2**	**Tutorials**	**2**	**lab**		**semester**	2nd	
Introduction - Construction Methods: Concrete, Drilling, Wrenches, Tunnels - Groundwater Dewatering Systems and Design Methods, Setting of Drill Sides, Planning of Construction Sites - Equipment Owning and Operating Costs - Factors that Affect the Selection of Construction Equipment and Calculation of Productivity - Soil Transfer and Excavation - Soil Fixation Compaction and equipment - dewatering								
References: *Leonhard E. Bernold, " Construction Equipment and Methods: Planning, Innovation, Safety",* *Wiley (1602), 2013*								

ARE031	Environmental sustainable architecture (history &theory)							Prerequisites
2Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	2nd	

Content

An introduction to introduce the different ecosystems and ecological systems. Understand and analyze environmental interactions and basic environmental processes. The environmental approach to urban planning. Levels of environmental studies and their institutional building in Egypt. Applied projects in the field of human and environmental studies

Basic concepts of ecological ecosystems, their types and their interactions. General foundations for environmental protection. Characteristics of ecosystems in Egypt. An Egyptian environmental case study

References

- Ivor H. Seeley. “Building Economics Appraisal and control of building design cost and efficiency”, 6th Edition, 2009.
- John M. Levy. “Contemporary Urban Planning” ,10th Edition, USA, 2013

- **Level 100**

A. First Term

ARE121	Architectural constriction (1)							Prerequisites
3 Cr.	lectures	2	Tutorials	2	lab	0	semester	1st	

Requirements: Engineering Drawing and architectural perspective

Content:
Architectural designing basics and principles - the basics of construction work (stones - bricks - concrete - steel) - Architectural and structural symbols and terms of materials - types of buildings (structural - bearing walls) - Construction methods of all types and structural elements , insulating layers , floors ,and stairs -methods of moisture isolation and rainwater drainage - buildings and finishing materials and equipment used - application with making executive drawings of the building - an introduction to the sanitary and extension fittings of the building - study the method of implementing the different stages of construction operations in theory and in the field at the sites introduction to technical installations

References:
- *Ching F. D. K. "Building Construction illustrated, CBS publishers& distributors", India, 2014.*

PWE101	Plane surveying								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	1	Semester	1st	----

Content:
Introduction to mapping and surveying science – Definitions and branches of surveying science and its applications – Different surveying instruments and their uses – The surveying maps and their types – Point positioning techniques – Introduction to vertical control in surveying – Different surveying instruments used for height difference measurement – Ordinary and precise leveling – Calculation of leveling – Applications of leveling – Grid leveling and generation of contour lines – Longitudinal profiles and cross sections. Introduction to Total Station.

References:
- *Johnson, Aylmer. "Plane and Geodetic Surveying 2nd Edition". CRC Press, 2014.*
- *Bossler, and Moffit. "Surveying 10th Edition". 2004.*

Lab	**The use of tape – Tidolite – levels**

ARE114	Architectural design (1)							Prerequisites
3 Cr.	lectures	2	tutorials	2	lab	0	semester	1st	

Requirements : visual training & free hand drawing

content:

Developing the ability to perceive and design architectural formations and formations - design considerations and functional requirements, study functional relationships, orientation, privacy and spatial formations - simplified projects that deal with aesthetic, cultural, environmental, functional and structural determinants of the architectural form and space - the foundations for the use and design of internal and external spaces, services and vertical and horizontal communication - and these topics are based on Human needs and their interaction with the surrounding 'natural and built environment - applications of architectural models and the study of methods of exit and architectural manifestation of projects

References:

- *Neufert, E. "Architect's Data, Crosby Lockwood Staples", 5th edition, London, 2019.*
- *Francis D. K. Ching. "Architectural Graphics", Amazon Digital Services LLC, April 2015.*
- *Ernest R. Norling. "Perspective Made Easy (Dover Art Instruction)", 2012.*
- *Nikolas, Davies & Jokiniemi, Erkki. "Dictionary of Architecture and Building construction", 1st Edition. 2008.*
- *Crosbie, Michael J. "Time Saver Standards for architectural design data", McGraw Hill book company, New York, 2009.*

BAS022	Computer applications in architecture							Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	**1st**	BAS021

Content Identifying the most important architectural drawing programs and their development since its inception in a brief way and the most important architectural outputs related to it, whether in two or three dimensions

Application of a project to a study of a drawing program such as Autocad and Revit, and a study of a wah, application of the program and a list to present a simplified architectural project in application of the program and the use of three-dimensional programs for architectural drawing, study of basic concepts and necessary tools and showing architectural models

References:
- *SELECTED SOFTWARE , DRAFTING PACKADGE CAD TOOLS&OTHER REFERANCES*

	ELECTIVE COURSE (1)							Prerequisites
Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	1 st	

1- **Interior Architecture** The course aims to support the student's skills in designing interior spaces by identifying contemporary concepts, styles and trends in interior design through the elements of colors, lighting, brushes, and local and international schools in interior design , The course also aims to refine the student's skills in showing and presenting various project proposals

2- **Architecture, Culture and Heritage**

The course aims to introduce the basics of knowledge, human studies, social studies, cultural studies, Local, architectural and urban heritage in local architecture and areas of cultural environment in North Africa and Andalusia

References
- Vincenzo de' Rossi as Architect: "A Newly Discovered Drawing and project for the Pantheon in Rome " Femke Speelberg and Furtio Rinaldi, 2015.
- - Janson, H.W. "History of Art", 8th edition., Thames & Hudson, London, 2010.

B- SECOND Term

ARE131	History and Theories of Architecture 1								
3 Cr.	lectures	2	tutorials	1	lab	0	semester	2nd	

Requirements:

content:

The concept of architecture and its theories - the architectural composition (line, plane and mass) - the principles of formation (unity - symmetry - homogeneity - rhythm - hierarchy - diversity - ....) - types of buildings - factors that affect architectural design - the concept of public and private spaces - standards And the design rates, capabilities and design determinants on the basis of providing efficiency, comfort and safety - spatial relationships - scale and dimensions of the human body and its relationship to standards for designing architectural spaces - elements of horizontal movement and elements of vertical movement in buildings - service units for individuals and the preparation of materials and infrastructure.

Ancient Egyptian architecture Mesopotamian architecture Malassic architecture (Greek and Roman) Christianity Fouger Byzantine architecture (Beneficial foundations for designing the different units: Special Use Units (Neum 000 intestinal spaces) and monocytes General use (User requirements Material 00) Service units Vertical and horizontal gear units.

References:

- *Ching, Francis D.K. "Architecture: form, space and order", van nostrand reinhold company, 4ed, New Yoek, 2014.*
- *Nikos A. Salingaros. "A Theory of Architecture", 2016.*

ARE122	Architectural construction 2								
	lecture	2	Tutorials	2	Lab	0	semester	1st/2nd	

Requirements: Architectural construction 1

content:

Building components - theoretical and field study of structural materials and systems - types of foundations - thermal insulation of final roofs and external walls - an introduction to finishing work and equipment used in building finishes, with application on a limited space example - studying different methods of building construction and construction - structural buildings - frames - slabs Sliding - Prestressed concrete - Applied slabs - Shell structures - Metal structures - Trusses - Stairs construction details.

References:

- *Neufert, E. "Architect's Data, Crosby Lockwood Staples", 5th edition, London, 2019.*
- *Francis D. K. Ching. "Architectural Graphics", Amazon Digital Services LLC, April 2015.*
- *Ernest R. Norling. "Perspective Made Easy (Dover Art Instruction)", 2012.*
- *Nikolas, Davies & Jokiniemi, Erkki. "Dictionary of Architecture and Building construction", 1st Edition. 2008.*
- *Crosbie, Michael J. "Time Saver Standards for architectural design data", McGraw Hill book company, New York, 2009.*

ARE114	**Architectural Design (2)**								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	2	Lab	0	Semester	2nd	Architectural design 1

Content:
Developing the ability to perceive architectural formations and their design – design considerations and functional requirements, study functional relationships, guidance, privacy and space configurations– simplified projects that address the aesthetic, cultural, environmental, functional and structural determinants of architectural form and space – the foundations for the use and design of internal and external spaces and services and vertical and horizontal communication – and focus those topics to human needs and its interaction with the surrounding environment ' natural and built – applications of architectural models and methods of studying directing and Manifesting architectural projects.

References:
- Neufert, E. "Architect's Data, Crosby Lockwood Staples", 5th edition, London, 2019.
- Francis D. K. Ching. "Architectural Graphics", Amazon Digital Services LLC, April 2015.
- Ernest R. Norling. "Perspective Made Easy (Dover Art Instruction)", 2012.
- Nikolas, D. & Jokiniemi, E. "Dictionary of Architecture and Building Construction", 1st Ed. 2008.
- Crosbie, Michael J. "Time Saver Standards for Architectural Design Data", McGraw Hill book company, New York, 2009.

STE101	**Structural Theories**							Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	2nd	

Content:
Types of loads – Types of focal points – Reactions – Balance of the statically determinate structures, specified disseminations – internal forces in the beams trusses, frame and arches – Trusses analysis. Influence lines: beams, trusses, frames (determinate).

References:

- *Kassimali, A. "Structural Analysis (Si Edition)". Stamford USA: Cengage Learning 2011.*

Kenneth M. Leet, Chia-Ming Uang, Joel T. Lanning, Anne M. Gilbert. "Fundamentals of Structural Analysis". McGraw-Hill Education, 2018.

ARE172	**Environmental Control and Energy**							Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2 nd	---

An introduction to the concept of environmental control by natural means. The influence of climatic regions on building design. Study the needs for achieving thermal comfort and visual comfort. Study the thermal performance of buildings and methods of controlling them, by studying the heat exchange processes between the building and the surrounding environment. Elements of natural lighting and how to achieve them in terms of quantity and quality. The effect of building design on providing natural light levels. Natural lighting analysis methods. Natural lighting systems and techniques.

References:
References:
- *Brown, G.Z., Sun, Wind and Light, Architectural Design Strategies, John Wiley & sons Inc, 2000.*
- *Koenigsberger, O.H., Igersoll, T.G., Mayhew. A., Szokolay, S.V., Manual of Tropical Housing and –*

Building, Longman, 1974.
- *Lechner, N., Heating, Cooling and Lighting; Design Methods for Architects, John Wiley & sons, USA, 1991.*
- *Robins, C., Daylighing Design and Analysis, Van Nostrand Reinhold Comp., 1986*

UNR241	**Communication and Presentation Skills**								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	2nd	

Communication skills - Presentation planning and preparation - Delivery skills such as eye contact, voice control, gestures, body language and appearance - Presenter's characteristics - Using visuals - Presentation structure - Elevator Pitch

References:

- *Joan van Emden, Lucinda Becker, Presentation Skills for Students, 3rd Edition, Red Globe Press, 2016*
- *M. Wa Mutua, S. Mwaniki, P. Kyalo, B. Sugut, Communication Skills: A University Book, Succex Publishers, 2016*
- *Ian Tuhovsky, Wendell Wadsworth, Communication Skills Training, Ian Tuhovsky, 2015*
- *Tabitha Wambui, Alice W. Hibui, Elizaeth Gathuthi, "Communication skills " Vol.1, Students' coursebook, LAP LAMBERT Academic Publishing, 2012*

ARE152	**ELECTIVE COURSE (2)**								

1- INTERIOR Architecture and computers

The course aims to introduce the history and methods of using computers in the stages of architectural design, demonstration, two-dimensional and three-dimensional designs and simulation operations of architectural buildings

2- Architecture and behavioral studies in society

The course aims to study the reciprocal relationship between architectural production and community behaviors, with a focus on the stages of transformation in the transformation of intellectual doctrines and their impact on perception in society on the behavior of individuals in society.

References

- *Annie R Pearce. "Sustainable Buildings and Infrastruction", 2012*.

- Mary Guszowski. "Towards Zero-energy Architecture New Solar Design", laurence king, 2010..

- **Level 200**
- **A FIRST TERM**

ARE215	**ARCHITECTURAL DESIGN (3)**								Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	1 st	Architectural design 2

Content:
Addressing the design process in its various dimensions - studying design performance techniques - analyzing the elements of medium-sized projects and installation - principles of studying the environmental impact of projects at the design stage - studying the importance of the structural idea in shaping architectural voids - simple structural systems and the architectural function - application with educational projects and studying architectural voids from In terms of quantity and quality.

References:

- *- Neufert, E. "Architect's Data, Crosby Lockwood Staples", 5th edition, London, 2019.*
- *- LAWSON, Bryan. "The Language of Space", Architectural Press, Oxford, 2015.*

- Annie R. Prerace, Yong Han Ahn and HanmiGlobal. "Sustainable Buildings and Infrastructure", by Routledge in USA and Canada, 2012.

ARE216	**Architectural Design (4)**								**Prerequisite**
3 Cr Elective	**Lectures**	**2**	**Tutorials**	**2**	**Lab**	**0**	**Semester**	**1st/2nd**	**Architectural Design (3) ARC215**

Content:
Methods for determining dealing with design problems - studying void spaces in terms of formation and function - studies assessing the environmental impact of openings on ventilation and natural lighting of buildings - construction materials and how to adapt design with its components and elements to the surrounding environment, habits and human characteristics - conducting research and field visits and applying them to architectural design projects .

References:

- *Neufert, E. "Architect's Data, Crosby Lockwood Staples", 5th edition, London, 2019.*
- *Annie R Pearce. "Sustainable Buildings and Infrastruction", 2012.*
- *Mary Guszowski. "Towards Zero-energy Architecture New Solar Design", laurence king, 2010.*

ARE223	**CONSTRUCTION DESIGN DETAILS (1)**								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**--**	Semester	**1 st**	

The foundations for preparing and clarifying all the elements in the projections, sectors and facades - a detailed study for preparing the full architectural executive drawings for large projects - a detailed study through implementation at the sites - and preparing researches in various and modern construction methods to cover the seas and large surfaces of specialized and varied buildings - Preparing the full architectural executive drawings for these projects Making field visits to the sites of engineering projects under construction to study operational details on the ground.

References:

- *Rosemary Kilmer, W. Otie Kilmer. "Construction Drawings and Details for Interiors", 3rd Edition, January 2016*

ARE224	DESIGN CONSTRUCTION DETAILS (2)								Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	--	Semester	1 st	CONSTRUCTION DESIGN DETAILS (1 (ARE223

Making feeding drawings - electrical drawings for all roles and high pressure lines - mechanical drawings for elevators, escalators and rooms that can adapt to cooling and heating - models of openings and fixed and moving partitions - fixed mattresses - tables and details of all finishing materials - making field visits to sites of engineering projects under construction to study the details Executive on the nature

References

- Rosemary Kilmer, W. Otie Kilmer. "Construction Drawings and Details for Interiors", 3rd Edition , January 2016.
- Crosbie, Michael J. "Time saver standards for architectural design data", McGraw hill book company, New York, 2004.
- Ching, F. D K. "Building Construction Illustrated", CBS publishers & distributors, India, 2008

ARE233	History and theories of Architecture (2)								3
	LECTURE	2	TUTORIALS	2	Lab	0	semester	1st	mandatary

Requirements: History and theories of Architecture (1)

content:

Analytical study of factors affecting architectural design (economic, functional, social, human, psychological and environmental) - Building materials technology - Study of architectural theories and design determinants of building elements - Units of vertical alignment and horizontal corridors - Theories of residential buildings - Administrative buildings - Commercial buildings - Study of visual relations of buildings and lighting And natural ventilation

Romanesque architecture, Gothic architecture, Islamic architecture in Egypt, the European Renaissance

The design determinants of public buildings, buildings of educational and cultural services, the role of the sacred museum, the museums, the misyar, the buildings -

Health, recreational buildings, social centers, commercial buildings, markets, tourist buildings 00.

References

- Neufert, E. "Architect's Data", John Wiley & Sons, 5th edition, London, 2019.

ARE234	History &Theory of Architecture (3)								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	ARE233

Content:
An analytical study of factors affecting architectural design (economic, functional, social, human, psychological, and environmental) - Building materials technology - Study of architectural theories and design determinants of building elements - vertical distribution units and horizontal corridors - theories of residential buildings - Administrative buildings - commercial buildings - study the visual relationships of buildings and means of lighting and natural ventilation.

References:
- *Ching, Francis D.K. "Architecture: form, space and order", van nostrand reinhold company, 4ed, NY, 2014.*
- *Nikos A. Salingaros. "A Theory of Architecture", 2016.*

Are273	**Contemporary Architectural Trends**								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2 nd	---

Content The course aims to study renewable and sustainable energy in architectural and urban design through exposure to different models of modern topics such as parametric architecture, history, origin, goals, the most important works, pioneers, and digital architecture and their impact on architectural production in Egypt and the world, as well as integrating topics related to bioengineering, biology and architecture as a topic in circulation in the 21st century And adding any future topics to the content of the course

References:
- Jabi, Wassim (2013). *Parametric Design for Architecture*. London: Laurence King. ISBN 9781780673141.
- Frazer, John (2016). "Parametric Computation: History and Future". *Architectural Design*. **86** (March/April): 18–23. doi:10.1002/ad.2019. S2CID 63435340

Are243	**Computer and simulation 1**								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2 nd	---

Content

The course aims to study the applications of various computer programs on the building envelope such as walls and ceilings in the field of architecture and make an environmental analysis of the building to study the thermal behavior through the outer envelope and the rates of ventilation and lighting to achieve the appropriate thermal comfort for the users of the space as well as the rationalization of energy consumption rates in the building through the application of one of the programs The appropriate analysis and simulation, for example, ECOTECT, DESIGN BUILDER, with an appropriate version, and to identify the basics and concepts and apply them to an existing building project or designed by the student.

References:
- *Vishal garge and others , Building energy simulation a work boo; using design builder2nd edition , crc press*

ARE242	**Building information modeling BIM**								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2 nd	COMPUTER APPLICATION IN ARCHITECTURE ARE141

The course aims to study BIM building information modeling so that it includes theoretical backgrounds and practical training on techniques through mathematical modeling and the concept of an imaginary building: basic principles, data entry, data editing and formatting, data processing, functions and equations, moving between worksheets, use of analysis, protection of the file and adding Notes. Architectural modeling through the use of 3D software for architectural drawing:

basic concepts and tools needed to make an imaginary 3D model, quantify the building, show models, make sun studies, snapshots of an imaginary reality.

References:

Vishal garge and others , Building energy simulation a work booK using design builder2nd edition , crc press

	Concrete, Soil and foundations								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2 nd	---

Content: A study of concrete in the field of (short) columns design. Under the influence of axial loads, design of shallow foundations, design of simple and continuous beams to cover spacious halls, design of various frames, covering large halls using veneers and crust tiles

Study of properties and mechanics of soil - Test and design of foundations - Study of stress transmission through the soil - Design of shallow foundations - Pile foundations - retaining walls - Soil research and selection of the appropriate type of foundation.

Principles of design of concrete structures - Analysis and design of sectors subject to bending - Load distribution - Reinforcement of beams and design - Solid bars - Columns - Stairs - Nerve bars and Hollow blocks. And studying the connections of the precast construction units.

Foundations settlements -Types of foundations - bearing capacity of the soil - design of shallow foundations under vertical loads - methods of foundation design - design of different types of concrete footings (combined footing - strip footing – strap footings – footing subjected to eccentricity – raft foundations- design different types of retaining walls.

References:

- *David R. H. Jones and Michael F. Ashby. “Engineering Materials 1: An Introduction to Properties”, Applications and Design by, 2011.*
- *Das, Braja M., “Principles of Foundation Engineering,” 2010.*
- *"Egyptian Code for Soil Mechanics and Design and Execution of Foundations", 2002.*
- *Barnes, G. E. "Soil Mechanics: Principles and Practice". Macmillan Education UK, 2000*

STE103	Properties and Strength of Materials								Prerequisite
3 Cr Compulsory	Lectures	2	Tutorials	1	Lab	1	Semester	First	Physics (1) BAS031 + Mechanics (1) BAS021

Content:

Introduction to the characteristics and tests materials – machines testing and calibration – the behavior of engineering materials under the influence : tensile static, pressure static, bending static, shear static – shock – fatigue – discuss the physical properties of the basic mechanical and for a variety of materials related to civil engineering , such as concrete, asphalt, wood, vehicles Fibers – Safety factor selection for design stresses – Metal rust – Fracture types – Fracture mechanics.

References:

- *Neville, A.M., "Properties of Concrete",5th ed., Longman, 2010.*

UNR281	Law and Human Rights								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	2ed	---
Systems and laws of institutions - Introduction to Accounting - Labor legislation and laws governing engineering professions - Industrial security legislation and environment - Historical philosophical origins of human rights - international sources of human rights - national sources of human rights - global bodies based on the protection of human rights.									

ENG211	Technical Reports Writing								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	2nd	UNR062
Technical writing definition - audience analysis - technical writing styles - technical document characteristics - automated document organization - official and unofficial document types - structure of different types of technical documents.									

References:

- *G. J. Alred, W. E. Oliu, The Handbook of Technical Writing, 12th Edition, Bedford/St. Martin's; 2018*
- *K. Hyland, Teaching and researching writing. 3rd edition Routledge academic publisher, 2016*
- *M. Markel, Technical Communication, 11th edition, MacMillan, 2015.*

ARE353	ELECTIVE COURSE (3)								

1- Virtual Interior Architecture:

An introduction to the subject of virtual internal architecture and its definition and its potentials for internal and external architectural design by studying the new aesthetic concepts related to it and arising from virtual architecture and its various technologies

2- Landscape in interior architecture:

The course aims to express the styles, planning systems and design of green spaces in architecture, types of plants and their different coordination methods, especially in interior design and their relationship to improving the internal environment of the space

The course also examines the composition of the land - spaces - buildings - trees - street brushes - water ... the history, theories and foundations of garden design through the ages. The impact of local variables such as traditions, climate ... on the design process. One or more projects for landscaping and designing

References

- CARMONA, Matthew and TIESDELL, Steve. “Urban Design Reader: The Dimensions of Urban Design”, The Architectural Press, 2007.
- Taylor & Francis Ltd. “The Urban Design Reader 2nd New edition, Routledge”, London, United Kingdom, 2012.
- Francis D. K. Ching. “Architectural Graphics”, 2015.
- Dynamic thermal environment and thermal comfort, Y. Zhu Q. Ouyang B. Cao X. Zhou J. Yu First published:14 July 2015
- Renewable and Sustainable Energy Reviews, Science direct journal, vol 65
- Architectural acoustics, M Long - 2005
- Environmental and architectural acoustics,Z Maekawa, J Rindel, P Lord - 2010

ARE253	Training (1)								Prerequisite
0 Cr Compulsory	Lectures	0	Tutorials	0	Lab	0	Semester	Summer	----

Content:
THIS Training After the completion of the second year - in institutions or engineering offices - the training period is four weeks - it ends with a discussion with the academic supervisor to determine the training skills acquired.

- **Level 300**

ARE361	Sustainable Architectural Design 1								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2 nd	---

Designing public buildings with open spaces such as tourist and medicinal villages of various types, foundations and theories followed, and studying the external surroundings in detail in terms of land composition - spaces - buildings - trees - street brushes - water ... History, theories and foundations of garden design through the ages. The impact of local variables such as traditions, climate ... on the design process. One or more projects for landscaping and designing

The course aims to study the architectural design of spaces from the point of view of building information modeling, which is a representation of the physical and functional characteristics of the facility in the form of a simulation model that is built using a computer that is the source of common information during the life cycle of that facility as it forms a reliable basis for decision-making. My work is applied to one of the appropriate residential or administrative projects designed by the student and the most important results of the building elements are drawn from the facades and projections, and the study of the landscape elements and site determinants surrounding the project

Autodesk Revit Architecture

Graphisoft ArchiCAD

References:

- *Neufert, E. "Architect's Data, Crosby Lockwood Staples", 5th edition, London,2019.*
- *Annie R Pearce. "Sustainable Buildings and Infrastruction", 2012.*
- *Mary Guszowski. "Towards Zero-energy Architecture New Solar Design", laurence king,2010.*
- Jan L.M. Hensen & Roberto Lamberts. "Building Performance Simulation for Design and Operation Hardcover", Routledge, 1st edition, Jan 2011.

ARE362	Sustainable Architectural Design 2								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2 nd	---

The content is a practical application on the student's architectural project. The following models can be expected as important outputs and results from the application of the BIM methodology at work and the most important application outputs expected through a model for the general site

And Model Massing.

: Architectural, Structural & MEP Models, Electromechanical and Structural Model, Architectural

Model

And application with available software such as RhinoBIM (BETA) and Energy Analysis Autodesk Green Building Studio

References:

- *Neufert, E. "Architect's Data, Crosby Lockwood Staples", 5th edition, London,2019.*
- *Annie R Pearce. "Sustainable Buildings and Infrastruction", 2012.*
- *Mary Guszowski. "Towards Zero-energy Architecture New Solar Design", laurence king,2010.*
- Jan L.M. Hensen & Roberto Lamberts. "Building Performance Simulation for Design and Operation Hardcover", Routledge, 1st edition, Jan 2011.

ARE343	Computer and simulation 2								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2 nd	---

Content: A theoretical introduction to green buildings, renewable energy and energy management, as well as a study of the most important international platforms and associations such as ASHRAE, CIBSE, IEEE, AEE.

Completing the advanced level helps the student to qualify for the LEED exam and study the simulation programs for thermal comfort and energy in terms of rationalizing them and reducing the building's consumption by reducing the air conditioning and heating loads of the façades and roofs, the modernization and cladding for all parts of the building. With the applied program and studying the most successful local and international projects in the field of energy consumption

References:

- *Francis D. K. Ching. "Architectural Graphics", 2015.*
- *Dynamic thermal environment and thermal comfort, Y. Zhu Q. Ouyang B. Cao X. Zhou J. Yu First published:14 July 2015*

STE305	**Steel Structures (1)**								**Prerequisite**
3 Cr Compulsory	**Lectures**	**2**	**Tutorials**	**2**	**Lab**	**0**	**Semester**	**1st**	**Structural Analysis (2) STE202**

Content :

Introduction – Introduction to different types of halls - Design methods of steel buildings (ASD - LRFD Methods) - type of loads – Design of trusses, tension members, compression members, beams (subjected to static and dynamic load), bolted connections, and welded connections.

References:

- *Alan Williams. "Steel Structures Design (ASD/LRFD)". USA: International Code Council, 2011.*
- *Liang, Q. Q. "Analysis and Design of Steel and Composite Structures". USA: Taylor & Francis, 2015.*
- *"Egyptian code of practice for steel construction and bridges (ASD)", Code No. ECP 205-2001, Edit 2009, Ministry of Housing, Utilities, & Urban Development.*

ARE374	Green building systems and Evaluation								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2 nd	---

Content Study of the green building that takes into account environmental considerations at every stage of construction, namely design, implementation, operation and maintenance, and the main considerations that take into account are the design of spaces, energy and water efficiency, resource use efficiency, the internal environmental quality of the building, and the impact of the building as a whole on the environment. We do not know the local and global systems such as leed, bream, as well as the study that qualifies for a certificate of one of the programs for global evaluation and study cases for examples of buildings that have the leed certificate

How to apply green building and sustainable design ideas and demonstrate how to use Building Information Modeling to achieve the optimal solution for sustainability. Discussing the definition of Egyptian systems, its importance, history, programs, and the role of the Housing and Building Research Center as an important reference in engineering, architecture and design

References:

- *Dynamic thermal environment and thermal comfort, Y. Zhu Q. Ouyang B. Cao X. Zhou J. Yu First published:14 July 2015*

ARE364	URBAN DESIGN AND HOUSING (1)								

Introduction to urban design. Foundations of visual perception. Visually analyzing the city: the visual image / visual elements / visual formation. Alternatives to the design and components of the urban formation of the city. Applied studies:
Methods of data collection, analysis, and presentation.
• Report on the formation of new or existing cities. Analyzing and designing urban spaces.
• Raise and analyze the elements of the visual formation of a study area, an applied study of the formation of the city. The problems of urban planning and housing in Egypt within the framework of its economic, social and urban dimensions - and the various approaches and concepts of it

References

R P Misra. "Regional Planning "Concepts, Techniques, Policies and case studies"", Peter Hall and Mark Tewdwr- Jones, Urban and Regional Planning, 5th Edition, 2010.

ARE335	HISTORY AND THEORIES OF URBAN DESIGN								

Urban design of some distinctive global cities and their development over the ages. Analyzing the foundations of urban design. The influence of natural, social and behavioral factors on urban formation and fabric
Urban design process: mission / objectives / case studies / analyzes / development of design thinking / design alternatives / evaluation / implementation. Work stages, inputs and outputs. Methods of analysis, deduction and solutions. Modern approaches to urban design: participatory design, sustainability, and rapid intervention method. An applied study of multiple methodologies models

References

- Carmona, M. heath, T& tiesdell, S. "Public Places Urban Space: the dimensions of the urban", Oxford, architectural press, 2nd Edition, 2010.

- John M. Nicholas. "Project Management for Business and Engineering: Principles and Practice", 5th Edition, 2012

ENG211	Project Management								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---

Fundamentals of biomedical project management – Integration management – Scope management – Time management – Cost management – Quality management – Human resources management – Communication management – Risk management – Procurement management – Biomedical projects case studies

References:

- *Kerzner, H. and H.R. Kerzner, Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons, 2017.*
- *Kalpakjian, S., K. Vijai Sekar, and S.R. Schmid, Manufacturing Engineering and technology. Pearson, 2014.*
- *Nigel J. Smith, "Engineering Project Management", 3rd Edition, Wiley-Blackwell, 2008.*

ARE354	ELECTIVE COURSE (4)								Prerequisite
3 Cr	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	

Content:

1- Morphology of architecture and urbanism:

Analysis of the foundations of architectural and urban formations. Why do architectural and urban projects take specific configurations and shapes? The process of generating, criticizing, evaluating, selecting and developing alternatives solutions The relationship of the building to the urban environment and the environment Evaluating a case study. Design project of a building / simple residential buildings or more. Small / mid-sized building design - one job.

In addition to the design concept, its steps, methodology and basic elements. Design ratios, ratios and benchmarks. Principles of identifying and forming voids. The basic architectural objectives (utilization, creation, beauty, economy). The development of the ability to visual design spaces and models and training in design skills and expression manually.

2- Applications of artistic works in interior architecture:

The course aims to study how to employ plastic artworks, whether they are pre-prepared artworks or plastic works specially designed and designed for an internal space in a given space, as well as studying contemporary patterns of artistic works, their raw materials, methods of displaying them, and how to make use of them to make use of a plastic job in the space.

Movement is also studied as a basic element of interior design, and movement is linked to space and furnishing, corridors and paths connect different areas to each other, and movement is studied through direction, proportions, scale, materials and lighting, as well as studying the element of time.

References:

Dynamic thermal environment and thermal comfort, Y. Zhu Q. Ouyang B. Cao X. Zhou J. Yu First published:14 July 2015

ARE365	URBAN DESIGN AND HOUSING (2)								Prerequisite
3 Cr	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	ARC354

Content:

Applied studies and practical training on the foundations and methods of analyzing and developing the urban structure. Preserving the urban and social fabric. Integration between urban development and economic return to achieve sustainability. International models for intervention and development methods. The integration of the theoretical aspect with a project to redesign and develop an existing urban area or urban axis.

Housing categories - the foundations and considerations of the housing model design and their groupings in residential buildings and assembly units - Classifications of units and residential buildings.

Exercises for designing and assembling residential models. Methodology for planning residential areas - preparing housing and services programs in light of needs and capabilities - generating alternatives for distributing residential areas, services, and motorized and pedestrian traffic networks. New residential area planning exercise
References John Randolph and Gilbert M. "Masters, Energy for Sustainability: Technology, Planning, Policy", Island press, Washington, DC, 2008.

UNR461	Ethics and Morals of The Profession								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	1st	---
General principles of professional ethics - Commitments to society - Responsibilities of the engineer - Detection of violations - Behavior - Case studies and general issues.									

References:

- *Lizabeth A. Stephan, David R. Bowman, William J. Park, Benjamin L. Sill, Matthew W. Ohland, "Thinking like an engineer", Published by Pearson 2018.*
- *Harris, C. E., Jr., Pritchard, M. S., & Rabins, M. J. Engineering Ethics. Second edition. Belmont, CA: Wadsworth, 2000*

ARE455	ELECTIVE COURSE (5)								Prerequisite
3 Cr Elective	Lectures	2	Tutorials	2	Lab	0	Semester	1	ARC354

Content:

Urban preservation and upgrading:
The course aims to identify the problems of the existing urban areas, the phenomenon of urban deterioration, their types, causes, methods of measurement and the methods used to address them. Classification of urban areas in cities (historical, traditional residential neighborhoods, informal housing areas ...). Methods of handling and dealing with urban areas: historic city centers / traditional residential neighborhoods / informal housing areas. Applications: Monitoring and measuring the aspects of deterioration in an existing urban area and determining treatment policies.

Computer applications in interior architecture:
The last decades of the twentieth century were marked by the emergence of major developments in information technology and the use of
Computers in dealing with internal architecture problems is one of the most important applications due to what computer information systems have in this
The field of a large amount of data that is recorded, processed, stored and suggested alternatives, which justifies the use of computers to rationalize work costs

References

-Architectural Drawing Course: Tools and Techniques for 2D and 3D Representation", 2nd edition, Mo Zell, 2018.

-Leonidas Stavridi. "Structural Systems: Behaviour and Design" - Volume 1: Plane structural systems, 2010

ARE355	ELECTIVE COURSE 6								Prerequisite
3 Cr	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	

1- **COMPUTER IN SUSTAINABLE PLANNING**

Content:

Introduction to the various computer operating systems. An introduction to database programs packages (Databases and an advanced study of the (EXCEL) program and its schematic applications. An introduction to engineering drawing programs. Principles of Auto Cad (2 & D 3 D) and principles of image handling programs (Photo shop)). Design methods, requirements and applications using different computer programs and their uses in various planning work.

Learn the basic concepts and advanced study of the application software program use. Spatial analyzes in different areas of urban planning. Learn about the advanced tools of geographic information systems

2- **ARCHITECTURE 3D MODELLING**

Content:

1- The course aims to identify the initial processes of design with two and three dimensions to reach an integrated plastic creativity based on basic principles and rules for design and the ability to analyze what the shape and different bodies are, their relationship and spatial suggestion

References

- ASCENT, Center for Technical. "AutoCAD 2018 3D Drawing & Modeling - Student Guide", Autodesk.2017.
- Norbert Lechner. 'Heating, Cooling and Lighting", Canada, 2015.
- *"What is Accurate Visual Representation?". Flying 3D. Retrieved 18 June 2015.*
- *Ian Gibson; Thomas Kvan; Ling Wai Ming (2002). "Rapid prototyping for architectural models". Rapid Prototyping Journal. **8** (2): 91–95. doi:10.1108/13552540210420961*

ARE354	Training (2)								Prerequisite
0 Cr Compulsory	Lectures	0	Tutorials	0	Lab	0	Semester	Summer	Training (1)

Training After the completion of the second year - in institutions or engineering offices - the training period is four weeks - it ends with a discussion with the academic supervisor to determine the training skills acquired

- Level 400

A- FIRST TERM

ARE463	Sustainable Architectural Design 3								Prerequisites
3 Cr.	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2 nd	Sustainable Architectural Design 2 ARE362

The course aims to find innovative solutions to environmental design problems - study various structural solutions to form internal vacuums with large surfaces and their relationships with the built and industrial environment - use computer applications in design and make applications with architectural models - study external environmental influences - develop skills for analysis and expression of the surrounding environment and social and cultural influences Training on multi-scale architectural projects.

The course also contains the most important concepts and knowledge of the LEED exam, how the student will complete this exam, the application of a practical model for a building being studied from public buildings, and a study of simulation programs at the city level and urban planning from Autodesk: 36 InfraWorks program

Or from an esri company like CityEngine and presenting a group project for students at the urban planning level in the urban environment in one of the Egyptian cities to extract the most important results and recommendations

References:

- *Annie R Pearce. “Sustainable Buildings and Infrastruction”,2012*
- *Jan L.M. Hensen & Roberto Lamberts. “Building Performance Simulation for Design and Operation Hardcover”, Routledge, 1st edition, Jan 2011.*

ARE466	INTERIOR ARCHITECTURE DESIGN (1)								Prerequisite
3 Cr	Lectures	2	Tutorials	2	Lab	0	Semester		ARC335

Content:

The course aims to develop a set of studies in the field of static interior architecture applications, starting with defining the concept of design and design standards in interior architecture through the different stages of design

The student is also exposed to the foundations of interior design and the formation of internal spaces for public and private buildings - the study of various technical schools of the main design trends in the field of interior design - the study of the architectural components of the interior spaces: lighting - acoustics - industrial design and furnishing - materials and materials - texture - architectural aesthetics - studying types of finishes The various public spaces and the work of quantities studies, specifications and engineering assays.

References

- Architectural Drawing Course: Tools and Techniques for 2D and 3D Representation”, 2nd edition, Mo Zell, 2018.
- Leonidas Stavridi. “Structural Systems: Behaviour and Design” - Volume 1: Plane structural systems, 2010

ARE436	HISTORY AND THEORIY OF INTERIOR ARCHITECTURE							Prerequisite
	Lectures	2	Tutorials	2	Lab	0	Semester	1st/2nd	

Content:

The course aims to clarify the concept of the evolution of styles in interior architecture and the relationship between it and the styles of architecture through different ages, starting from the ancient and middle ages and ending with the standards and factors that affect the formulation of new thinking in this field, whether it is abstract or functional, through a review of the emergence and historical development, as well as a study of schools, trends and modern concepts that I influenced in this area

The course aims to understand the nature of interior architecture theories and their role as a necessary input to the analysis of spatial and spatial functions and movement studies, by analyzing and understanding the components of the internal space and the nature of the integration of these functions within the design system as well as analyzing the criteria that affect the internal design process

References

- Architectural Drawing Course: Tools and Techniques for 2D and 3D Representation", 2nd edition, Mo Zell, 2018
- Rosemary Kilmer, W. Otie Kilmer. "Construction Drawings and Details for Interiors", 3rd Edition
- Brian w. Edwards and Emanuele. "Green Buildings Pay", Routledge, USA and Canada, 2013

ARE467	INTERIOR ARCHITECTURE DESIGN (2)								Prerequisite
3 Cr	Lectures	2	Tutorials	2	Lab	0	Semester	2	ARC466

Content:

The course aims to support the student's skills in designing commercial spaces through the identification of contemporary concepts, styles and trends. It also aims to refine the student's skills in showing and methods of expressing the elements of interior designs such as brushes, colors, landscapes and the relationship of the building internally with the external landscape through application to one of the appropriate public building projects Of the stage

References

- *Antoine E. Naaman, "Prestressed Concrete Analysis and Design Third Edition ", Techno Press 3000, 2012.*
- Architectural Drawing Course: Tools and Techniques for 2D and 3D Representation", 2nd edition, Mo Zell, 2018.

UNR471	Marketing								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	1st	---

Principles of products marketing - Marketing research - Customers buying behavior - Marketing mix - Plotting marketing strategy - Building marketing plan - Pinpointing the target market - Marketing on the world wide web - Branding strategy - Developing new products - Advertising and promotions - Costing and pricing strategies - Case studies on products marketing

References:

- *Principles of Marketing, University of Minnesota Libraries Publishing, 2015, ISBN 13: 9781946135193*

ARE481	GRADUATION PROJECT (1)								Prerequisite
3 Cr	Lectures	2	Tutorials	2	Lab	0	Semester		ARC467 + 120 CR

Content:
Collecting data and information - choosing the site and the project and its causes - analyzing the site and its accessibility, environmental and urban studies for the project - the project relationship and the surrounding environment - designing the general site for the project - studying the societal needs of the project and the relationship with the urban development and development in Egypt - the socio-economic feasibility of the project - designing the survey and functional program for the project And determine its components.

Carmona, M. heath, T& tiesdell, S. "Public Places Urban Space: the dimensions of the urban", Oxford, architectural press, 2nd Edition, 2010.
Scott Boylston. "Designing Sustainable Packaging Paperback", Laurence King Publishing, April, 2009

ARE425	INTERIOR CONSTRUCTION DETAILES AND FURNITURE								Prerequisite
3 Cr	Lectures	2	Tutorials	2	Lab	0	Semester	2	

Content:
The course aims to develop the student's abilities in the executive graphics course by training him on the rules of drawings
And preliminary executive panels, through the work of projections and sectors for different applications of the elements of internal architecture, as well as understanding the properties of raw materials and their various types, from raw materials and modern materials in finishes and technological manufacturing
And learn about the methods and techniques used in building architecture or internally and externally. The course also deals with furniture styles, dimensions, design and theories related to its development over the ages.

References

- Jan L. M. Hensen & Roberto Lamberts. "Building Performance Simulation for Design and Operation", Routledge, February, 2011
- Qasim S.R., Motley E. M. and Zhu G. "Engineering: Planning, Design & Operation", A hand book, Eastern Economy Edition, 2011.

ARE457	ELECTIVE COURSE 7								Prerequisite
2 Cr	Lectures	2	Tutorials	1	Lab	0	Semester	1st	

CONRACTS, SPACIFICATIONS & Quantities

Content:
a definition of contracts, how they are drafted, and the different types of contracts - the components of the contract and the points it must include - how to bid the bid - parties involved in construction work and the relationship between them - project delivery methods - contract documents

Calculate the quantities of the various items and counting methods. Explore concepts, methods, and procedures used to estimate construction. Study the principles and application of construction cost estimates. Initial cost estimation: unit method, space method, etc., adjusting initial costs for time, space and time factors, detailed costing of materials, equipment and workers, estimating business costs, building information modeling, estimating and costs from the point of view of the contractor or the owner's engineers. Estimate details with an emphasis on labor, materials and equipment, indirect cost estimation, margin estimation, business item pricing and assay composition and pricing policies.

Architectural and artistic criticism

Content:

The course aims to study technical and performance problems in artistic expression, especially the interior design of spaces at the civilizational and social level, and ancient and contemporary art schools, as well as studying a number of artistic methods using the comparative approach

References:

- *Datta, B.N., " Estimating and Costing in Civil Engineering: Theory & Practice Including Specifications and Valuation", Sangam Books Ltd, 27 revised edition, 2002.*
- *- Joseph Gwilt. "Elements of Architectural Criticism for the Use of Students", Amateurs, and Reviewers, 2010*

ARE458	ELECTIVE COURSE 8								Prerequisite
2 Cr	Lectures	2	Tutorials	1	Lab	0	Semester	1st	

1- Urban preservation and upgrading:

Content: The course aims to identify the problems of the existing urban areas, the phenomenon of urban deterioration, its types, causes, methods of measurement and the methods used to address them. Classification of urban areas in cities (historical, traditional residential neighborhoods, informal housing areas ...). Methods of handling and dealing with urban areas: historic city centers / traditional residential neighborhoods / informal housing areas. Applications: Monitoring and measuring the aspects of deterioration in an existing urban area and determining treatment policies.

2- Computer applications in interior architecture:

Content: The last decades of the twentieth century were marked by major developments in information technology and its use

Computer in dealing with internal architecture problems is one of the most important applications due to the large amount of data that computer information systems have in this field that are recorded, processed, stored and suggested alternatives, which justifies the use of computers to rationalize work costs

References

- *Architectural Drawing Course: Tools and Techniques for 2D and 3D Representation", 2nd edition, Mo Zell, 2018.*
- *Leonidas Stavridi. "Structural Systems: Behaviour and Design" - Volume 1: Plane structural systems, 2010*

ARE482	GRADUATION PROJECT (2)							Prerequisite
3 Cr	Lectures	2	Tutorials	2	Lab	0	Semester	ARC481

Content:

Presenting a new architectural thought for current and future problems - perceptions and a new philosophy of solutions - dealing with design determinants (architectural - urban - environmental - technical - humanitarian - construction - cultural ...) and linking them with various sciences to produce a distinct architectural product.

Preparing the graduation project in the field of architectural and urban design - setting goals - analyzing issues, problems and possibilities - problematic and their importance - making planning decisions - solutions alternatives and their evaluation - detailed program analysis - final solutions - preparing graduation project documents. Project presentation and presentation.

References:

- Scott Boylston. “Designing Sustainable Packaging Paperback”, Laurence King Publishing, April, 2009

Chapter Ten:

A B. Sc. Program in Civil and Environmental Engineering (Sustainable Water Engineering) with Credit Hours System

Table of Contents

1. Introduction

The Civil and Environmental Engineering (CEE) plays a major role in solving many of the most applied and pressing problems which facing humanity, including concerns about water, energy and the environment. Where, the mission of CEE is to provide the basic infrastructure necessary to support urban settlements through a sustainable and integrated ways and technologies taking in consideration the balance between society's need for long-term infrastructure and environmental health. The field of CEE covers overlapping, cross-disciplinary focus research areas like Materials, Geotechnical Engineering, Structural Engineering, Transportation Engineering, Hydraulics Engineering, Environmental Engineering, Water and Energy Resources Management and Engineering. So, the offered program covers the principles and in-depth knowledge of Civil and Environmental Engineering concerning on Sustainable Water Engineering (SWE) that is one of its most pressing branches.

Freshwater is the primary source of life, fueling all sectors in every nation; domestic uses, food and industrial production, power generation, and recreational activities. Out of the total volume of water on our blue planet, only 0.01% is freshwater running in rivers and lakes, two thirds of which are shared between two or more countries, like the Nile River. Currently, according to WHO, almost half of the global population is living in water-stressed areas, while at least 2 billion people lack access to clean water and basic sanitation facilities. In addition, 10% of the world's population is thought to consume food irrigated by wastewater. Such water-related problems in developing countries Reduce human wellbeing and hinder social and economic development. Moreover, this dramatic scene is overshadowed by future risks of climate change, population growth, expanding urbanization, and environmental pollution.

All these facts and uncertainties led the UN, through its Sustainable Development Goals (SDGs); which aim to work to end poverty, protect the planet, ensure that all people enjoy peace and prosperity, and achieve a balance between social, economic and environmental sustainability by 2030; to target safe access to clean water, equitable sanitation for all, adequate food security, climate action and sustainable and inclusive cities. In this context, prominent higher-educational and research institutions worldwide have given special priority to evolving specialized academic programs and study plans in the field of integrated and sustainable water engineering.

If we look at the water situation in Egypt, the Egyptian case is even more complicated as bout 97% of Egypt's freshwater is supplied by the Nile River whose is shared between ten countries other than Egypt, each with its own national water plans, which may threaten Egyptian water security in the event of lack of coordination and integration between Nile Basin countries. More than 95% of residents are settling in the narrow Nile Valley and Delta, which represents around no more than 7% of the total country's area. In addition, rapid population growth and urbanization have widened the gap between national food needs and local production. Moreover, sea-level rise due to climate change may cause the loss of hundreds of thousands of acres of farmlands and the displacement of millions of people in the Delta.

In line with the UN-SDGs, Egypt has developed its Sustainable Vision Strategy (SVS) 2030, which comprises several national projects with the aim of promoting the welfare of residents in old cities in addition to building new smart cities and implementing agricultural and industrial schemes across the Egyptian deserts. Such an ambitious vision requires various detailed plans to be prepared and carried out in collaboration with private sector and civil society, such as developing irrigation and drainage canals networks, enhancing food productivity, improving wastewater treatment, and exploiting sustainable alternative water resources besides the Nile waters (i.e. groundwater, rainwater harvesting, and seawater desalination).

In this framework, the Faculty of Engineering at Mansoura University, represented in the Department of Irrigation and Hydraulics Engineering offers a Bachelor's Degree in Civil and Environmental Engineering (Sustainable Water Engineering) (CEE-SWE) to contribute in the realization of the Egyptian Sustainable Vision Strategy (SVS 2030), which of its goals are the integrated and sustainable development of Egyptian water resources from Nile River, ground water, rainwater, sea water desalination, sustainable urban water development, irrigation technology development and agriculture. The CEE-SWE program will generate highly qualified civil engineers contributing with innovative solutions for the ever-changing water and environmental problems in our society and all over the world, competing in national and international water technology markets, leading members in NGOs dealing with water issues, and promising academics willing to teach and research on water-related problems, prospective policy-makers and experts working in the water sector. Therefore, the CEE-SWE program is designed as interdisciplinary program covering the knowledge needs from the civil and environmental engineering and other related disciplines, being comparable with the accredited programs in the international ranked universities and fulfilling the requirements of national and international accreditation and quality committees.

2. Basic Information

The CEE-SWE program is an interdisciplinary program concerning on one of most important branch of civil engineering and covering the relevant knowledge needs in the field of architecture, sustainability and environmental engineering, management sciences, and law to keep pace with the technological changes and the scientific development to meet the needs of labor markets.

The CEE-SWE program is designed to providing students with the educational needs, learning experience, competences and outcomes that permit them to build up knowledge, skills and abilities following the Egyptian Reference Framework for Preparing Study Programs for the Bachelor in Faculties of Engineering (2020) and The Egyptian Reference Terms for the Study System with the

Credit Hour System in the Faculties of Engineering (2020). The program covers and satisfies the quality and accreditation requirements of the National Academic Reference Standards (NARS 2018) for Engineering and the International Accreditation Board for Engineering and Technology (ABET 2020-2021). Furthermore, Comprehensive studies and benchmarking are carried out to show the compatibility between the program (CEE-SWE) and other similar and accredited programs in ranked national and international universities as one of the set milestones for the requirements of the Qualifications Framework for Higher Education Institutions and the national and international academic standards for engineering. This was detailed in the ninth item "Benchmarks for assessing and developing the CEE-SWE program" of this chapter.

2.1 Program Vision:

Achieve leadership and distinction in the field of Civil and Environmental Engineering with emphasis in Sustainable Water Engineering and gain the confidence of the local and international community in the program's graduate.

2.2 Program Mission:

Preparing a distinguished civil engineer specializing in Sustainable Water Engineering and qualified to compete in national and international water technology markets, as well capable of contributing innovative solutions for the ever-changing water and environmental problems and researching water-related problems to support the local and global community

2.3 Awarded Degree by the program

Bachelor of Science Degree in Civil and Environmental Engineering (Sustainable Water Engineering) with Credit Hours System

2.4 Specifications of the Program Graduate:

Generally, graduates from the CEE-SWE program are prepared to be distinguished civil engineers who able to achieve excellence in decision making, design, participation and lead the labor market in Sustainable Water Engineering (SWE) as a specific field of civil and environmental engineering covering needed related knowledge from other fields such as Sustainable Engineering, Architectural Engineering, Building Science, Environmental Engineering and Hydropower.

Carefully, the graduate of CEE-SWE program must:

1. Master a wide spectrum of engineering knowledge in the field of Civil and Environmental Engineering and specialized skills in the field of Sustainable Water Engineering and can apply acquired gained knowledge using theories and abstract thinking in real life situations;
2. Apply analytic critical and systemic thinking to identify, diagnose and solve SWE problems with a wide range of complexity and variation;
3. Behave effectively, professionally and adhere to engineering ethics and standards through understanding and applying law, ethics and engineering codes of practice;

4. Work in and lead a heterogeneous team of professionals, designers and site or lab technicians from different engineering specialties and assume responsibility for own and team performance;
5. Recognize his/her role in promoting the field of CEE-SWE and contribute in development of the profession and the community by discovering innovative solutions for the ever-changing water and environmental problems and applications;
6. Value the importance of the water and environment, both physical and natural, and work to promote and incorporate sustainability principles and concepts during not only realization stages of water projects but also in educating culture of sustainability for all project partners in order to develop sustainable and integrated water engineering and management;
7. Use techniques, skills and modern engineering tools, IT and technologies necessary for engineering practice;
8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies in the field of sustainable water engineering;
9. Communicate effectively using different modes, tools and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner;
10. Demonstrate leadership qualities, business administration and entrepreneurial skills.

2.5 Program Aims:

The CEE-SWE program is committed to providing high-quality education in accordance with the most distinguished educational national and international standards for its students in the field of civil and environmental engineering concerning on sustainable water engineering. Faculty members and students should participate as productive individuals in the society and contributors with the highest levels of expertise in the field of Sustainable Water Engineering.

The CEE-SWE program aims are summarized as follows:

1. Prepare civil engineers who capable to apply engineering principles, technical knowledge, logical thinking and administrative skills to solve engineering problems.
2. Provide fundamentals and in-depth knowledge in the field of Civil and Environmental Engineering with a focus on sustainable water engineering and related technologies to achieve excellence in engineering decision-making, planning, managing, design and construction of the water projects.
3. Establish the deep appreciation for professional and ethical values and understand of law, global, societal, environmental and sustainability issues related to water engineering sector.
4. Exhibit effective communication, teamwork, entrepreneurial, and leadership skills when collaborate with colleagues and others in solving problems.

5. Improve the capability of graduates for keeping up with developments in technology, self- & lifelong learning and career advancement through research, training activities and membership in professional societies.
6. Qualify graduates to pursue and share cutting edge scientific research and postgraduate studies through the cooperation and development of creative thinking and the ability to analyze problems and systematic thinking.
7. Inspire and encourage graduates to work and engage not only in the local water-technology markets and community but also in the global water-technology markets and society especially in Arab and African regions.
8. Promote and incorporate sustainability concepts in the program courses as well as embody a culture of sustainability for staff, students and graduates.
9. Create and strengthen a collaborative partnership with stakeholders in the field of skills, knowledge generation and application.

2.6 Graduate Competencies in Accordance with NARS 2018 and ABET 2020-2021

According to NARS 2018, a CEE-SWE graduate must be able to:

A1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.

A2. Develop and conduct appropriate experimentation and/or simulation, analyze, and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

A3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

A4. Utilize contemporary technologies, codes of practice, and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

A5. Practice research techniques and methods of investigation as an inherent part of learning.

A6. Plan, supervise, and monitor implementation of engineering projects, taking into consideration other trades requirements.

A7. Function efficiently as an individual and as a member of multi-disciplinary and multicultural teams.

A8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

A9. Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10. Acquire and apply new knowledge; and practice self, lifelong and other learning strategies

A11. Select appropriate and sustainable methods and technologies for planning, designs and construction of Civil Structures, especially Water Structures and associated Infrastructures, and Hydropower Plants by applying the full range concepts of civil engineering disciplines and the in-depth knowledge of water engineering and sustainability and considering their codes of practices and standards.

A12. Plan and manage current water resources projects and develop new water resources taking in consideration the constrains of law, politics, environmental, social and sustainability as well safety and risk assessment issues**.**

A13. Demonstrate the knowledge of principles and applications of computer programs and IT such as CAD, BIM, GIS and Remote Sensing Techniques in the specialized field.

A14. Achieve an optimum water urban planning and designs that satisfy both aesthetic and technical requirements, using adequate knowledge of related building physics and environmental technologies and sciences.

According to ABET2020-2021, a SWE graduate must have the ability to:

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. Communicate effectively with a range of audiences
4. Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. Acquire and apply new knowledge as needed, using appropriate learning strategies.

The following mapping table represents the relationship between the Competencies of CEE-SWE program graduates per the NARS 2018 and the ABET2020-2012:

		ABET2020-2021						
		1	**2**	**3**	**4**	**5**	**6**	**7**
Competencies of SWE Program Graduates according to NARS 2018	**A1**	x						
	A2						x	
	A3		x					
	A4		x					
	A5						x	x
	A6		x		x			
	A7					x		
	A8			x				
	A9				x	x		
	A10							x
	A11	x		x				
	A12	x		x				
	A13	x					x	x
	A14	x						

3. Course Coding System

The course coding system aids in managing the program, generating reports and registering students. For those reasons, the generating of unique code which identifies the course is strongly suggested. The used course coding system is followed section (6) in the Egyptian Reference Framework for Preparing Study Programs for the Bachelor in Faculties of Engineering (2020) as shown in figure (1) while each code has two parts detailed as below:

- **The first part** of the course code is **alphabetic** which related to the scientific department that offers it as shown in Table (1). The course code used SWE is, standing for Sustainable Water Engineering.
- **The second part** of the code is **numeric** and consists of three digits:
    - **The first digit** represents the level/year when course is offered. The Program shall be covered in five academic years (i.e. five levels names 000, 100, 200, 300, 400) for full time students.
    - **The second digit** indicates nature of the course discipline and its exact specialization within the scientific department as reflected in follows:
        - 1 - General Requirements
        - 2 - Structural Engineering
        - 3 - Construction Engineering and Management
        - 4 - Geotechnical Engineering
        - 5 – Public Works
        - 6 - Water Resources and Hydraulics Engineering
        - 7- Environmental and Urban Engineering
        - 8 - Hydropolitics and Water Laws
        - 9 - Special Topics, Project and Training
    - **The third digit** is sequencing of the course within a specific specialization in the same level.

Not all of these letters indicate the majors in which the degree is given, some of which represent university requirements, engineering requirements, or specialized courses.

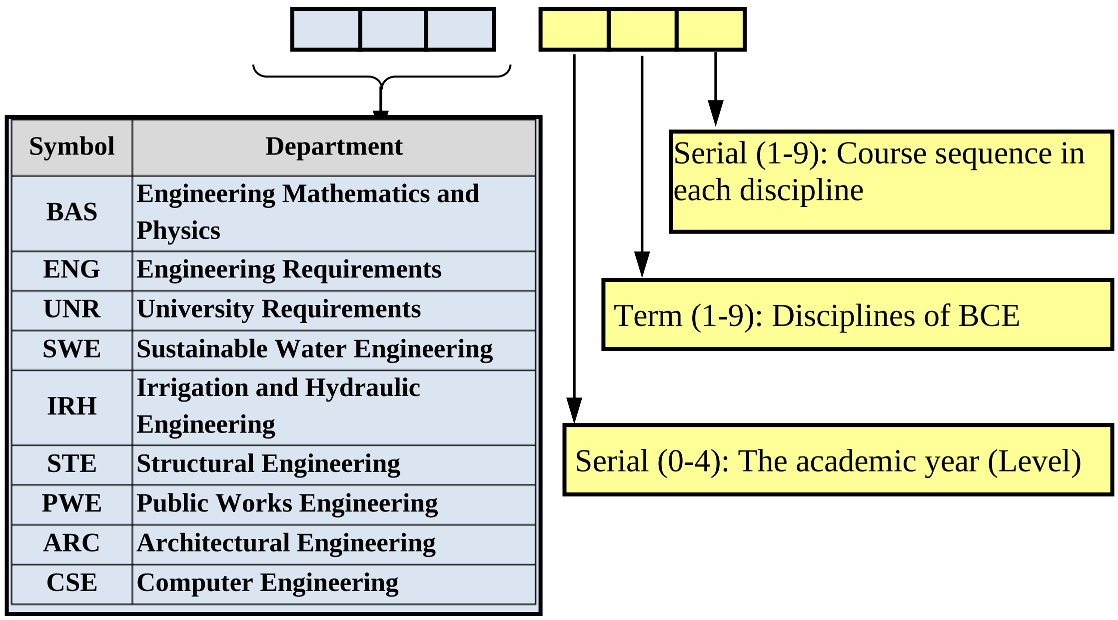


Figure 1: Course Coding System

Table 1: Scientific Departments and Course Codes

Code	Department
BAS	Engineering Mathematics and Physics
ENG	Engineering Faculty Courses
UNR	University Courses
SWE	Sustainable Water Engineering
IRH	Irrigation and Hydraulic Engineering
STE	Structural Engineering
PWE	Public Works Engineering
ARC	Architectural Engineering
CSE	Computer Engineering

Not that the course code refers to the level in which this course is usually taught. These dates are subject to change, as not all courses are taught every year. Before the start of each semester, college affairs present a table of courses that will be taught in this semester and their teaching dates and those who are teaching them.

4. Structure and Requirements of the SWE Program

On the way to be granted a bachelor's degree in Civil and Environmental Engineering (Sustainable Water Engineering) “CEE-SWE” with credits hours' system from the Faculty of Engineering in Mansour University, the student must complete minimum 160 credit hours. The structure of the CEE-SWE program consists of 160 credit hours distributed as represents in table (2).

Table 2: Distribution of Credit Hours

Requirements		Compulsory Credit Hrs.	Electives Credit Hrs.
University Requirements		8	6
Faculty Requirements	Basic Science	32	0
	General Engineering	13	0
General Major Requirements		58	0
Accurate Specialization Requirements		19	18
Senior Projects		6	0
Field Training		0	0
Total Credit Hours		**160**	

4.1 University Requirements:

The main purpose of university education is not only to prepare students for successful careers but also to provide them with the knowledge and skills necessary to develop a rational and successful personal identity. Moreover, the university requirements of Mansoura University assists students in gaining an appreciation of the natural and cultural environments in which they live and their roles in society and community services. So, the university requirements for the CEE-SWE program consist of 14 credit hours (8.75% of the total 160 credit hours), which are met by completing four compulsory courses and three electives that are reflected in Tables 3a and 3b

Table 3a: Compulsory Courses for University Requirements (8 credit hours)

Code	Course Name	Pre-requisite	Lec.	Tr.	Pr.	Credit Hours
UNR061	English language	------	1	2	0	2
UNR071	Computer Fundamentals and Programming for Engineers	-------	2	1	2	3
UNR181	History of River Nile and Water Resources in Egypt	------	1	0	0	1
UNR113	Communication and Presentation Skills	ENG012	1	2	0	2
Total Credit Hours						**8**

Note that: **Lec.** = Lectures contact hours per week, **Tr.** = Tutorials contact hours per week, and **Pr.** = Practical contact hours per week

Table 3b: Electives for University Requirements (6 credit hours)

Code	Course Name	Pre-requisite	Lec.	Tr.	Pr.	Credit Hours
UNR081	Law and Human Rights	------	2	0	0	2
UNR082	Fundamentals of Economics and Accounting	------	2	0	0	2
UNR374	Environmental Impact Assessment	------	2	0	0	2
UNR481	Ethics and Morals of the Profession	------	2	0	0	2
UNR482	Water, Energy and Climate Change Issues	------	2	0	0	2
Total Credit Hours for Two Elective Course						**6**

- Student must select three elective courses from table 3b that weighted 6 credit hours for university requirements.

4.2 Faculty Requirements:

The faculty requirements provide students with the knowledge and skills in the basic science and general engineering fields that are necessary to develop a successful engineer. The standard requirement of faculty courses includes basic knowledge courses for all engineering graduates such as mathematics, physics, mechanics, engineering drawing, engineering design, and chemistry. The faculty requirements for the CEE-SWE program consist of 45 credit hours

(28.125% of the total 160 credit hours), which are completed by completing sixteen (17) mandatory courses, as listed in Table 4.

Table 4: Compulsory Courses for Faculty Requirements (45 credit hours)

Code	Course Name	Pre-requisite	Lec.	Tr.	Pr.	Credit Hours
BAS011	Mathematics (1)	-------	2	2	0	3
BAS021	Mechanics (1)	-------	2	2	0	3
BAS031	Physics (1)	-------	2	1	1.5	3
BAS041	Engineering Chemistry	-------	2	1	1.5	3
BAS012	Mathematics (2)	BAS011	2	2	0	3
BAS022	Mechanics (2)	BAS021	2	2	0	3
BAS032	Physics (2)	BAS031	2	1	1.5	3
BAS111	Mathematics (3): Multivariate Calculus	BAS012	2	2	0	3
BAS112	Mathematics (4): Differential Equations	BAS111	2	2	0	3
BAS113	Probability Theory and Statistics	BAS012	1	2	0	2
BAS211	Mathematics (5): Linear Algebra and Computational Methods	BAS111	2	2	0	3
ENG011	Engineering Design and Innovation	-------	2	2	0	3
ENG012	Technical Reports Writing	UNR061	1	2	0	2
ENG111	Engineering Thermodynamics	BAS032	2	1	0	2
IRH112	Engineering Drawing for Civil Engineers	-------	2	3	0	3
ENG191	Engineering Seminar	UNR113	1	0	0	1
ENG231	Engineering Economics and Sustainability	BAS113	2	1	0	2
Total Credit Hours						**45**

4.3 General Major and Accurate Specialization Requirements:

The general major and accurate specialization requirements in the CEE-SWE program consist of 101 credit hours (63.125% of a total of 160 credit hours), which are fulfilled by completing the following:

- (21) Compulsory courses of general major weighted 58 credit hours as listed in table (5-A).
- (7) Compulsory courses of accurate specialization weighted 19 credit hours as listed in table (5-B).
- (6) Elective courses of accurate specialization weighted 18 credit hours that can student select them from the list provided in Table (6).
- Two field training programs (1) and (2) as shown in Table (7)
- Two senior projects (1) and (2) equivalent to 6 credit hours as shown in Table (7)

Table 5-A: General Major Requirements: Compulsory Courses (58 credit hours)

Code	Course Name	Pre-requisite	Lec	Tr.	Pr.	Credit Hours
IRH114	CAD/BIM Applications for Civil Engineers	IRH112	2	1	3	3
STE121	Structural Mechanics	BAS022	2	0	2	3
STE122	Structure and Properties of CE Materials	STE121	2	1	2	3
STE123	Structural Analysis (1)	STE121	2	1	0	2
PWE151	Principles and Practice of Geomatics	BAS012	2	1	2	3
STE221	Structural Analysis (2)	STE123	2	1	0	2
STE222	Reinforced Concrete Design	STE122 STE221	2	2	0	3
STE241	Engineering Geology & Soil Mechanics	BAS032	2	1	2	3
STE242	Geotechnical Engineering	STE241	2	0	2	3
IRH261	Hydraulics	BAS111	2	2	0	3
IRH262	Hydraulics Laboratory	IRH261 Co-requisite	0	0	2	1
IRH263	Irrigation and Drainage Systems	------	2	2	0	3
IRH264	Introduction to Hydrology	IRH261	2	2	0	3
PWE271	Environmental Engineering	IRH261	2	2	1	3

Table 5-A (continue): General Major Requirements: Compulsory Courses

Code	Course Name	Pre-requisite	Lec.	Tr.	Pr.	Credit Hours
STE321	Steel Structures Design	STE221	2	2	0	3
STE341	Foundation Engineering	STE242	2	2	0	3
IRH361	Open Channel Hydraulics	IRH261	2	2	0	3
IRH362	Design of Hydraulic Structures	IRH361	2	2	0	3
STE331	Construction Engineering and Sustainability	STE222-ENG231	2	1	0	2
STE431	Project Planning and Management	STE331	2	2	0	3
PWE451	Highway and Transportation Engineering	PWE151 – STE122	2	2	0	3
Total Credit Hours						**58**

Table 5-B: Accurate Specialization Requirements: Compulsory Courses (19 credit hours)

Code	Course Name	Pre-requisite	Lec	Tr.	Pr.	Credit Hours
ARC272	Building Physics & Environmental Control	ENG111	2	2	0	3
ARC372	Sustainable Site and Water Efficiency in Architecture	ARC272	2	1	0	2
ARC373	Water Urbanism	SWE371	2	2	0	3
SWE371	Urban Hydraulics	PWE271	2	1	0	2
IRH363	Water Resources Engineering and Sustainability	IRH264	2	2	0	3
IRH461	Coastal and Harbors Engineering	IRH362	2	2	0	3
IRH462	Integrated Water Resources Management	IRH363	2	2	0	3
Total Credit Hours						**19**

Table 6: Accurate Specialization Requirements: 6 Elective Courses (18 credit hours)

Code	Course Name	Pre-requisite	Lec.	Tr.	Pr.	Credit Hours
SWE311	Computer Applications for SWE	BAS211 IRH261	2	1	2	3
SWE312	Computational Simulation of Flow and Transport in the Environment	BAS211 IRH264	2	2	0	3
STE342	Excavation & Retaining Walls	STE242	2	2	0	3
SWE351	GIS and Remote Sensing Applications for SWE	PWE151 IRH261	2	2	0	3
IRH364	Bridge Engineering	IRH361 STE222	2	2	0	3
IRH365	Smart Irrigation and Drainage Technologies	IRH263	2	2	0	3
IRH366	Surface Hydrology	IRH264	2	2	0	3
IRH367	Subsurface Hydrology	IRH264	2	2	0	3
IRH368	Water Measurement and Analysis Methods	IRH262	2	2	0	3
IRH375	Smart Design for Water Treatment and Desalination Units	PWE271	2	2	0	3
IRH376	Water Quality Modelling	PWE272	2	2	0	3
IRH463	Dam Engineering	IRH362	2	2	0	3
IRH464	Offshore Engineering	IRH461	2	2	0	3
IRH465	Physical Hydrology for Ecosystems	IRH264	2	2	0	3
IRH466	Watershed and Wetlands	IRH264	2	2	0	3
IRH467	River Engineering	IRH361	2	2	0	3
IRH468	Sediment Transportation Engineering	IRH361	2	2	0	3
IRH469	Floods and Droughts, Dams and Aqueducts	IRH361 IRH363	2	2	0	3
IRH472	Providing Safe Water for the Developing World	IRH363	2	2	0	3

Table 6 (continue): Accurate Specialization Requirements: Elective Courses

Code	Course Name	Pre-requisite	Lec.	Tr.	Pr.	Credit Hours
IRH473	Environmental Hydraulics	IRH361	2	2	0	3
IRH474	Introduction to Environmental and Ecological Engineering	IRH361	2	2	0	3
SWE392	Water Power Resourses	IRH261	2	2	0	3
SWE481	National and International Water Law, and Hydropolitics	----	3	0	0	3
SWE492	Waterpower Engineering and Sustainability	IRH392	2	2	0	3
SWE493	Hydroelectric Power Plants and Technologies	IRH362	2	2	0	3
SWE494	Development of Water Resources in River Nile Basin	IRH363	2	2	0	3
IRH491	Special Topics in Water Engineering & Sustainability	Advisor approval	2	2	0	3
Total Credit Hours						**18**

- Not that all electives are offered with department/advisor approval.

4.4 Project and Field Training Requirements:

Table 7: Project and Training Requirements (6 credit hours)

Code	Course Name	Pre-requisite	Credit Hours
SWE291	Training (1)	------	0
SWE391	Training (2)	Training (1)	0
SWE498	Senior Project (1)	Pass 120 credits	3
SWE499	Senior Project (2)	Senior Project (1)	3
Total Credit Hours			**6**

5. Mapping of Courses to Competencies

Program competencies are enlisted in the first row of the table (by their code number: a1, a2……etc), then the course titles or codes are enlisted in first column, and an "x" mark is inserted where the respective course contributes to the achievement of the program competencies.

Table 8: Mapping of Courses to Competencies

Course Title	Code	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14
Mathematics (1)	BAS011	x													
Mechanics (1)	BAS021	x													
Physics (1)	BAS031	x	x												
Engineering Chemistry	BAS041	x	x												
English Language	UNR061							x	x						
Computer Fundamentals and Programming for Engineers	UNR071	x	x			x		x						x	
Mathematics (2)	BAS012	x													
Mechanics (2)	BAS022	x													
Physics (2)	BAS032	x	x					x							
Engineering Design and Innovation	ENG011	x	x		x	x				x	x				
Technical Report Writing	ENG012					x		x	x						
Mathematics (3): Multivariate Calculus	BAS111	x													
Engineering Thermodynamics	ENG111	x	x					x							
Engineering Drawing for Civil Engineers	IRH112	x						x	x		x			x	
Structural Mechanics	STE121		x					x	x				x		
Communication and Presentation Skills	UNR113								x	x					
Principles and Practice of Geomatics	PWE151	x	x					x						x	
History of River Nile and Water Resources in Egypt	UNR181												x		
Mathematics (4): Differential Equations	BAS112	x													
Probability Theory and Statistics	BAS113	x	x												
CAD/BIM Applications for Civil Engineers	IRH114		x	x				x	x		x	x		x	
Structure and Properties of CE Materials	STE122	x	x					x	x				x		

Course Title	Code	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14
Structural Analysis (1)	STE123	x	x					x	x				x		
Engineering Seminar	ENG191					x			x		x			x	
Mathematics (5): Linear Algebra and Computational Methods	BAS211	x	x			x									
Structural Analysis (2)	STE221		x					x	x				x		
Engineering Geology & Soil Mechanics	STE241	x	x												
Hydraulics	IRH261	x	x									x			
Hydraulics Lab.	IRH262	x	x				x								
Irrigation and Drainage Systems	IRH263	x	x	x	x							x	x		
Reinforced Concrete Design	STE222			x	x							x			
Engineering Economics and Sustainability	ENG231	x		x	x							x			
Geotechnical Engineering	STE242		x	x				x							
Introduction to Hydrology	IRH264	x													
Environmental Engineering	PWE271		x	x	x			x				x			
Building Physics & Environmental Control	ARC272	x			x										x
Steel Structures Design	STE321			x	x							x			
Foundation Engineering	STE341			x	x							x			
Open Channel Hydraulics	IRH361			x								x			
Urban Hydraulics	SWE371			x								x			x
Construction Engineering and Sustainability	STE331			x	x		x			x		x			
Design of Hydraulic Structures	IRH362			x	x							x	x		
Water Resources Engineering and Sustainability	IRH363	x		x	x							x	x		
Sustainable Site and Water Efficiency in Architecture	ARC372			x	x			x			x	x	x		x
Water Urbanism	ARC373			x											x
Highway and Transportation Engineering	PWE451			x	x							x			
Coastal and Harbors Engineering	IRH461	x		x	x							x	x		

Course Title	**Code**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**	**A13**	**A14**
Integrated Water Resources Management	IRH462			x	x					x	x	x	x		
Project Planning and Management	STE431			x	x	x	x	x	x	x			x	x	
University Elective (1)	UNRXXX		x				x	x							
University Elective (2)	UNRXXX		x		x				x	x					x
University Elective (2)	UNRXXX					x	x			x	x				
Elective course (1)	Elective				x		x			x		x	x	x	
Elective course (2)	Elective		x				x		x		x	x			x
Elective course (3)	Elective			x	x		x				x	x	x	x	
Elective course (4)	Elective		x	x	x	x			x		x	x		x	
Elective course (5)	Elective		x	x	x	x			x		x	x	x	x	
Elective course (6)	Elective				x		x			x			x		x
Training (1)	SWE291							x			x	x			
Training (2)	SWE391		x	x				x	x		x	x	x	x	x
Senior Project (1)	SWE498		x		x	x	x	x	x	x		x	x	x	x
Senior Project (2)	SWE499		x	x	x	x	x	x	x	x	x	x	x	x	x

6. Study Plan for the CEE-SWE Program (Distributed at Levels)

Table 9: Regular Distribution of CEE-SWE Courses on Levels

Level 000: First Semester

Course Coding		No. of Hrs/week						Course grades					Pre-requisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
BAS011	Mathematics (1)	3	2	2	0	4	8	20	30	0	50	100	---------------
BAS021	Mechanics (1)	3	2	2	0	4	8	20	30	0	50	100	---------------
BAS031	Physics (1)	3	2	1	1.5	4.5	9	20	20	10	50	100	---------------
BAS041	Engineering Chemistry	3	2	1	1.5	4.5	9	20	20	10	50	100	---------------
UNR061	English Language	2	1	2	0	2	5	20	30	0	50	100	---------------
UNR071	Computer Fundamentals & Programming for Engineers	3	2	1	2	4	9	20	20	10	50	100	---------------
Total		**17**	**11**	**9**	**5**	**23**	**48**					**600**	
Total Contact hours = 25 hrs/week								**Total SWL = 48 hrs/week**					

Second Semester

Course Coding		No. of Hrs/week						Course grades					Pre-requisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
BAS012	Mathematics (2)	3	2	2	0	4	8	20	30	0	50	100	BAS011
BAS022	Mechanics (2)	3	2	2	0	4	8	20	30	0	50	100	BAS021
BAS032	Physics (2)	3	2	1	1.5	4.5	9	20	20	10	50	100	BAS031
ENG011	Engineering Design and Innovation	3	2	2	0	5	9	20	20	10	50	100	-----------------
ENG012	Technical Reports Writing	2	1	2	0	3	6	20	30	0	50	100	UNR 061
UNRXXX	University Elective (1) from Table (3b)	2	2	0	0	2	4	20	30	0	50	100	-----------------
Total		**16**	**11**	**9**	**1.5**	**22.5**	**44**					**600**	
Total Contact hours = 21.5 hrs/week								**Total SWL = 44 hrs/week**					

Level 100: Third Semester

Course Coding		No. of Hrs/week						Course grades					Pre-requisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
BAS111	Mathematics (3): Multivariate Calculus	3	2	2	0	4	8	20	30	0	50	100	BAS012
ENG111	Engineering Thermodynamics	2	2	1	0	3	6	20	30	0	50	100	BAS032
IRH112	Engineering Drawing for Civil Engineers	3	2	3	0	6	9	20	30	0	50	100	---------------
STE121	Structural Mechanics	3	2	0	2	4	9	20	20	10	50	100	BAS022
PWE151	Principles and Practice of Geomatics	3	2	1	2	4	9	20	20	10	50	100	BAS012
UNR113	Communication and Presentation Skills	2	1	2	0	1	4	20	30	0	50	100	ENG012
UNR181	History of River Nile and Water Resources in Egypt	1	1	0	0	1	3	20	30	0	50	100	---------------
Total		**17**	**12**	**9**	**4**	**23**	**48**					**700**	
Total Contact hours = 25 hrs/week, Total SWL = 48 hrs/week													

Fourth Semester

Course Coding		No. of Hrs/week						Course grades					Pre-requisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
BAS112	Mathematics (4): Differential Equations	3	2	2	0	4	8	20	30	0	50	100	BAS111
BAS113	Probability Theory and Statistics	2	1	2	0	2	5	20	30	0	50	100	BAS012
IRH114	CAD/BIM Applications for Civil Engineers	3	2	1	3	4	10	20	20	10	50	100	IRH112
STE122	Structure and Properties of CE Materials	3	2	1	2	4	9	20	20	10	50	100	STE121
STE123	Structural Analysis (1)	2	2	1	0	4	7	20	30	0	50	100	STE121
ENG191	Engineering Seminar	1	1	0	0	3	4	20	30	0	50	100	UNR113
Total		**14**	**10**	**7**	**5**	**21**	**43**					**600**	
Total Contact hours = 22 hrs/week, Total SWL = 43 hrs/week													

Level 200: Fifth Semester

Course Coding		No. of Hrs/week						Course grades					Pre-requisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
BAS211	Mathematics (5): Linear Algebra and Computational Methods	3	2	2	0	4	8	20	30	0	50	100	BAS111
STE221	Structural Analysis (2)	2	2	1	0	4	7	20	30	0	50	100	STE123
STE241	Engineering Geology & Soil Mechanics	3	2	1	2	3	8	20	20	10	50	100	BAS032
IRH261	Hydraulics	3	2	2	0	4	8	20	30	0	50	100	BAS111
IRH262	Hydraulics Laboratory	1	0	0	2	2	4	20	20	10	50	100	IRH261 Co-requisite
IRH263	Irrigation and Drainage Systems	3	2	2	0	3	7	20	30	0	50	100	---------------
Total		15	10	8	4	20	42					600	
Total Contact hours = 22 hrs/week, Total SWL = 42 hrs/week													

Sixth Semester

Course Coding		No. of Hrs/week						Course grades					Pre-requisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
STE222	Reinforced Concrete Design	3	2	2	0	4	8	20	30	0	50	100	STE122 – STE221
ENG231	Engineering Economics and Sustainability	2	2	1	0	3	6	20	30	0	50	100	BAS113
STE242	Geotechnical Engineering	3	2	2	0	4	8	20	30	0	50	100	STE241
IRH264	Introduction to Hydrology	3	2	2	0	3	7	20	30	0	50	100	IRH261
PWE271	Environmental Engineering	3	2	2	1	3	8	20	20	10	50	100	IRH261
ARC272	Building Physics & Environmental Control	3	2	2	0	4	8	20	30	0	50	100	ENG111
SWE291	Training (1)	-	-	-	-	3	3	-	-	-	-	-	---------------
Total		17	12	11	1	24	48					600	
Total Contact hours = 24 hrs/week, Total SWL = 48 hrs/week													

Level 300: Seventh semester

Course Coding		No. of Hrs/week						Course grades					Pre-requisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
STE321	Steel Structures Design	3	2	2	0	4	8	20	30	0	50	100	STE221
STE341	Foundation Engineering	3	2	2	0	4	8	20	30	0	50	100	STE242
IRH361	Open Channel Hydraulics	3	2	2	0	4	8	20	30	0	50	100	IRH261
SWE371	Urban Hydraulics	2	2	1	0	3	6	20	30	0	50	100	PWE271
Elective	Elective course (1)	3	2	2	0	4	8	20	30	0	50	100	As per in table 6
UNRXXX	University Elective (2) from Table (3b)	2	2	0	0	2	4	20	30	0	50	100	-----------------
Total		**16**	**12**	**9**	**0**	**21**	**42**					**600**	
Total Contact hours = 21 hrs/week, Total SWL = 42 hrs/week													

Eighth Semester

Course Coding		No. of Hrs/week						Course grades					Pre-requisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
STE331	Construction Engineering and Sustainability	2	2	1	0	3	6	20	30	0	50	100	STE222-ENG231
IRH362	Design of Hydraulic Structures	3	2	2	0	4	8	20	30	0	50	100	IRH361
IRH363	Water Resources Engineering and Sustainability	3	2	2	0	3	7	20	30	0	50	100	IRH264
ARC372	Sustainable Site and Water Efficiency in Architecture	2	2	1	0	3	6	20	30	0	50	100	ARC272
ARC373	Water Urbanism	3	2	2	0	3	7	20	30	0	50	100	SWE371
Elective	Elective course (2)	3	2	2	0	3	7	20	30	0	50	100	As per in table 6
SWE391	Training (2)	-	-	-	-	8	8	-	-	-	-	-	SWE291
Total		**16**	**12**	**10**	**0**	**27**	**49**					**600**	
Total Contact hours = 22 hrs/week, Total SWL = 49 hrs/week													

Level 400: Ninth semester

Course Coding		No. of Hrs/week						Course grades					Pre-requisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
PWE451	Highway and Transportation Engineering	3	2	2	0	4	8	20	30	0	50	100	PWE151 STE122
IRH461	Coastal and Harbors Engineering	3	2	2	0	4	8	20	30	0	50	100	IRH362
IRH462	Integrated Water Resources Management	3	2	2	0	4	8	20	30	0	50	100	IRH363
UNRXXX	University Elective (3) from Table (3b)	2	2	0	0	2	4	20	30	0	50	100	--------------
Elective	Elective course (3)	3	2	2	0	4	8	20	30	0	50	100	As per in table 6
SWE498	Senior Project (1)	3	1	2	3	2	8	20	20	10	50	100	Pass 120 credit hours
Total		**17**	**11**	**10**	**3**	**20**	**44**					**600**	
Total Contact hours = 24 hrs/week, Total SWL = 44 hrs/week													

Tenth Semester

Course Coding		No. of Hrs/week						Course grades					Prerequisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
STE431	Project Planning and Management	3	2	2	0	4	8	20	30	0	50	100	STE331
Elective	Elective course (4)	3	2	2	0	4	8	20	30	0	50	100	As per in table 6
Elective	Elective course (5)	3	2	2	0	4	8	20	30	0	50	100	As per in table 6
Elective	Elective course (6)	3	3	0	0	4	7	20	30	0	50	100	As per in table 6
SWE499	Senior Project (2)	3	1	2	3	6	12	20	20	10	50	100	SWE498
Total		**15**	**10**	**8**	**3**	**22**	**43**					**500**	
Total Contact hours = 21 hrs/week, Total SWL = 43 hrs/week													

The following table (9) represents **list of overall data about the CEE-SWE program**:

Table 9: List of overall data about the programs

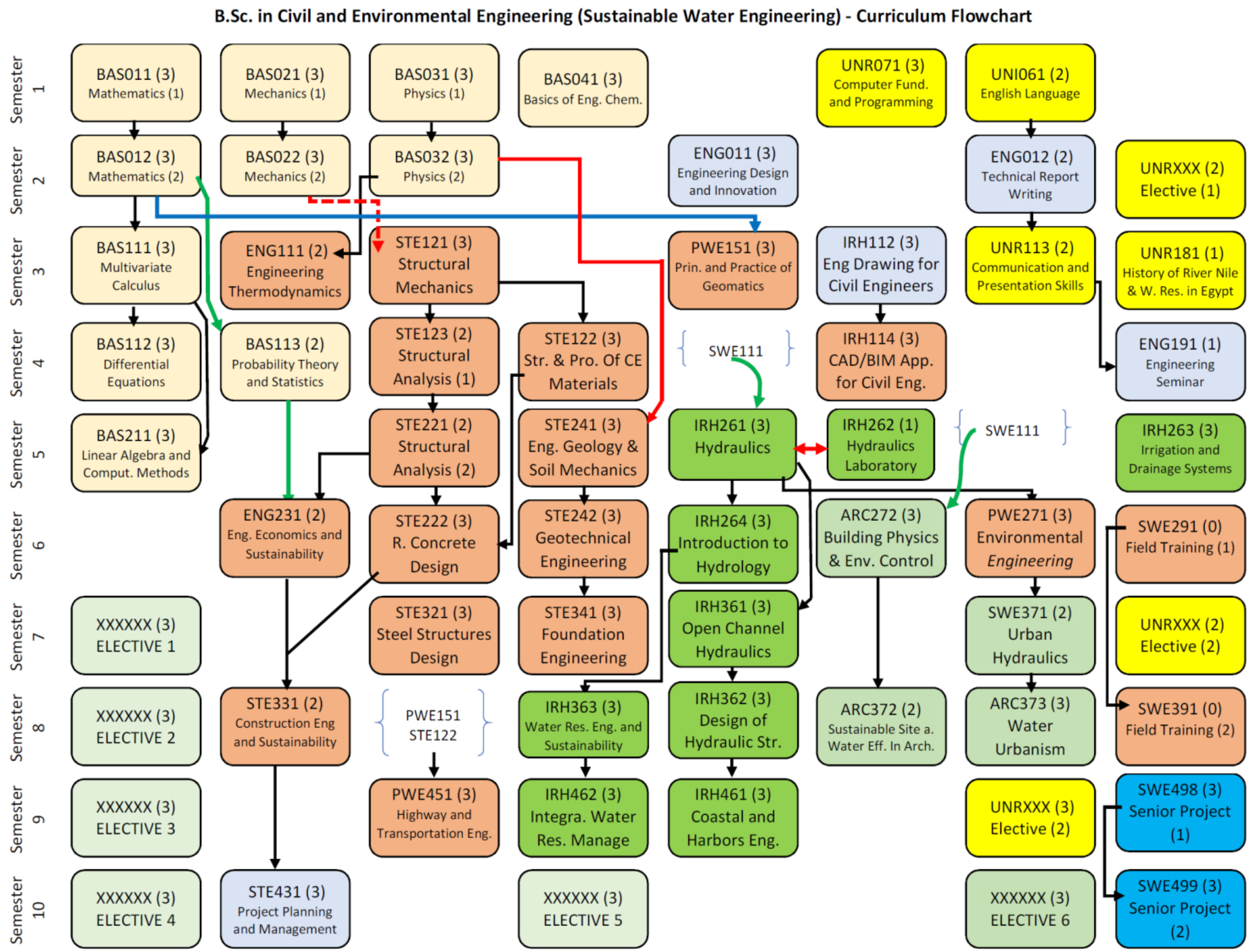
#	Program	NC	Credits and SWL			Total Contact Hours				4 Requirements %				BS %	EC %
			CH	ECTS	SWL	Lec	Tut	Lab	TT	UR	FR	DR	PR		
1	**SWE**	60	160	28.86	721.6	111	**90**	26.5	227.5	8.75	28.125	26.875	36.25	20	15

NC	Total number of Courses	UR	University Requirement
CH	Credit Hour	FR	Faculty Requirement
ECTS	European Credit Transfer System	DR	Discipline Requirement
SWL	Student Workload	PR	Program Requirement
Lec	Lectures		
Tut	Tutorials	BS	Basic Sciences Percentage, Credit Hours
Lab	Laboratory	EC	Elective Courses Percentage, by Credit Hours
TT	Total		

Checklist for each program:

- The total number of credit hours should be between 144 and 165
- The percentage of the 4 requirements is calculated by credit hours and should follow the percentages in the Terms of Reference.
- The percentage of Basic Sciences is calculated by credit hours and should follow the percentages in the Terms of Reference.
- The maximum number of courses is 60
- The maximum number of weekly contact hours is 280 Contact Hours. The maximum number of Lecture Contact hours is 50% of total contact hours or 130 contact hours, whichever is less.
- The Electives Pool should be at least 15% of the total credit hours of the program.
- All engineering programs must have at least 30 semester credit hours (or equivalent) of math and basic science to satisfy the requirement of ABET 2020-2021.

7. CEE-SWE program - Curriculum Flowchart



8. Benchmarks for assessing and developing the CEE-SWE program

The benchmarks for CEE-SWE program with related studies and programs in national and international ranked universities contained herein, are employed and developed as one of the set milestones for the development of program satisfying the requirements of Qualifications Frameworks for Higher Education Institutions (HEI) and Quality Assurance Systems in national (NARS 2018) and international (ABET 2020-021) levels. The importance and objectives of benchmarking are to: (1) act as a guide and tool for designing the curriculum for HEI programs, (2) help the reviewer to assess the quality of the programs, (3) show harmonization of the specific program with other related programs in the region and worldwide, (4) Support students mobility while the study and (5) insure the quality of the graduate and internationalization their labor market. The following tables (10 and 11) reflects the benchmarks of CEE-SWE program curriculum with selected similar and accredited programs in national and international universities. Note that the name of courses may be differ from university to others but the similarity of most courses' syllabus, objectives and outcomes are considered as the key to benchmarking.

Acronyms

MU: Mansoura University (Egypt)

NTU: Nanyang Technological University (Singapore)

Stanford: Stanford University (USA)

UCB: University of California, Berkeley (USA)

Purdue: Purdue University (USA)

Cornell: Cornell University (USA)

CU: Cairo University (Egypt)

HRI: Hydraulic Research Institute (Egypt)

CEE-SWE: Civil and Environmental Engineering (Sustainable Water Engineering)

WEE: Water Engineering and Environment

RED: River Engineering Diploma

Eng.: Engineering

Tech.: Technology

ABET: Accreditation Board for Engineering and Technology (USA)

HEI: Higher Education Institution

NARS: National Academic Reference Standards for Engineering (Egypt)

Table 10: Benchmarks of Compulsory Courses for CEE-SWE Program

University	Stanford	NTU	UCB	Purdue	Cornell	CU	HRI	MU
Shanghai Ranking	2	2	8	18	51-75	301-400		801-900
QS Ranking – Eng. and Tech.	2	8	5	32	32	176		
QS Ranking – Eng.- Civil and Structural	13	12	4	27	51-100	101-150		
ABET- program accreditations	X	-	X	X	X			-
CEE-SWE program – Compulsory Courses								
Mathematics (1)	X	X	X	X	X	X		X
Mechanics (1)	X		X	X		X		X
Physics (1)	X	X	X		X	X		X
Engineering Chemistry	X		X	X	X	X		X
English Language		X	X			X		X
Computer Fundamentals and Programming for Engineers	X		X			X	X	X
Mathematics (2)	X	X	X	X		X		X
Mechanics (2)				X	X	X		X
Physics (2)	X	X	X	X	X			X
Engineering Design and Innovation		X	X	X		Design		X
Technical Report Writing			X	X		X		X
Mathematics (3): Multivariate Calculus	X		X	X	X	X		X
Engineering Thermodynamics		X	X	X	X			X
Engineering Drawing for Civil Engineers	X	X		X		X		X
Structural Mechanics	X	X	X	X	X	X		X
Communication and Presentation Skills		X		X	X	X		X
Principles and Practice of Geomatics				X		X		X
History of River Nile and Water Resources in Egypt							X	X
Mathematics (4): Differential Equations			X	X	X	X		X
Probability Theory and Statistics	X	X		X	X	X		X
CAD/BIM Applications for Civil Engineers		X		CAD		CAD		X
Structure and Properties of CE Materials		X	X	X		X		X
Structural Analysis (1)		X	X	X	X	X		X
Engineering Seminar	X	X		X	X	X		X
Mathematics (5): Linear Algebra and Computational Methods	X	X	X		X		X	X
Structural Analysis (2)		X				X		X
Engineering Geology & Soil Mechanics	X	X	X			X		X

Table 10 (continue): Benchmarks of Compulsory Courses for SWE Program

Hydraulics	X	X		X	X	X		X
Hydraulics Lab.	X	X		X				X
Irrigation and Drainage Systems						X		X
Reinforced Concrete Design		X	X			X		X
Engineering Economics and Sustainability		X			X			X
Geotechnical Engineering	X	X	X	X	X			X
Introduction to Hydrology		X		X	X	X		X
Environmental Engineering	X	X	X	X	X	X		X
Building Physics & Environmental Control	X							X
Steel Structures Design		X	X			X		X
Foundation Engineering		X	X			X		X
Open Channel Hydraulics	X	X		X		X	X	X
Urban Hydraulics	X	X		X				X
Construction Engineering and Sustainability		X	X					X
Design of Hydraulic Structures		X				X	X	X
Water Resources Engineering and Sustainability	X			X	X	X		X
Sustainable Site and Water Efficiency in Architecture								X
Water Urbanism		X				X		X
Highway and Transportation Engineering			X		X	X		X
Coastal and Harbors Engineering	X	X		X		X		X
Integrated Water Resources Management	X			X		X		X
Project Planning and Management	X	X	X			X		X
Training		X	X			X		X
Project	X	X	X		X	X	X	X

Table 11: Benchmarks of Electives Courses for CEE-SWE Program

University	Stanford	NTU	UCB	Purdue	Cornell	CU	HRI	MU
Law and Human Rights			X	X				X
Fundamentals of Economics and Accounting		X			X	X		X
Ethics and Morals of the Profession	X	X	X	X		X		X
Environmental Impact Assessment					X	X	X	X
Water, Energy and Climate Change Issues								X
Computer Applications for SWE	X	X		X				X
Computational Simulation of Flow and Transport in the Environment	X				X		X	X
Excavation & Retaining Walls		X				X		X
GIS and Remote Sensing Applications for SWE				X		X	X	X
Bridge Engineering		X						X
Smart Irrigation and Drainage Technologies								X
Surface Hydrology				X	X			X
Subsurface Hydrology			X	X			X	X
Water Measurement and Analysis Methods		X			X			X
Smart Design for Water Treatment and Desalination Units								X
Water Quality Modelling		X		X		X		X
Dam Engineering							X	X
Offshore Engineering		X		X				X
Physical Hydrology for Ecosystems					X			X
Watershed and Wetlands	X			X	X			X
River Engineering	X					X		X
Sediment Transportation Engineering				X	X		X	X
Floods and Droughts, Dams and Aqueducts	X							X
Providing Safe Water for the Developing World	X							X
Environmental Hydraulics		X				X		X
Introduction to Environmental and Ecological Engineering				X				X
Water Power Resources								X
Waterpower Engineering and Sustainability							X	X
Hydroelectric Power Plants and Technologies							X	X
Development of Water Resources in River Nile Basin							X	X
Special Topics in Water Engineering & Sustainability				X			X	X
National and International Water Law, and Hydropolitics				X		X		X

9. Courses Syllabus for CEE-SWE Program

First Semester

BAS011	Mathematics (1)							Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**1st**	--------

<u>Calculus:</u> Function (definition - theorems) - Basic functions - limits - Continuity - Derivation - definition - theorems - types - higher orders - Applications on derivatives - Partial derivatives - indefinite integral - theories and properties of integration.

<u>Algebra:</u> Binomial theorem (with any exponent and applications) - Partial Fractions - Theory of Equations - Matrices - System of linear equations - Gauss elimination method.

<u>References:</u>

- Akhtar and Ahsan (2009). **Textbook of Differential Calculus (2nd edition)**. PHI Learning Private Limited.
- Alan Jeffrey (2010). **Matrix operations for Engineers and Scientists**. Springer Science & Business Media

BAS021	Mechanics (1)								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**1st**	--------

Equilibrium of a particle: Two-Dimensional - Force vectors in three dimensions - Equilibrium of a particle in three dimension – System of forces and moments – Moment of a force about point - Moment of a couple – Equivalent systems of forces and couples – Reduction of systems of forces and couples - Equilibrium of Rigid body in two dimension - Center of gravity and centroid– Frames and Machines: Analysis of frames – Dismembering connected parts of the frame - Analysis of Machines - Friction: Types of friction, Theory of dry friction – Static friction and Impending motion – kinetic friction – Types of problems involving dry friction.

<u>References:</u>

- R.C. Hibbeler (2016). **Engineering Mechanics: Statics and Dynamics (14th Edition).** Pearson Prentice Hall, New Jersey.
- J. L. Meriam, L. G. Kriage, and J. N. Botton (2016). **Engineering Mechanics: Statics (8th Edition).** John Wiley & Sons, New York.
- F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg (2010). **Vector Mechanics for Engineering: Statics and Dynamics (9th Edition).** McGraw-Hill Science.

BAS031	Physics (1)								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester	**1st**	--------

Properties of matter: physical quantities – dimensions and units– oscillatory motion – mechanical properties of material – fluid characteristics – viscosity – surface tension – acoustic waves – waves across elastic bodies.

Heat and thermodynamics: heat transfer – kinetic theory of gases – first law of thermodynamics – entropy and second law of thermodynamics – temperature scales and thermometers – heat expansion.

References:

- R.A. Serway and J.W. Jewett (2014). **Physics for Scientists and Engineers (6th Edition).** Thomson Brooks/Cole Publishing Co.
- Paul A. Tipler (2008). **Physics for scientists and engineers (6th edition).** Freeman, W. H. & Company

BAS041	Engineering Chemistry								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester	**1st**	--------

Equations of state-chemical thermodynamics - Material and energy balance in chemical processes- properties of solutions - Basic principles in electrochemistry and its applications – Introduction to chemical engineering: basic operations and plastics, fertilizers, dyes and petrochemical industries.

References:

- Brown, L. T, LeMay H. E. Jr, Bursten, B. E., Murphy, C.J., and Woodward, P. (2009). **Chemistry the Central Science (11th edition).** Pearson Prentice Hall.
- Brown T. E., LeMay H. E., Bursten B. E., Murphy C. J., Woodward P., and Stoltzfus M. E. (2020). **Chemistry: The Central Science (14th Edition) (Mastering Chemistry) (14th Edition)**. Pearson Prentice Hall.

UNR061	English Language							Prerequisites
2 Cr.	Lecture	**1**	Tutorial	**2**	Lab.	**0**	Semester	**1st**	--------

Analysis and explanation of technical texts – abbreviating texts at different levels of conciseness – continuation of preparation for standard language tests.

References:

- Mark Ibbotson (2011). **Cambridge English for Engineering Student's book (student edition)**. Cambridge University Press.

UNR071	Computer Fundamentals and Programming for Engineers								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**2**	Semester	**1st**	--------

Review on fundamentals of digital computer: basic components and organization – operation systems - data processing and number systems – Data communications and networks- etc
Principles of Programming for engineers: Elements of Programming Paradigms (procedural - and object-oriented programming) - data structures and algorithms – basic computational algorithms - basic concepts of algorithmic thinking to solve problems of relevance in engineering practice - examples drawn from science, and engineering
Programming with MATLAB: Introduction - Basics of MATLAB - Control Structures - Writing MATLAB Functions -Data Structures and Classes - Solving system of linear equations - Data smoothing, inter- and extrapolation - Drawing Curves – Applications relevant to simple water engineering applications.

References:

- Tad W. Patzek and Ruben Juanes (2006). **An Introduction to Computer Programming for Engineers and Scientists.** University of California
- Arun Prakash. **Introduction to Computing with MATLAB**. School of Civil Engineering, Purdue University
- Bradley A. R. (2011). **Programming for Engineers: A Foundational Approach to Learning C and MATLAB.** Springer, ISBN-13: 978-3642233029
- Peter Van Roy and Seif Haridi (2012). **Concepts, Techniques, and Models of Computer Programming.** The MIT Press.
- López, C.P. (2014). **Introduction to MATLAB, in MATLAB Numerical Calculations**. Springer
- Stephen J. Chapman (2020). MATLAB Programming for Engineers (6th edition). Cengage Learning, ISBN: 978-0-357-03039-4.

Second Semester

BAS012	Mathematics (2)								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**2nd**	BAS011

Integral Calculus: Definite integral - Methods of integration – Applications on definite integral (plane area - volume of revaluation - length of a plane curve - area of surfaces of revolution) - improper integral.

Analytic Geometry: Equations of second degree - Equation of pair of straight lines - Translation of axes - Conic sections - parabola - ellipse - hyperbola) Equation of plane - Equation of sphere

References:

- Jumarie, G. (2013). **Fractional Differential Calculus for Non-Differentiable Functions: Mechanics, Geometry, Stochastics, Information Theory**. LAP Lambert Academic Publishing.
- Hestenes, D. and G. Sobczyk (2012). **Clifford algebra to geometric calculus: a unified language for mathematics and physics. Vol. 5**. Springer Science & Business Media.
- Grossman, S.I. (2014). **Multivariable calculus, linear algebra, and differential equations (2nd edition)**. Academic Press.

BAS022	Mechanics (2)								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**2nd**	BAS021

Introduction to dynamics – Kinematics of a particle: curvilinear Motion – Rectangular components – Motion of projectiles – Normal and Tangential components – cylindrical components - Kinetics of a Particle: Force and Acceleration; The Equation of Motion in: Rectangular Coordinates, Normal and Tangential Coordinates, Cylindrical Coordinates. Work and Energy; Principle of a Work and Energy, Conservative Forces and Potential Energy, Conservation of Energy, Power and Efficiency. Linear Impulse and Momentum: Conservation of Linear Momentum for a System of Particles, Impact.

References:

- R.C. Hibbeler (2016). **Engineering Mechanics: Statics and Dynamics (14th Edition).** Pearson Prentice Hall, New Jersey.
- F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg (2010). **Vector Mechanics for Engineering: Statics and Dynamics (9th Edition).** McGraw-Hill Science

BAS032	**Physics (2)**							**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**1.5**	Semester	**2nd**	BAS031

Electricity and magnetism: the shipment and material - electric field - Coulomb's law - Flood electrophoresis - Law Gauss - voltage - capacitors and insulating materials - current and resistance and potential electric power - Ohm's law and simple circuits - magnetic field - Biot and Savart law - magnetic flux and the law of Gauss - Faraday's law - magnetic induction. Light: light engineering - the wave nature of light and the principle of HOI - interference and diffraction - polarization of light - optical fiber - Atomic physics: atomic structure - Bohr theory - the principles of quantum theory - Laser - PV phenomenon - the theory of relativity

References:

- R.A. Serway and J.W. Jewett (2014). **Physics for Scientists and Engineers (6th Edition).** Thomson Brooks/Cole Publishing Co.
- Paul A. Tipler (2008). **Physics for scientists and engineers (6th edition).** Freeman, W. H. & Company

ENG011	**Engineering Design and Innovation**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**2nd**	--------

An introductory to the exciting and complex world of engineering design and innovation (EDI) - A systematic approach (theoretical and analytical)to the engineering method of design and problem solving techniques - Roles of systems thinking, innovation and creativity in the design process and decision making - Basic systems engineering concepts - Creativity tools - Engineering design process - Project management principles - Professional reflections - Principles of safe design – Practical engineering design problems – Applications.

References:

- Suh, Nam P., Cavique, Miguel, Foley, Joseph (2021). **Design Engineering and Science.** ISBN 978-3-030-49232-8, Springer.
- Brenner, Walter, Uebernickel, Falk (2016). **Design Thinking for Innovation**. Springer
- Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H. (2007). **Engineering Design: A Systematic Approach.** ISBN 978-1-84628-319-2, Springer
- Andrew Samuel and John Weir (1999). **Introduction to Engineering Design (1st edition).** ISBN: 0750642823. Elsevier Science & Technology Books
- Cynthia Gayton (2017). **Legal Aspects of Engineering, Design, AND Innovation (10th Edition).** ISBN-13: 978-1465295316, Kendall Hunt Publishing

ENG012	Technical Reports Writing								Prerequisites
2 Cr.	Lecture	**1**	Tutorial	**2**	Lab.	**0**	Semester	**2nd**	UNR061
Introduction to technical writing - elements of writing strategy - planning technical reports – writing a technical report: using illustrations, organizing and numbering, writing reference lists and appendices. Formal reports: categories and structure - Applications in report writing: laboratory report, field report, periodic reports, proposals, theses - Ethical considerations and plagiarism - writing a CV.									

References:

- G. J. Alred, and W. E. Oliu (2018). **The Handbook of Technical Writing (12th Edition).** Bedford/St. Martin's.
- K. Hyland (2016). **Teaching and researching writing (3rd edition).** Routledge academic publisher.
- M. Markel (2015). **Technical Communication (11th edition).** MacMillan.

Third Semester

BAS111	Mathematics (3): Multivariate Calculus								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**3rd**	BAS012
Introduction to Multivariate Calculus-Parametric equations and polar coordinates - Vectors in 2- and 3-dimensional Euclidean spaces - Differential calculus of several variables-Partial derivatives- Multiple integrals - Vector calculus - Theorems of Green, Gauss, and Stokes-the divergence theorem									

References:

- Grossman, S.I. (2014). **Multivariable calculus, linear algebra, and differential equations (2nd edition)**. Academic Press.
- S. A. Wirkus, and R. J. Swifi (2015). **A Course of Ordinary Differential Equations**. Taylor & Francis Group, LLC.
- Akhtar and Ahsan (2009). **Textbook of Differential Calculus (2nd edition)**. PHI Learning Private Limited.

ENG111	Engineering Thermodynamics							Prerequisites
2 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**0**	Semester **3rd**	BAS032

Introduction to the basic principles of thermodynamics relevant to buildings and other Civil Engineering infrastructure - Fundamental laws of thermodynamics for simple substances – Energy Concepts - First and second laws of thermodynamics, entropy, reversible and irreversible processes - properties of pure substances - chemical and materials thermodynamics - Multiphase and multicomponent thermodynamic equilibria in systems - Application to engineering problems

References:

- S. K. Gupta (2013). **Engineering Thermodynamics**. ISBN: 9788121942706, S. Chand Publishing
- Nihal E Wijeysundera (2010). **Engineering Thermodynamics with Worked Examples.** World Scientific.
- Yunus A. Cengel (2007). **Introduction to Thermodynamics and Heat Transfer (2nd edition).** McGraw-Hill Science/ Engineering/ Math.

IRH112	Engineering Drawing for Civil Engineers							Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**3**	Lab.	**0**	Semester **3rd**	

Principles techniques and skills of engineering drawing – Free hand sketching – Civil engineering drawings practices - Legend and symbols - Scales and drawing size - Normal and auxiliary projections - Principle of tangency - First and third angle projection - Sectional view - Isometric view - Intersections between planes and solids – Applications on civil projections and reading of blueprints such as Earthworks and Retaining Walls, Water Structures and infrastructures, RC and Steel Structures, etc. - Introduction to 2D Computer Aided Design (CAD) – Basic tools and functions– Drafting screen – preliminary create, design and layouts for simple drawings.

References:

- K. Venugopal (2014). **Engineering Drawing.** New Age International Publisher, ISBN-13: 978-8122436679.
- Autodesk. **Autodesk AutoCAD Essentials Courseware**. Available edition and materials
- K. Venugopal (2007). **Engineering Drawing and Graphics + AutoCAD**. New Age International Publisher, ISBN - 8122413129, 9788122413120
- M. V. Thomas (1982). **A Guide to the Preparation of Civil Engineering Drawings.** Macmillan Publishers Limited, ISBN- 978-0-333-32699-2
- Parker M. A. and Pickup F. (1991). **Engineering Drawing with Worked Examples (3rd edition).** Stanley Thornes Ltd.

STE121	Structural Mechanics								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**0**	Lab.	**2**	Semester	**3rd**	**BAS022**

Introduction to structural mechanics of materials - Basic mechanical and geometric properties of materials - Loads - Internal forces - Structural forms - Analysis of Stress and strain - Axially loaded members - Flexural members - Torsional members- Combined loading conditions - Shear stresses - Combined stresses - Stress (strain) deformation - Buckling **Laboratory:** Basic behavioral characteristics of structural elements and systems are illustrated by laboratory experiments for: stress, stiffness and strength evaluation, deformation and mechanical properties in different cases of loading.

References:

- R. C. Hibbeler (2013). **Statics and Mechanics of Materials (4th Edition).** Pearson Publisher, ISBN-13: 978-0133451603.
- Beer F. P., E. Russell Johnston Jr. R., DeWolf J. T., Mazurek D. F. (2014). **Mechanics of Materials (7th edition).** McGraw-Hill.

PWE151	Principles and Practice of Geomatics								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**2**	Semester	**3rd**	**BAS012**

Introduction of surveying history and fundamentals, Scale, chain surveying (tape), Bearings & obstacles, Traverse types and adjustment, omitted observations, levelling theory, types of leveling - Area for regular and irregular shapes, Volumes from longitudinal and grid levelling - Theory of observational errors and error propagation - Fundamental concepts of horizontal and vertical control systems – contour lines and contour maps, surveying maps - - use of topographic maps and plan- profile sheets – Theodolite and total station - computation of horizontal and vertical curves - introduction to computer tools used in Civil Engineering.

References:

- John Olusegun Ogundare (2015). **Precision Surveying: The Principles and Geomatics Practice.** ISBN: 978-1-119-10251-9, Wiley Press.
- Anderson, M.J., and E.M. Mikhail (2017). **Surveying: Theory and Practice (5th Edition)**. McGraw Hill.

UNR113	Communication and Presentation Skills							Prerequisites
2 Cr.	Lecture	**1**	Tutorial	**2**	Lab.	**0**	Semester **3rd**	**ENG012**

Communication Skills: Introduction to communication - communication process - communication skills - verbal and nonverbal communication -interpersonal communication - small group communication - online communication - workplace communication.

Presentation Skills: Overview of oral presentations - preparing and creating a presentation - presentation software - attending a presentation - presentation writing skills.

References:

- Joan van Emden, Lucinda Becker (2016). **Presentation Skills for Students (3rd Edition).** Red Globe Press.
- M. Wa Mutua, S. Mwaniki, P. Kyalo, B. Sugut (2016). **Communication Skills: A University Book.** Succex Publishers.
- Ian Tuhovsky, Wendell Wadsworth (2015). **Communication Skills Training**. Ian Tuhovsky.
- Tabitha Wambui, Alice W. Hibui, Elizaeth Gathuthi (2012). **Communication skills " Vol.1, Students' coursebook.** LAP LAMBERT Academic Publishing.

UNR181	History of River Nile and Water Resources in Egypt							Prerequisites
1 Cr.	Lecture	**1**	Tutorial	**0**	Lab.	**0**	Semester **3rd**	--------

Scope of the course and its aims- Nile River: Ancient and modern history, Historical significance, Facts, Definition, Maps and Location - Infrastructures along the River and its social, economic, health and environmental impacts. Egyptian water resources (River Nile, Participation, Groundwater, Water desalination, etc.) - Water resources systems and use - The MWRI's National Water Resources Plan (NWRP) - Future water resources planning and management - Improvement of irrigation and agricultural water use - Introduction to Legal and institutional framework as well The Nile Basin Initiative between the Nile riparian countries.

Fourth Semester

BAS112	**Mathematics (4): Differential Equations**							**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**4th**	BAS111

Introduction to ordinary and partial differential equations - First order equations - Second and n'th order equations - Series solutions - Fourier series - solution by Laplace transform, systems of linear equations - A substantial part of this course involves partial differential equations such as the heat equation, the wave equation, and Laplace's equation.

References:

- S. A. Wirkus, and R. J. Swifi (2015). **A Course of Ordinary Differential Equations**. Taylor & Francis Group, LLC.
- Edwards C. H., Penney D. E., and Calvis D.T. (2017). **Differential Equations and Linear Algebra (4th Edition).** Pearson Publisher

BAS113	**Probability Theory and Statistics**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**4th**	BAS012

Introduction to statistics - Basic concepts of Probability- Rules and theorems of probability- Total Probability Theorem - Measures of tendency and dispersion - Random variable - Discrete and continuous probability distributions - Sampling theorem - Expectations - Confidence intervals - Hypothesis test - non-parametric tests - regression and correlation - time series- Applications.

References:

- Mary C. Meyer (2019). **Probability and Mathematical Statistics: Theory, Applications, and Practice in R.** SIAM, ISBN: 1611975786, 9781611975789.
- Benjamin, J. R. and Cornell, C. A. (2014). **Probability, Statistics, and Decision for Civil Engineers (V. 1)**. Dover Publications.
- Alfredo H-S. Ang and Wilson H. Tang (2006). **Probability Concepts in Engineering: Emphasis on Applications to Civil and Environmental Engineering (v. 1) (2nd Edition).** Wiley Publisher. ISBN-13: 978-0471720645

IRH114	**CAD/BIM Applications for Civil Engineers**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**3**	Semester	**4th**	IRH112

Overview of computer aided design, graphics and documentations for civil engineering applications, taking in consideration the industry graphic standards and their technical visual applications. Introduction of the use of 2D and 3D Computer Aided-Design (CAD) and Building Information Modelling (BIM)to acquire basic techniques and skills to create 3D models and to generate 2D construction drawings.

References:

- Autodesk. **Autodesk AutoCAD Essentials Courseware (Last available edition).** Autodesk, Inc., U.S.A.
- Karen K. and Douglas N. (2014). **Building Information Modelling: BIM in Current and Future Practice (1st edition).** John Wiley & Sons, Inc., Hoboken, New Jersey, U.S.A.
- Eddy K. and James V. (2015). **Mastering Autodesk Revit Architecture 2015: Autodesk Official Press.** John Wiley & Sons, Inc., Indianapolis, Indiana, U.S.A.
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STE122	**Structure and Properties of CE Materials**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**2**	Semester	**4th**	STE121

Civil engineering materials and environmental considerations - Nature and performance of materials under load - Structure of materials - Concrete Technology: constituent materials and their properties, mix design methods, manufacture, properties, and standard and quality control testing - Masonry - Steel - Wood and timber - Polymers, plastics, and fiber-reinforced composites - Highway materials - Green construction materials, special concrete.

Laboratory: Testing for Quality Control.

References:

- Mamlouk, M. S. and Zaniewski, J. P. (2016). **Materials for Civil and Construction Engineers (4th edition)**. Pearson Educational International, ISBN: 978-0134320533
- Neville, A. M. and Brooks, J. J. (2010). **Concrete Technology (2nd edition)**. Pearson Education Canada. ISBN: 978-0273732198
- N. Jackson, and R.K. Dhir (1996). **Civil Engineering Materials (5th edition)**. Palgrave, New York.

STE123	Structural Analysis (1)								Prerequisites
2 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**0**	Semester	**4th**	STE121

Scope of the course – Introduction: structural loads, forms and classifications- Structural analysis and design – Determinacy and stability of beams and frames - Stress resultants (reactions, axial forces, shear forces, and bending moments) for beams and framed structures - Analysis of simple beams: shear force and bending moment functions and diagrams - Deflections of beams and frames with different geometric and energy methods - Analysis of statically indeterminate beams and frames - Determinacy and stability of trusses - Analysis of planer trusses - Deflections of trusses.

References:

- Hibbeler, R.C. (2012). **Structural Analysis (8th edition).** Pearson Prentice-Hall.
- U ang, C-M, Gilbert, AM. (2011). **Fundamentals of Structural Analysis (4th edition)** McGraw-Hill.
- Leet, K.M., Uang, C.M., Gilbert, A.M. (2008). **Fundamentals of Structural Analysis (3rd edition).** McGraw-Hill.
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ENG191	Engineering Seminar								Prerequisites
3 Cr.	Lecture	**1**	Tutorial	**0**	Lab.	**0**	Semester	**4th**	UNR113

The course has been designed to provide students with the opportunity to meet and discuss various topics related to the engineering in general and in the field of study with an expert such as: Faculty advisor to discuss the engineering curriculum and programs, rules and examinations, the engineering careers and the engineers' duties and so on - Faculty member to explore an intellectual topics or an active research in the engineering - Expert from industrial establishments relevant to the program may be invited to give talks and presentations. Students themselves may work in groups on a written report and presentation on new topics in engineering under an instructor supervision.

Fifth Semester

BAS211	**Mathematics (5): Linear Algebra and Computational Methods**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**5th**	BAS111

Review to linear algebra, matrix algebra. vector spaces, determinates, Linear system of equations, Gauss elimination and solution types, Linear independence and Gauss Jordan elimination - Applications - Mathematical Modelling -Qualitative methods- Numerical Methods - Roots of Equations - Numerical Interpolation - Numerical Integration and Differentiation - Numerical Solution of Ordinary Differential Equations - Applications.

References:

- Granville Sewell (2014). **Computational Methods of Linear Algebra (3rd Edition)**. World Scientific Publishing Co.
- Michael Schäfer (2006). **Computational Engineering: Introduction to Numerical Methods.** Springer
- Howard Anton and Chris Rorres (2005). **Elementary Linear Algebra with Applications (9th Edition).** John Wiley & Sons.
- Chapra, S. C. and Canale R. P. (2006). Numerical **Methods for Engineers (5th Edition)**. McGraw-Hill.
- Edwards C. H., Penney D. E., and Calvis D.T. (2017). **Differential Equations and Linear Algebra (4th Edition).** Pearson Publisher

STE221	**Structural Analysis (2)**								**Prerequisites**
2 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**0**	Semester	**5th**	STE123

Influence lines and their applications, maximum response functions for continuous beams and frames - Analysis methods for statically determinate and indeterminate structures: Behaviour of beams, trusses and frameworks - Equilibrium and compatibility conditions - Consistent deformation, redundant reactions and member forces - Displacement methods for statically indeterminate structures – The slope-deflection method -Application to beams and frames - Principles of iterative solution; the moment distribution method - Analysis of vertical, shear and combined stresses analytical and graphical methods.

References:

- Hibbeler, R.C. (2012). **Structural Analysis (8th edition).** Pearson Prentice-Hall.
- U ang, C-M, Gilbert, AM. (2011). **Fundamentals of Structural Analysis (4th edition)** McGraw-Hill.
- Leet, K.M., Uang, C.M., Gilbert, A.M. (2008). **Fundamentals of Structural Analysis (3rd edition).** McGraw-Hill.

STE241	**Engineering Geology & Soil Mechanics**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**1**	Lab.	**2**	Semester	**5th**	BAS032

The essential concepts of earth science and basic knowledge of engineering geology related to civil engineering works and the environment - Plate tectonics, minerals and rocks - Geological time scale and Soil forming processes - Geological structures and rock mass properties - Geological maps and geology of Egypt and River Nile Basin.

The fundamental principles of soil mechanics – Identification and engineering characterizations of soils - Soil classification, particle size and soil indices - Phase relationships and soil compaction - Flow of water in soils, flow nets and effective stress concept - Soil permeability, unidirectional and bidirectional flow - Soil compressibility and consolidation.

References:

- Knappett, J.A. and Craig, R.F. (2012). **Craig's Soil Mechanics (8th edition)**. CRC Press.
- Waltham, T. (2009). **Foundations of Engineering Geology (3rd edition).** ISBN: 978-0415469609, CRS Press Imprint, Tayor and Franxis Ltd.
- Das, Braja M. (2010). **Principles of Foundation Engineering** (7th edition). ISBN:978-0495668107, Cengage Learning.
- **"Egyptian Code for Soil Mechanics and Design and Execution of Foundations" (Last available edition)**.
- Barnes, G. E. (2000). **Soil Mechanics: Principles and Practice.** Macmillan Education UK, 2000

IRH261	**Hydraulics**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**5th**	BAS111

Introduction to fluid mechanics and hydraulics engineering - Fluid properties – Units and Dimensions – Hydrostatics - Kinematics and dynamics of fluid flows – Conservation of mass, energy, and momentum: fundamentals, integral and differential formulations, and applications related to the program – Basics of flows in pipes and open channels – Steady pipe flow - Introduction to Flow visualization and computation techniques using MATLAB.

References:

- Cengel, Y. and Cimbala, J. (2017). **Fluid Mechanics in SI Units (3rd edition)**. ISBN-13: 978-9339204655, McGraw Hill Education.
- Webber, N. B. (1990). **Fluid Mechanics for Civil Engineers: SI edition (1st Edition).** ISBN-13: 978-0412106002, CRC Press.
- Longo, S., Tanda, M. G., and Chiapponi, L. (2021). **Problems in Hydraulics and Fluid Mechanics (Springer Tracts in Civil Engineering) 1st edition.** ISBN-13: 978-3030513863, Springer Tracts in Civil Engineering, Springer

IRH262	**Hydraulics Laboratory**							**Corequisite**
1 Cr.	Lecture	**0**	Tutorial	**0**	Lab.	**2**	Semester **5th**	IRH261

Laboratory course aims to provide you with a hands-on practical experience in collecting, analyzing and discussing experimental data in relation to the theories learned in Hydraulics such as: Hydrostatic forces, Centre of pressure, The energy principle, Discharge through an Orifice, Impact of jet, Friction losses in pipe flow, etc. - Formal laboratory experiments with technical reports- Small group laboratory assignments.

References:

- Chen, G. and Youneng, S. (2017). **Environmental and Hydraulic Engineering Laboratory Manual Lab Manual Edition**. ISBN-13: 978-1604271379, J. Ross Publishing.
- Ahmad Kamal. , N. (2010). **Fluid mechanics and hydraulics. laboratory manual (OBE).** ISBN: 9789673631087, Shah Alam : University Publication Cente, Universiti Teknologi MARA.
- Likhi, S. K. (1995). **Hydraulics: Laboratory Manual.** ISBN: 9788122405163, New Age International.

IRH263	**Irrigation and Drainage Systems**							**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester **5th**	

Introduction to Irrigation and Drainage Systems Engineering (IDSE) – Crop water requirements and hydrologic determination of the design flow - Principles and concepts of design and construction of IDSE projects – Types of surface and subsurface irrigation methods and systems – Design of traditional irrigation systems such as irrigation by flooding and by strips – Fundamentals of elements and design of modern irrigation methods and systems such as sprinkler and drip irrigations – Types of drainage methods and systems and factors influencing selection and design – Planning and design of selected drainage system - Introduction to the environmental impact assessment (EIA) of irrigation and drainage projects – Overview of environmental sustainability of irrigation systems based on the efficiency parameters and the definitions of sustainability.

References:

- Chaudhry, S. and Garg, Sh. (2019). **Smart Irrigation Techniques for Water Resource Management.** IGI Global Publisher of Timely Knowledge.
- Waller, P., and Muluneh, Y. (2016). **Irrigation and drainage engineering**. ISBN 978-3-319-05699-9, Springer International Publishing.

- Azhar, A. H., Ashraff, Ch. M., Ahmed, M. (2011). **Modern irrigation techniques and technologies: Efficient Utilization of Scarce Water Resources.** ISBN-13: 978-3639364590, VDM Verlag Dr. Müller.
- Hoffman, G.J., Evans, R.G., Jensen, M.E., Martin, D.L., and Elliott R.L. (2007). **Design and operation of farm irrigation systems (2nd edition).** St. Joseph, MI: American Society of Agricultural and Biological Engineers.
- Wracien, D. D., Ritter, W. F. and Quest, J. **Irrigation & Drainage Systems Engineering (Latest Edition).** ISSN: 2168-9768 - Open Access Journal, HiLARIS.
- Sharma, R. K. and Sharma, T. K. (2002), **Irrigation Engineering**. ISBN :9788121921282, S. Chand Publishing
- Walski, M.T., Haestad Methods, Inc (2002). **Computer Applications in Hydraulic Engineering-connecting theory to practice.** Haestad Press, Waterbury, CT, U.S.A.

Sixth Semester

STE222	**Reinforced Concrete Design**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**6th**	STE122 STE221

Introduction to the behaviour and design of reinforced concrete structures - **Basic design concepts**: Basic layout of concrete structural systems, loading, design Philosophies: working Stress, wltimate load and limit state - **Analysis of structure**: Load combinations and loading arrangements, simplification of framed structures, moment redistribution – **Design of flexural members**: Singly and doubly reinforced rectangular sections, flanged sections, shear, bond and anchorage, serviceability – **Design of slabs under flexural and shear:** Slab actions, design of one-way slabs, two-way slabs – Analysis of various slab forms such as in site solid slabs, ribbed slabs, paneled beam slabs or precast units – **Design of Columns:** Classification, column behaviour, axially loaded, uni-axially bent and bi-axially bent columns, column interaction diagram – **Applications** including drawings of layout of the structural system and details of reinforcement considering the limitations of the design code and the design method – **Introduction to programs** for reinforced concrete design.

References:

- Fanella, D. A. (2016). **Reinforced Concrete Structures: Analysis and Design, (2nd edition).** ISBN: 9780071847841, McGraw-Hill Education.
- Wight, J.K. (2015). **Reinforced Concrete: Mechanics and Design (7th edition)**. Pearson/Prentice Hall.

- El-behairy, S. (2002). **Reinforced Concrete Design Handbook (5th edition).** Ain Shams University, Egypt.
- ECP (Latest edition). **Egyptian Code for Design and Construction of Reinforced Concrete Structures, Design of Concrete Mixes.** Housing and Building Research Center, Egypt.

ENG231	Engineering Economics and Sustainability							Prerequisites
2 Cr.	Lecture	2	Tutorial	1	Lab.	0	Semester	6th	BAS113

Introduction to Engineering Economics as a subset of the field of economics that draws upon the logic of economics and sustainability engineering in addition to analytical power of mathematics and statistics - The principles, basic Concepts and methodology of engineering economics and its sustainability analysis including making purchasing decisions, deciding between project alternatives through fundamental analysis of alternatives, evaluating different processes, and balancing environmental and social sustainability and costs against economic costs - Effects of time, interest on money and life cycle costs - Economic evaluation of alternatives - Economic sustainability analysis - Basics of financial and depreciation accounting relevant to the course - Cost benefit ratio analysis - After tax Economic analysis - Effects of inflation on economic evaluation - Replacement analysis - Decision Making under uncertainty - Applications relevant to the SWE program.

References:

- Newnan, D., Eschenbach, T., Lavelle, J. and Lewis, N. (2019). **Engineering Economic Analysis (14th Edition).** ISBN-13: 978-0190931919, Oxford University Press
- Brian Chi-ang Lin and Siqi Zheng (2017). **Environmental Economics and Sustainability**. ISBN: 978-1-119-32820-9, Wiley Press.
- Blank, L. and Tarquin, A. (2017). **Engineering Economy (8th edition).** McGraw-Hill Education, New York.
- Ronald A. Chadderton (2015). **Purposeful Engineering Economics**. ISBN: 978-3-319-18847-8, Springer International Publishing.
- Newnan, D.G., Whittaker, J., Eschenbach, T.G. and Lavelle, J.P. (2014). **Engineering economic Analysis (3rd edition).** Don mills, Toronto, Ontario, 2014.

STE242	Geotechnical Engineering							Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	0	Semester	6th	STE241

Completing the soil mechanics principles and their applications to geotechnical design - Soil as a Continuum - Shear Strength of Soil - Lateral Earth Pressure - Elastic Stress Distribution -

Slope stability – Soil compaction - Soil Improvement – Applications on practical problems relevant to water infrastructures.

References:

- Knappett, J.A. and Craig, R.F. (2012). **Craig's Soil Mechanics (8th edition)**. CRC Press.
- Holtz, R.D. Kovacs, W.D. and Sheahan, T.C. (2011). **An Introduction to Geotechnical Engineering (2nd edition).** Pearson.
- Das, Braja M. (2010). **Principles of Foundation Engineering (7th edition).** ISBN:978-0495668107, Cengage Learning.
- Coduto, D.P. (1999). **Geotechnical Engineering, Principles and Practices**. Prentice Hall.
- "Egyptian Code for Soil Mechanics and Design and Execution of Foundations" **(Last available edition)**.

IRH264	**Introduction to Hydrology**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**6th**	IRH261

Introduction to Engineering Hydrology - Description, measurement, and analysis of hydrologic processes: precipitation, evapotranspiration, infiltration, and runoff – Groundwater: fundamentals, aquifers, yield and hydraulics of groundwater flow- well hydraulics - Definition of catchment characteristic - Hydrograph analysis: unit and synthetic unit hydrographs and flood routing– Statistical analysis of hydrologic data - Reservoir yield and storage - Case studies and applications in both surface and groundwater flows.

References:

- Elsalmian, S. (2014). **Handbook of Engineering Hydrology: Environmental Hydrology and Water Management (1st Ed.).** ISBN: 9781466552494, CRC Press.
- Warren Viessman, Jr. and Gary L. Lewis (2011). **Introduction to Hydrology (5th International Edition)**. ISBN-13: 978-0132763608, Pearson Education.
- Subramanya, K. (2009). **Engineering Hydrology (3rd edition).** ISBN-13: 978-0070151468, McGraw-Hill Education.

PWE271	**Environmental Engineering**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**1**	Semester	**6th**	IRH261

Introduction to environmental engineering - Water use and demand - Water quality and standards – **Water treatment processes**: preliminary treatment processes, coagulation and flocculation, sedimentation, filtration, disinfection, and other treatment processes – Wastewater characteristics, composition and generation – **Wastewater treatment processes**: trickling filters, activated sludge process, sludge treatment – **Introduction to solid waste management:** generation, minimization, collection, treatment and disposal of municipal wastes – **Introduction to programs** for environmental engineering - **Formal Laboratory Experiments** for students in groups under the supervision of faculty member.

References:

- Metcalf, & Eddy, Tchobanoglous, G., Stensel, H., Tsuchihashi, R., and Burton, F. (2013). **Wastewater Engineering: Treatment and Resource Recovery (5th Edition).** ISBN-13: 978-0073401188, Mc Graw-Hill Education.
- Hammer and Hammer (2011). **Water and Wastewater Technology (7th Edition).** ISBN-13: 978-0135114049, Pearson.
- Chen, G. and Youneng, S. (2017). **Environmental and Hydraulic Engineering Laboratory Manual Lab Manual Edition**. ISBN-13: 978-1604271379, J. Ross Publishing.

ARC272	Building Physics & Environmental Control								Prerequisites
3 Cr.	Lecture	2	Tutorial	2	Lab.	0	Semester	6th	ENG111

Introduction to the principles of engineering and dynamics of building envelope and environmental control systems as integrated solutions for enhanced quality and control of building systems - Concepts, theories and performance of building envelope systems - Analysis and design theory of building control systems - Operational principles and maintenance issues - passive and active environmental control systems - natural ventilation – Insulation materials for moisture and sound – Reverberation and eco problems - Introduction to building performance assessment.

References:

- Fuller Moore (1993). **Environmental Control Systems: Heating, Cooling, Lighting**. McGraw-Hill, Inc. New York. ISBN: 978-0071127240.
- Hugo S. L. Hens (2016). **Applied Building Physics: Ambient Conditions, Building Performance and Material Properties (2nd Edition).** ISBN: 978-3-433-03147-6, Wiley Press.
- Randall McMullan (2017). **Environmental Science in Building (8th Edition).** ISBN: 9781137605443, Red Globe Press.

SWE291	Training (1)								Prerequisites
0 Cr.	Lecture	-	Tutorial	-	Lab.	-	Semester	6th	--------

Students are required to carry out professional training on industrial establishments relevant to the program. Training lasts for total of 120 hours, during a period about four weeks. The program training advisor schedules at least one follows up visit to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. *The course is graded as Pass/Fail grade- system*.

Seventh Semester

STE341	**Foundation Engineering**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**7th**	STE242

Scope of the course and its aim to provide student with a basic understanding of geotechnical principles in the design and analysis of shallow foundations, deep foundations and retaining Structures - Site investigation and evaluation of soil parameters – Introduction to design philosophy and sequence the process involved in a foundation - Retaining walls - Braced excavations – Design simple foundation systems - Bearing capacity and settlement of shallow foundations - Axial pile capacity, load tests and pile groups.

Footing design: Design consideration, design of axially loaded pad footing, eccentrically loaded pad footing, eccentric footing

References:

- Coduto, D.P., Kitch, W.A., and Yeung, M.R. (2016**). Foundation Design, Principles and Practices (3rd edition).** Prentice Hall, New Jersey.
- Das, Braja M. (2010). **Principles of Foundation Engineering (7th edition).** ISBN:978-0495668107, Cengage Learning.
- Tomlinson, M.J. (2001). **Foundation Design and Construction (7th edition)**. Prentice Hall.
- "Egyptian Code for Soil Mechanics and Design and Execution of Foundations" (Last available edition).

SWE371	Urban Hydraulics								Prerequisites
2 Cr.	Lecture	2	Tutorial	1	Lab.	0	Semester	7th	PWE271

Introduction to the course - Sources and distribution of water in urban environment, including surface reservoir requirements and utilization of groundwater – Planning and design of water storage and distribution systems – Analysis and design of sewer systems and drainage courses for the disposal of both wastewater and storm water - Pumps and lift stations - Urban planning and storm drainage practice – Introduction to urban hydraulics software.

References:

- Metcalf, & Eddy, Tchobanoglous, G., Stensel, H., Tsuchihashi, R., and Burton, F. (2013). **Wastewater Engineering: Treatment and Resource Recovery (5th Edition).** ISBN-13: 978-0073401188, Mc Graw-Hill Education.
- Hammer and Hammer (2011). **Water and Wastewater Technology (7th Edition).** ISBN-13: 978-0135114049, Pearson.
- Viessmann, W., Hammer, M.J., Perez, E.M., and chadik, P. A. (2008). **Water Supply and Pollution Control (8th Edition).** ISBN-13: 978-0132337175, Pearson.
- J. C. Y. Guo (2006). **Urban Hydrology and Hydraulics Design**. ISBN-13: 978-1887201483, Water Resources Publications.
- Akan, A. O. and Houghtalen., R. J. (2003). **Urban Hydrology, Hydraulics and Stormwater Quality**. John Wiley and Sons.

Eighth Semester

ARC372	Sustainable Site and Water Efficiency in Architecture								Prerequisites
2 Cr.	Lecture	1	Tutorial	1	Lab.	0	Semester	8th	ARC272

Introduction: Fundamentals of sustainability, definitions, historical development of the concept of sustainability and sustainable development – Fundamentals of water efficiency - Sustainable architecture as a subset of sustainable development. Sustainable Sites: Site assessment- Site design – Green Building and Rainwater Management: Reduce runoff and impervious surfaces, Reuse Rainwater and Low impact development - Green landscaping and heat island effect: Reasons and effects of urban heat island, and Strategies to reducing heat islands such as Building/Infrastructure Size Ratio, shading, green and cool roofs, cool pavements, open-grid Pavement, etc. – Site management and landscaping – applications. Water efficiency: Approaches for efficiency - Water conservation strategies: Outdoor strategies – Indoor strategies – Process water strategies – Water reduction measurements- Case study.

References:

- **LEED Green Associate Exam Preparation Study Guide (LEED v4 Edition)**. Green Building Education Services, LLC (2013).
- **Reference Guide for Building Design and Construction (v4)**. U.S. Green Building Council (2013).
- Kemi Adeyeye (2014). **Water Efficiency in Buildings: Theory and Practice.** ISBN:9781118456576, John Wiley & Sons, Ltd.

SWE391	**Training (2)**								**Prerequisites**
0 Cr.	Lecture	**-**	Tutorial	**-**	Lab.	**-**	Semester	**8th**	SWE291

Students are required to carry out professional training on industrial establishments relevant to the program. Training lasts for total of 120 hours, during a minimum period of four weeks. The program training advisor schedules at least two follow-up visits to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. The course is graded as Pass/Fail grade- system.

Ninth Semester

PWE451	**Highway and Transportation Engineering**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**9th**	PWE151 STE122

Scope of the course - Land transportation systems – Transportation Planning: Four main stages of the process (Survey and data collection - Transportation models: trip generation, trip distribution, traffic assignment and model split - Future land use and travel demand forecasting- and Policy evaluation) - Traffic flow theory and studies: Principles of traffic flow theory - Traffic flow parameters - Methods of measurement - Performance measures - Geometric design of vertical and horizontal alignments of highways - Earthworks quantities for highway construction - Structural design of highways - Functions and characterizations of pavements and its constituent materials – Road pavement design: Design of asphalt mixtures - Tests of asphalt mixtures - Used aggregate tests – Traffic description - Traffic loads of vehicles - Structural design of layer thicknesses of flexible pavements - Concepts for sustainable transportation and integrated planning, and the impacts assessment in economic, environmental and social terms as well as the quality of life in our local and our global climate.

References:

- Jialiang Yao, Zhigang Zhou, Hongzhuan Zhou (2019). **Highway Engineering Composite Material and Its Application**. - ISBN-13: 978-9811360671, Springer.
- Martin Rogers, Bernard Enright (2016). **Highway Engineering (3rd Edition).** ISBN: 978-1-118-37815-1, Wiley-Blackwell
- Khisty C. J. and Lall B. K. (2003). **Transportation Engineering – An Introduction (3rd Edition).** Prentice-Hall, Inc., New Jersey, USA. 2003
- Hot Mix Asphalt Materials, Mixture Design, and Construction, NCAT 2nd edition, 1996.

SWE498	**Senior Project (1)**								**Prerequisites**
3 Cr.	Lecture	**1**	Tutorial	**2**	Lab.	**3**	Semester	**9th**	Pass 120 credit hours

Planning and design of a major capstone design project in the field of water engineering taking in consideration the concepts for sustainable and integrated planning and design and the impacts assessment in economic, environmental and social terms. Planning and preliminary design during the current course "Senior Project (1); final design completed in the course "Senior Project (2)". Students will work in groups under the supervision of a faculty member. An oral presentation is required to be approved. The student should give an written report and oral presentation to be approved.

Tenth/Graduation Semester

STE431	**Project Planning and Management**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**10th**	STE331

Introduction on project planning and management – Techniques of project planning & management (CPM, LOB, Bar Chart) – Legal Frameworks and Regulation - Projects & Organization Strategy – Resources planning and management – Quality control – Cost planning and management.

References:

- Griffiths, J. (2018). **Civil Engineering: Construction Planning and Management**. ISBN: 978-1632407122, CLANRYE INTERNATIONAL
- Netscher, P. (2017). **Construction Project Management: Tips and Insights**. Panet Publications.

- Antill, J. M. and Woodhead, R.H. (1991). **Critical Path Methods in Construction Practice (4th edition).** ISBN: 978-0-471-62057-0, Wiley.
- Blank, L. and Tarquin, A. (2017). Engineering Economy (8th edition). McGraw-Hill Education, New York.

SWE499	**Senior Project (2)**								**Prerequisites**
3 Cr.	Lecture	**1**	Tutorial	**2**	Lab.	**3**	Semester	**9th**	SWE498

Continuation of design the major capstone project related to Water Engineering under the guidance of a faculty member. A dissertation on the project is submitted on which the student is examined orally.

Elective Courses

SWE311	Computer Applications for SWE							Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	-	BAS211, IRH261

Introduction to computer programming language – Numerical modeling techniques - Computer modeling of surface and subsurface hydrology – Computer modeling of flood plain hydraulics – Computer modeling of water resources – Computer modeling in hydraulics, coastal engineering, port engineering. Computer modeling of hydraulic structures design- Morpho-dynamics - coastal process and/or sedimentation. Theoretical basis - application and design studies. Integrated student-developed original computer programs and commercially available software will be used to further students understanding usage and programming.

References:

- **Tutorial Manuals** for available Hydraulics and Hydrology software
- Haestad Methods Engineering Staff, (2013). **Computer applications in hydraulic engineering: connecting theory to practice**. The Bentley Institute Press
- M. A. Ahmed, and M. I. M. Abdel-Magid (2017) **Computer Modeling Applications for Environmental Engineers**. CRC Press.
- C. A. Brebbia, D. A. Gomar, and F. L. Aguayo, eds. (2003) **Coastal Engineering VI: Computer Modelling and Experimental Measurements of Seas and Coastal Regions**. Vol. 9. Wit Pr/Computational Mechanics.
- T.E. Barnard (2002**) Computer applications in hydraulic engineering**. Haestad Press.C. A. Brebbia, D. A. Gomar, and F. L. Aguayo, eds. (2003) **Coastal Engineering VI: Computer Modelling and Experimental Measurements of Seas and Coastal Regions**. Vol. 9. Wit Pr/Computational Mechanics.
- T.E. Barnard (2002) **Computer applications in hydraulic engineering**. Haestad Press.

SWE312	Computational Simulation of Flow and Transport in the Environment								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	-	BAS211, IRH264

Fundamental principles, concepts; Approximate forms of the Navier-Stokes equations; Turbulence modeling; Some aspects of discretization: Errors and uncertainty; verification and validation; Best practice guidelines; Application in SWE.

References:

- Y. Bazilevs and K. Takizawa (2017) **Advances in Computational Fluid-Structure Interaction and Flow Simulation**. Birkhäuser.
- J. H. Ferziger, M. Perić, and R. L. Street (2002) **Computational methods for fluid dynamics.** Vol. 3. Berlin: springer.

STE342	**Excavation & Retaining Walls**							**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	STE242

Shear strength of soils; Introduction to deep excavation; Groundwater control; Stability of excavations; Design of support systems; Ground movements; Construction monitoring; Lateral earth pressures and seepage pressures; Compaction pressures and externally applied loads; Backfilled walls; Reinforced soil walls; Cantilevered and propped walls; Anchored bulkheads.

References:

- H. Brooks and J. Nielsen (2010) "**Basics of retaining wall design."** HBA Publication 11.
- K. J. Bakker (2000) **Soil Retaining Structures**. CRC Press.

SWE351	**GIS and Remote Sensing Applications for SWE**							**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	**PWE151, IRH261**

Introduction to geographic information systems and remote sensing technologies; Active and passive remote sensing; Data structures Map projections and coordinate systems; Processing of digital geographic information; Creation of digital elevation models; Visualization; Mapping of water and environmental features; Watersheds, streams and aquifers delineation; Soil and land use mapping; Terrain analysis for hydrological and hydraulic modelling; Presentation of modelling results; Analysis to generate new information and knowledge; Dissemination of new information and knowledge; GIS as a decision support tool.

References:

- A. van Dijk and M. G. Bos, eds. (2001) **GIS and remote sensing techniques in land-and water-management.** Kluwer Academic.
- X. Wang and H. Xie (20189) **"A review on applications of remote sensing and geographic information systems (GIS) in water resources and flood risk management".**

IRH364	**Bridge Engineering**							**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH361, STE222

Bridge hydraulics analysis (bridge hydraulic modeling, hydraulic model selection, bridge design impacts on scour and stream instability, and sediment transport) - Scour and Stream Instability- Main types of bridges (Beam bridges and Arch bridges, Truss bridges, Suspension bridges, Cable stayed bridges)- Loads (DEAD LOADS, LIVE LOADS, LIVE LOAD CALCULATION , INFLUENCE LINE, Pedestrian live loads and Dynamic allowance factor, Distribution of LL through the girders, wind and earthquake loads, LRFD Load combination explanation)- Bridge elements (Main elements of the bridge, Types of spans, Super structure vs sub structure,

Substructure part 1: Pier, Substructure part 2 – Abutments)- Main design methods (Load resistance , LFD , LRFD methods)- Design example (CSI bridge – Bridge layout, CSI bridge material definition and super structure – CSI bridge substructures; piers and abutment)

References:

- R.N. Krishna (2008) **"Design of Bridges",** 4th Edition, Oxford and IBH Publishing Co., Ltd.
- P. Swamy, "**Bridge Engineering**", 4th Edition, McGraw-Hill Publication, 2008.
- S. Saran (2006) **"Analysis and Design of sub-structures",**2nd Edition, Oxford IBH Publishing co ltd.
- V. Vazirani, M. Ratvani & M. Aswani (2006) "**Design of Concrete Bridges**",5th Edition, Khanna Publishers, 2006.

IRH365	**Smart Irrigation and Drainage Technologies**							**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	**IRH263**

Arid and Semi-Arid Water Resource; Management Plants – Soil – Water Relations; Irrigation and Fertigation; Nutrition Regimes; Intensive Crop Production; Desertification ; Mitigation Food Security ; Climate Control and Data Collection; Case Study of new innovative irrigation project in Egypt.

References:

- S. Chaudhry and S. Garg. (2019) **"Smart irrigation techniques for water resource management."** Smart Farming Technologies for Sustainable Agricultural Development. IGI Global. 196-219.
- E. E. Omran and A. M. Negm. "**Technological and Modern Irrigation Environment in Egypt."**

IRH366	**Surface Hydrology**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH264

Basic hydrometeorology, weather and climate; Global and regional energy budgets: concepts and definitions; Global and regional water budgets: concepts and definitions; Catchment hydrology, delineation and rainfall processes; Measuring and monitoring the hydrological cycle: precipitation; Measuring and monitoring the hydrological cycle: soil moisture and infiltration; Measuring and monitoring the hydrological cycle: evaporation; Measuring and monitoring the hydrological cycle: streamflow and runoff; Rainfall processes: recurrence intervals and intensity-frequency-duration; Hydrograph analysis, flow generation and runoff prediction; Climate change and variability: hydrological context and understanding the past.

References:

- S. L. Dingman (2002). **Physical hydrology.** Upper Saddle River, N.J: Prentice Hall.
- M. G. Wolman and H. C. Riggs (1990) **Surface Water Hydrology**. Geological Society of America.

IRH367	**Subsurface Hydrology**							**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH264

Hydrologic and geologic factors controlling the occurrence and use of groundwater on regional and local scales; Physical, mathematical, geologic and engineering concepts fundamental to subsurface hydrologic processes; Introduction to ground-water flow and transport modeling with emphasis on model construction and simulation.

References:

- M. P. Anderson, W. W. Woessner, and R. J. Hunt, Eds. (2015) **Applied Groundwater Modeling (Second Edition)**, San Diego: Academic Press.
- G. F. Pinder and M. A. Celia (2006) **Subsurface hydrology.** John Wiley & Sons.

IRH368	Water Measurement and Analysis Methods							Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH262

The Hydrologic Cycle; Measurement and Processing of Hydrological Data; Measurement and Processing of Rainfall Data; Measurement and Processing of Streamflow Data; Measurement and Processing of Meteorological Data; Measurement and Processing of Water Quality Data; Ground Water and Other Data; Acquisition and Management of Spatial Data; Hydrological databases and Dissemination of Data; Statistical Analysis of Hydrological Data; Correlation and Regression.

References:

- L. Nollet and L. De Gelder, eds. **Handbook of water analysis**. CRC press, 2000.

IRH375	Smart Design for Water Treatment and Desalination Units								Prerequisites
1 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	PWE271

Introduction - Co-ordination Action for Autonomous Desalination Units based on Renewable Energy Systems – ADU-RES - Water Supply situation in the rural areas of Egypt - The Situation of Drinking Water Supply in Egypt - Solar Thermal Desalination for Rural Applications - a few current views upon an old technology and its possible new role in the global Water Crisis - The Solco PV-RO system – Maldives Case Study - Introduction of a new Energy Recovery System – optimized for the combination with renewable energy - Using geothermal and solar energy for autonomous water desalination units - Energy Efficiency in Reverse Osmosis Systems - Low-Temperature Solar Rankine Cycle System for Reverse Osmosis Desalination - PV-Powered Desalination in Australia: Technology Development and Applications.

Status of design concepts of nuclear desalination plants.

References:

- Nikolay Voutchkov (2011). **Desalination Plant Concentrate Management (1st Edition).** Hardcover.
- Chaudhery Mustansar Hussain and Ajay Kumar Mishra (2020). **Handbook of Smart Photocatalytic Materials: Fundamentals, Fabrications and Water Resources Applications (1st Edition)**. Kindle Edition .

IRH376	Water Quality Modeling							Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	PWE272

Mathematical modeling of chemical and biological processes occurring in natural aquatic systems; Classical oxygen demand and nutrient processes are modeled, as well as chemical specific transport and fate processes; Evaluation and control of water quality in streams, lakes, and estuaries; Mathematical analyses of patterns of water movement and their relation to water quality.

References:

- P. Pritchard (2011) **Mathcad: A Tool for Engineering Problem Solving.** McGraw-Hill Science Engineering.
- J. L. Schnoor (1996) **Environmental Modeling: Fate and Transport of Pollutants in Water, Air, and Soil:** Wiley.
- R.V. Thomann and J. A. Mueller (1987) **Principles of Surface Water Quality Modeling and Control.** Harper-Collins, New York, 644 p.

IRH463	Dam Engineering								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH362

Introduction to dam engineering and hydropower -Soil mechanics for dams -Concrete technology for dams -The basic design principles for different types of dams -How to select a dam site -Dam foundation, settlement, seepage and stresses - Different types of loads on dams -Dam stability analysis - Dam safety inspection, operation and emergency control -Cost estimation of a dam.

References:

- R. Fell (2015) **Geotechnical engineering of dams** (Second edition). CRC Press.
- P. Novák, A. Moffat, C. Nalluri and R. Narayanan (2007) **Hydraulic structures**: CRC Press.

IRH464	**Offshore Engineering**							**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH461

Introduction to offshore engineering - Fixed offshore structures: design criteria and loadings, computer modeling, fatigue analysis, seismic and dynamic analysis and marine studies. - Floating structures: moorings systems, wave loads, dynamic behavior of floating structures, stability, construction of floating structures. Computer analysis (GTSTRUDL and Orcaflex packages).

References:

- S. Chakrabarti (2005) **Handbook of Offshore Engineering**, Vol 1 and 2, Elsevier.
- American Petroleum Institute (2000) **Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms** - Working Stress Design, 21st ed., (TP690.A642 RP2A-WSD).
- American Petroleum Institute (1993) **Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms - Load and Resistance Factor Design, 1st Edition.** (TP690.A642 RP2A-LRFD)

IRH465	**Physical Hydrology for Ecosystems**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH264

Hydrological cycle and its components – Catchments/watersheds – Precipitation – Infiltration – Runoff and Interflow – Evapotranspiration – Soil moisture – Groundwater – Ecohydrology - Erosion & Hydrogeomorphology – Floods – Spread of Contaminants and pollution.

References:

- G. M. Hornberger, P. L. Wiberg, J. P. Raffensperger, and P. D'Odorico, (2014) **Elements of Physical Hydrology**: Johns Hopkins University Press.
- W. Brutsaert (2005). **Hydrology: An Introduction.** Cambridge: Cambridge University Press. doi:10.1017/CBO9780511808470.

IRH466	**Watershed and Wetlands**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH264

Introduction to hydrology - classification watersheds (natural and managed watersheds) - water quality processes in watersheds - wetlands hydrology - hydrologic measurements and data collection – hydrology, water quality management, and urban ecosystems - watershed restoration.

References:

- W. Ji (2007) Wetland and Water Resource Modeling and Assessment: A Watershed Perspective: CRC Press.
- J. G. Lyon (2002) GIS for Water Resource and Watershed Management: CRC Press.

IRH467	**River Engineering**							**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH361

Introduction, equations and units – Steady flow in rivers - Unsteady flow in rivers - Continuity and momentum equations – River dynamics and sediment transport – River protection and stabilization - River flood control – River modeling (Rigid-bed model - Mobile-bed river models - Finite-difference approximations - One-dimensional and multidimensional river models).

References:

- P. Y. Julien (2002) **River Mechanics**: Cambridge University Press.
- M. S. Petersen (1986) **River Engineering**: Prentice-Hall.

IRH468	**Sediment Transportation Engineering**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH361

Introduction - Flow Past a Sphere - Open-channel flow and boundary layer flow- Physical properties of sediment- Incipient motion, bed-load, and suspended load - Bed configurations - Hydraulic roughness - Velocity and stress fields in open channels - Scour and deposition of bed material - Sediment transport rate - Bank erosion - Reservoir sedimentation.

References:

- R. J. Garde and K. G. R. Raju (2000) Mechanics of Sediment Transportation and Alluvial Stream Problems: New Age International.
- W. H. Graf (1984) Hydraulics of Sediment Transport: Water Resources Publications.

IRH469	**Floods and Droughts, Dams and Aqueducts**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH361, IRH363

Introduction to 'extreme events' in hydrology: floods and droughts - Acquisition and processing of hydro-meteorological data (including remote sensing data) – Prediction of flood hazard (rainfall-runoff models, river flow propagation models, flood mapping) - Reducing flood impacts - Drought analysis and monitoring – Using dams and aqueducts as sustainable solutions to floods and droughts.

References:

- C. Gifford (2005) **Flooding and Drought**: Evans.
- M. Collier and R. H. Webb (2002) **Floods, Droughts, and Climate Change**: University of Arizona Press.

IRH472	**Providing Safe Water for the Developing World**							**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	-	IRH363

Introduction to water development – defining water poor and water rich countries - Different sources of water and planning of water supply systems - Water quality assessment - water treatment and safe storage.

References:

- J. A. Dracup (2020) **Clean Water for Developing Countries**: John A. Dracup.
- United Nations Development Programme (2006) **Human Development Report 2006 — Beyond Scarcity: Power, Poverty and the Global Water Crisis.** New York, NY: United Nations Development Programme, chapter 1. ISBN: 9780230500587.

IRH473	**Environmental Hydraulics**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	-	IRH361

Fluid definition and basic properties; Hydrostatics, Pascal's principle, pressure and applications; Flow and Velocity; Basic concepts of Energy and Head in Flow; Head and Pressure; Concepts, equations of energy degradation (head loss); Introduction to network models; Introduction to Pumping Systems; Water Hammer and Cavitation; Introduction to Open Channel Flow: qualitative difference from pressure flow. Concept of normal flow; Specific Energy, subcritical, supercritical & critical flow; Rapidly Varied Flow (RVF) and Energy, Momentum; Control Points and Hydraulic Profiles; Hydraulics and Treatment Plant Design; Treatment Plant Hydraulics Problems; Treatment Plant Hydraulics Problem-solving and review.

References:

- R.J. Houghtalen, A. O. Akan, and N. H.C. Hwang, (2010) **Fundamentals of Hydraulic Engineering Systems, 4th Edition.** Prentice Hall, Boston
- G.L. Asawa (2006) **Laboratory Work in Hydraulic Engineering**, New Age International Publishers, New Delhi.
- A.L. Simon (1976) **Practical Hydraulics**, John Wiley & Sons, New York.
- F.M. Henderson (1966). **Open Channel Flow**, MacMillan, New York.

SWE481	**National and International Water Law, and Hydropolitics**								**Prerequisites**
1 Cr.	Lecture	**1**	Tutorial	**0**	Lab.	**0**	Semester	-	-----------

Introduction to the International Water Law – Problems, Principles and Terminology - Evolution of the International Regulation on Fresh Water Resources - Development of international water law from the 1966 Helsinki Rules to the UN 1997 Convention - Discussing of the Nile CFA 2010. Introduction to National Water Laws and Regulations - Discussion of selected laws like Law 12 (1984), Law 27 (1978), Law 213 (1994), Law 48 (1982) and Law 4

(1994). Introduction to water politics - Hydropolitics in the third world - Water Governance at Multiple Levels - Neo-realist, Neo-liberal Institutionalist, and Cognitivist Approaches - Water Sharing vs. Benefit Sharing - Hydro-hegemony - State and Non-state actors in Water Politics - World Commission on Dams 2000 Framework - the UN 1997 Convention in Water Conflict Resolution - Case Studies for Transboundary Water Cooperation Conflicts - The Nile Case.

References:

- Samaan, M. M. (2019). **The Nile Development Game.** Springer International Publishing. ISBN: 978-3-030-02665-3
- NWRP Project. **Water for Future: National Water Resources Plan 2017**. Ministry of Water Resources and Irrigation, Egypt.
- O. McIntyre (2016). **Environmental Protection of International Watercourses under International Law**. ISBN: 9781317142218, Routledge
- S.G. Setegn and M.C. Donoso (2015). **Sustainability of Integrated Water Resources** Management**: Water Governance, Climate and Ecohydrology**. ISBN: 9783319121949, Springer
- Schmeier, S. (2013). **Governing International Watercourses: River Basin Organizations and the Sustainable Governance of Internationally Shared Rivers and Lakes.** Routledge, an imprint of Taylor and Francis Group. ISBN: 9780415623582.
- Anton Earle (2013). **Transboundary Water Management: Principles and Practice**. Earthscan Publisher. ISBN: 9781849776585.
- Shimon C. Anisfeld (2011). **Water Resources**. Island Press.

IRH474	**Introduction to Environmental and Ecological Engineering**							**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH361

Definitions and classification of ecological engineering; Ecosystems and ecology; Ecological design principles; Stream and river restoration; Lake and reservoir restoration; Wetland creation and restoration; Coastal restoration; Treatment wetlands; Mine and disturbed land reclamation.

References:

- W.J. Mitsch and S.E. Jorgenson (2004) **Ecological Engineering and Ecosystem Restoration.** John Wiley and Sons, Hoboken, New Jersey, 411pp. ISBN: 978-0471332640.

SWE392	**Water Power Resources**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH261

Overview of Renewable Energy: Comparisons with conventional technologies; generation and transmission of electricity basics; Water power: Technology overview of conventional hydropower; in-stream hydrokinetics (river/ocean current and tidal power); wave power;

resource assessment; power and energy calculations; hydraulic efficiency of turbine operation; design issues; and environmental impact; Hydropower history and the design of a hydropower station; Dams, spillways and waterways.

References:

- J. S. Gulliver and R. E. A. Arndt (1991). **Hydropower Engineering Handbook**. McGraw-Hill, Inc. Retrieved from the University of Minnesota Digital Conservancy, http://hdl.handle.net/11299/195476

SWE492	Waterpower Engineering and Sustainability								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH392

Introduction to the course and the importance of sustainable engineering; Sustainability indicators; Water Power, its development and use, relation of water power and hydrology; Water Power Estimate; Water Ways: Intake, gates, valves, cannels, surges and its effects, penstocks, classification, design criteria; Classification of turbines, Francis, Kaplan and Pelton Turbines, Component parts and their function; Location of power house, general arrangement of Hydroelectric unit, Number and size of units, Power house; Life cycle and cost-benefits analysis; sustainability assessment of conventional water power energy systems; sustainability assessment of alternative water power energy systems;

References:

- C. T. Hendrickson, L. B. Lave, H. S. Matthews (2006). **Environmental Life Cycle Assessment of Goods and Services: An Input-Output Approach**. Resources for the Future Press.
- R. Heijungs, S. Suh (2002) **The Computational Structure of Life Cycle Assessment,** Kluwar Academic Publishers: Dordrecht, The Netherlands.
- B. C. Punmia, P. B. B. Lal, A. K. Jain, and A. K. Jain (2009) **Irrigation and Water Power Engineering**: Laxmi Publications Pvt Limited.

SWE493	Hydroelectric Power Plants and Technologies								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH362

Hydropower history and the design of a hydropower station; Meteorology and hydrology; Applied fluid dynamics; Hydraulic losses, torque on a runner blade; Turbine and draft tube; Electrical generators, the generator on the grid; Transmission of electrical power; Hydraulic transients; Regulation and dynamics; Design and construction of Hydroelectric Power Stations; Environment and laws; Marine current power; Pumped storage hydropower; Production planning; A large scale project (e.g. new building / renovation of a larger power station); Elaborations on surges, water hammer, generators, and hydraulic losses; A group project where a hydropower station will be modeled.

References:

- P. K. Nag (2002) **Power Plant Engineering:** Tata McGraw-Hill.
- L. F. Drbal, P. G. Boston, and K. L. Westra, Eds. (1996) **Power Plant Engineering,** MA: Springer US.
- L. Drbal, K. Westra, and P. Boston (2012) **Power Plant Engineering**: Springer US.

SWE494	Development of Water Resources in River Nile Basin								Prerequisites
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	IRH363

Water problems in the Nile basin; Water: quantity and quality in the Nile basin; Nile River Valley: Physiography, Climate, Hydrology, Population, Water resources utilization; Nile River Basin Projects: Basin-Wide Cooperation, Monitoring, Forecasting and Simulation project (MFS), Georgia Tech –Nile Basin Management, The UNDP Nile River Basin Cooperative Framework Project, FAO Nile Basin Water Resources Project, FAO Lake Victoria Water Resources Project, Lake Victoria Environmental Management Project; Water Balance Modeling: Runoff, Estimation of Surface Water Yield by Using a Rainfall-Runoff Function, River and Reservoir Routing Using the Rivers Model, Watershed delineation.

References:

- J. Booth, J. M. Jaquet (1998) **A proposal for the Nile river Basin**, UNEP/DEWA/GRID-Geneva.
- FAO (1997) **Irrigation potential in Africa: A basin approach**, FAO LAND AND WATER BULLETIN 4.
- FAO (1998) **Monitoring, Forecasting and Simulation of the Nile River in Egypt - Phase III;** Project Status, July 1998.
- M. M. Kivugo (1999) **Towards Technical Cooperation in the Nile Basin**, Seventh Nile 2002 Conference, Cairo, Egypt.
- J. M. SMITH (1996) **Nine Nations, One Nile, Population-Environment Dynamics:** Ten Case Studies University of Michigan Eih 575, Monograph, Fall Term.

IRH491	**Special Topics in Water Engineering & Sustainability**								**Prerequisites**
3 Cr.	Lecture	**2**	Tutorial	**2**	Lab.	**0**	Semester	**-**	Topic Advisor approval
Special topics course is developed to cover contemporary issues or applications in the field of sustainable water engineering such as sustainable use of water resources, water desalination, new engineering methods for the containment and treatment of water, water infrastructures, etc. Study of the course can be supervised for each student individually or in students' groups. The topic and scope must be submitted in writing to topic advisor for approval of the SWE program management council prior to registration. Requirements must be completed by the end of its semester of registration.									

UNR374	**Environmental Impact Assessment (EIA)**								**Prerequisites**
2 Cr.	Lecture	**2**	Tutorial	**0**	Lab.	**0**	Semester	**-**	-------
EIA Introduction and Definitions - Socio-Economic impacts - Air quality and climate- Soils, geology and geomorphology - Ecology, overview and terrestrial systems - Freshwater ecology - Coastal ecology an - Shard and integrative methods - Environmental risk assessment and risk management - Environmental remote sensing (RS) - Quality of life									
References: Peter Morris and Riki Therevil (2000). **Methods of Environmental impact assessment (2nd edition)**. SPON Press. London and New York.									

Chapter Eleven:

A B. Sc. Program in Structural Engineering Program (STE) with Credit Hours System

1. Program Introduction

Civil Engineering concerns with the study, analyze and design of various civil construction like: residential and services buildings, roads, bridges, dams, tunnels, airports, ports, water drink networks, water pumping stations, wastewater networks, water stations and irrigation constructions. Also, it concerns with the supervision of the constructed buildings and structures. So, it is vital and effective member for development, construction, repair, growth of national resources, good and safe sustainable environment for next generations.

It embraces various engineering fields including:

- Structural Engineering,
- Construction Engineering,
- Geotechnical Engineering,
- Environmental Engineering,
- Hydrological Engineering,
- Public works Engineering,
- and Transportation Engineering.

Structural Engineering is a fundamental Civil Engineering field because of its main contribution in driving the progress wheel forward through urban renaissance. In practice, the structural engineer is an essential member in engineering projects with responsibilities ranging from the design and construction of new structures, such as:

- buildings,
- bridges,
- dams,
- tunnels,
- pipelines,
- and oil platforms,
- to the planning and management of the project.

Furthermore, the structural engineer is responsible for the maintenance, repair, and rehabilitation of existing structures according to the latest techniques and for the utilization of natural resources of the nation.

Hence, there is always a great demand for skillful structural engineers in both the national and international job-markets. In recent years, this demand has increased drastically due to the large number of major development plans and urban projects in Egypt and world- wide.

Therefore, the Faculty of Engineering at Mansoura University established a new Bachelor program in Structural Engineering (STE) based on the credit hours' system (CHS), which participates in 2030 Egypt's vision achievement. This will be by providing the society with proficient structural engineers capable of supporting the progress efforts and urban renaissance in Egypt, in the middle-east region, and abroad by possessing good knowledge and hands-on skills according to the latest technical advancement to work in the areas of:

- structural design,
- stress analysis,
- project planning,
- construction,
- site management, and maintenance of structures.

2. Basic Information

2.1 Vision

Pioneering in the field of structural engineering at the local and regional levels.

2.2 Mission

Preparing a distinguished graduate and researcher in the field of structural engineering, able to compete in the local and regional labor market and able to participate in practical solutions for our society.

2.3 Program's Objectives

The educational objectives of the Structural Engineering program at the Faculty of

Engineering, Mansoura University, are to prepare its graduates to:

1. Perform successfully in a work environment by utilizing their technical knowledge, intellectual abilities, and practical skills.
2. Communicate effectively in a business environment and present high work ethics.
3. Design and construct efficient civil structures and infrastructure systems by applying the principles and methods of structural engineering and sustainability.
4. Analyze and solve complex engineering problems by working individually or within multidisciplinary teams.
5. Examine and evaluate different practical alternatives and select efficient structural systems for engineering projects.
6. Plan and manage diverse engineering projects by applying their management, scheduling, intellectual, leadership and professional skills.
7. Apply information technology and computational abilities in structural engineering projects.
8. Continue career development through life-long learning, professional seminars, and licensure.

2.4 Program's Description

The STE program offers a bachelor's degree in civil engineering with a major specialty in Structural Engineering with credits hours system, covers the core topics in the Civil Engineering discipline, as well as fundamental and advanced topics in the field of Structural Engineering.

Thus, the STE graduates acquire in-depth knowledge and skills of the civil and structural engineering professions, the areas of materials, mechanics, analysis, and design. Also, they will be capable of effectively participating in the design, construction, and management activities for different projects.

As the curriculum is based on the credit hours' system, a total of 160 credits should be completed before graduation. The 160 credits are spread over 60 courses and offered over a period of 10 main semesters, the Fall and Spring semesters per academic year.

2.5 Program Graduate Attributes

Based on NARS 2018, 2nd Edition Engineering National Standards and as stated in the reference framework, Jan. 2020, a graduate of the Structural Engineering Program must be able to acquire the following general skills:

1- Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations,

2- Apply analytic critical and systemic thinking to identify, diagnose, and solve engineering problems with a wide range of complexity and variation,

3- Behave professionally and adhere to engineering ethics and standards,

4- Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance,

5- Recognize his/her role in promoting the engineering field and contribute to the development of the profession and the community,

6- Value the importance of the environment, both physical and natural, and work to promote sustainability principles,

7- Use techniques, skills, and modern engineering tools necessary for engineering practice,

8- Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies,

9- Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner, and

10- Demonstrate leadership qualities, business administration, and entrepreneurial skills.

2.6 Graduate Competencies in Accordance with the National Academic Standards (NARS 2018)

2.6.1 Level A

A graduate must be able to:

A1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.

A2. Develop and conduct appropriate experimentation and/or simulation, analyze, and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

A3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

A4. Utilize contemporary technologies, codes of practice, and standards, quality guidelines, health and safety requirements, environmental issues, and risk management principles.

A5. Practice research techniques and methods of investigation as an inherent part of learning.

A6. Plan, supervise, and monitor implementation of engineering projects, taking into consideration other trades requirements.

A7. Function efficiently as an individual and as a member of multi-disciplinary and multicultural teams.

A8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools .

A9. Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10. Acquire and apply new knowledge, and practice self, lifelong and other learning strategies.

2.6.2 Level B

In addition to the above competencies, a civil graduate must be able to:

B1. Select appropriate and sustainable technologies for construction of buildings and infrastructures; using either numerical techniques or physical measurements and/or testing by applying a full range of civil engineering concepts and techniques of: Structural Analysis and Mechanics, Properties and Strength of Materials, Surveying, Soil Mechanics, Hydrology and Fluid Mechanics.

B2. Achieve an optimum design of Reinforced Concrete and Steel Structures, Foundations and Earth Retaining Structures; and at least three of the following civil engineering topics: Transportation and Traffic, Roadways and Airports, Railways, Sanitary Works, Irrigation, Water Resources and Harbors; or any other emerging field relevant to the discipline.

B3. Plan and manage construction processes; address construction defects, instability, and quality issues; maintain safety measures in construction and materials; and assess environmental impacts of projects.

B4. Deal with biddings, contracts and financial issues including project insurance and guarantees.

2.6.3 Level C

C1. Investigate different practical alternatives and select efficient structural systems for engineering projects.

C2. Use information technology and computational abilities in structural engineering projects.

3. *Coding System*

Courses are coded according to Figure 1, and the course is related to the scientific section that presents it. The first part of the course code is the code of the scientific department, and the second part of the course code consists of three numbers:

A. The first of which represents the level,

B. While the second number represents the specialization number within the scientific department.

C. The third number is a series of courses in the exact specialization in the same study year.

Not all these letters indicate the majors in which the degree is given, some of which represent university requirements, engineering requirements, or specialized courses.

Course code refers to the semester in which this course is usually given, but these dates are subject to change, as not all courses are taught every year. Before the start of each semester, students' affairs in the college display a table of the courses that will be taught in this semester and their teaching dates and those who are responsible for teaching.

Department Code

Course's Code

Symbol	Meaning
BAS	Engineering Mathematics and Physics
STE	Structural Engineering
PWE	Public Works Engineering
IRH	Irrigation and Hydraulic Engineering
ARE	Architecture Engineering
CSE	Computer Engineering
ECE	Communication Engineering
MPE	Mechanical Power Engineering
PDE	Production Engineering
ELE	Electrical Engineering
UNR	University Requirements
ENG	Engineering Requirements
INT	Inter Department Course

Serial (1-9): Course sequence in each discipline

Term (1-9): Disciplines of STE

Serial (0-4): The academic year (Level)

Fig. (1): Courses Coding System

4. *The Structure and Contents of the Structural Engineering Program*

The Structural Engineering program consists of 60 courses: 50 compulsory courses (130 credits) and ٨ elective courses (٢٤ credits) and 6 credits for graduation project and field training. The total 160 credits of the STE program are distributed between lectures (LEC) and tutorials (TUT), where a tutorial is classified as a problem-solving session (PSS) and/or a practical work/laboratory session (PLS). The one credit of a tutorial corresponds to 2-3 hours to provide sufficient practical training for the students.

The requirements of the Structural Engineering program are distributed as follows:

4.1 University Requirements

The main purpose of a university education is not only to prepare students for successful careers but also to provide them with the knowledge and skills to develop a rational, well-rounded, and successful personal identity. Moreover, Mansoura University helps students to gain an appreciative understanding of the natural and cultural environments in which they live and their roles in the society and community services.

The university requirements of the CHS bachelor programs consist of 13 credits (8.125 % of total 160 credits), which are satisfied by completing seven (7) compulsory courses as listed in Table 1.

Table 1: Compulsory Courses of University Requirements

(13 credits, 8.125 % of total 160 credits)

#	Code	Course Title	Cr.H	Lect.	Tut.	Lab	PreReq
1	UNR011	History of Engineering and Technology	1	1	-	-	-
2	UNR112	Law and Human Rights	2	2	-	-	-
3	UNR211	Communication and Presentation Skills	2	2	-	-	ENG111
4	UNR311	Profession Ethics	2	2			80CR
5	UNR021	English Language	2	2	-	-	-
6	UNR326	Marketing	2	2			80CR
7	CSE014	Computers for Engineers	2	1	-	3	-
		Total	13	12	-	3	

4.2 <u>College Requirements</u>

The college requirements of the CHS bachelor programs include courses of basic knowledge essential to all engineering graduates such as Mathematics, Physics, Mechanics, Graphics and Design, Manufacturing, and Chemistry. These requirements consist of 40 credits (25 % of total 160 credits), which are satisfied by completing sixteen (16) compulsory courses, as listed in Table 2.

Table 2: Compulsory Courses of College Requirements

(40 credits, 25 % of total 160 credits)

#	Code	Course Title	Cr.H	Lect.	Tut.	Lab	PreReq
1	ENG111	Technical Reports Writing	2	2	-	-	
2	ENG215	Numerical Analysis with computer	2	1	2	1	BAS122
3	BAS011	Mechanics-1	3	2	3	-	-
4	BAS012	Mechanics-2	3	2	2	1	BAS011
5	BAS021	Mathematics-1	3	2	3	-	-
6	BAS022	Mathematics-2	3	2	3	-	BAS021
7	BAS110	Mathematics-3	3	2	3	-	BAS022
8	BAS031	Physics	3	2	1	2	-
9	BAS051	Engineering Chemistry	3	2	2	1	-
10	BAS113	Dynamics of Rigid Bodies	2	1	2	-	BAS012
11	BAS122	Mathematics-4	3	2	3	-	BAS110
12	BAS123	Mathematics-5	3	2	3		BAS122
13	BAS223	Probability and Statistics	2	1	2		BAS122
14	PDE012	Production Engineering	2	1	1	1	
15	PDE119	Engineering Economy	2	1	2	-	-

16	INT213	Mechanical and Electrical Systems	1	1	-	-	54 CR
		Total	40	26	32	6	

4.3 Discipline Requirements

As structural Engineering is one of the key fields in the Civil Engineering discipline. Thus, the STE program offers several courses that are common with some – but not all – CHS Bachelor programs. For example, there are common civil engineering courses between the STE program and the CEM program (Construction Engineering and Management) and the WEE program (Water Engineering and Environment).

The discipline requirements of the STE bachelor program consist of 56 credits (35 % of total 160 credits)-listed in Table 3, which are satisfied by completing twenty (20) courses in Civil Engineering that cover topics on Structural, Construction, Geotechnical, Hydrological, Environmental, Public-Works and Transportation Engineering.

Table 3: Compulsory Courses of Discipline Requirements, Civil Engineering

(56 Credits, 35 % of total 160 credits)

#	Code	Course Title	Cr.H	Lect.	Tut.	Lab	PreReq
1	ARE111	Architectural Design	3	2	3	-	IRH014
2	IRH014	Civil Engineering Drawing	3	2	3	-	-
3	PWE211	Water and Wastewater Engineering	2	1	3	-	-
4	PWE118	Surveying for Engineers	3	2	2	1	BAS110
5	PWE311	Highway Engineering	2	1	3	-	90 CR
6	STE052	Structural Analysis-1	3	2	3	-	BAS011
7	STE112	Structural Analysis-2	3	2	3	-	STE052
8	STE053	Properties and Strength of Material	3	2	1	2	BAS031
9	STE114	Structure Mechanics	3	2	2	-	STE053
10	STE115	Building Construction Materials	2	1	2	-	STE053
11	STE211	Design of Structural Concrete I	3	2	3	-	STE112,STE114
12	STE224	Construction Project Management	3	2	3	-	54 CR
13	STE218	Soil Mechanics	3	2	2	1	STE114
14	STE312	Foundations Engineering-1	3	2	3	-	STE218
15	STE217	Design of Structural Concrete II	3	2	3	-	STE211
16	STE216	Design of Steel Structures I	3	2	3	-	STE112,STE114
١٧	STE317	Design of Steel Structures II	3	2	3	-	STE216
18	PWE445	GIS and Remote Sensing Applications	2	1	2		PWE118
19	STE341	Composite Materials	3	2	2	-	STE214, 130 CR
20	STE420	Foundations Engineering-2	3	2	3	-	STE312
		Total	56	36	52	4	

4.4 Major Requirements

The major specialty requirements of the STE bachelor program consist of 45 credits (32.875 % of total 160 credits), which are satisfied by completing fifteen (15) courses in the field of Structural Engineering:

- Seven (7) compulsory courses equivalents to 21 credits (13.125 %), as listed in Table ٤.
- Three (3) elective course-G1, equivalent to 9 credits (5.625 %), as listed in Table ٥.
- At least five (5) elective courses-G2, equivalents to 15 credits (9.375 %), as listed in Table 6.

The Graduation Projects and Training are equivalents to 6 credits (3.75 %), as listed in Table 7.

Table 4: Compulsory Courses of Major Requirements, Structural Engineering

(21 credits, 13.125 % of total 160 credits)

#	Code	Course Title	Cr.H	Lect.	Tut.	Lab	PreReq
1	STE116	Concrete Technology	3	2	1	2	STE053
2	STE315	Matrix Methods of Structural Analysis	3	2	1	2	STE112
3	STE214	Modern Building Materials	3	2	2	-	STE116
4	STE322	Construction Planning and Scheduling	3	2	2	1	STE224
5	STE414	Metallic bridges	3	2	2	-	STE317
6	STE419	Quantity Surveying and Cost Engineering	3	2	2	-	-
7	STE441	Design of Structural Concrete III	3	2	3	-	STE217
		Total	21	14	13	5	

Table 5: Elective Courses of Discipline Requirements, Civil Engineering-G1: (Select 9 credits, (5.625% of total 160 credits)

#	Code	Course Title	Cr.H	Lect.	Tut.	Lab	PreReq
1	IRH311	Introduction to Water Resources Engineering	3	2	2	1	-
2	IRH312	Hydraulic Engineering	3	2	2	1	-
3	IRH358	Design of Pipelines and Pumping Stations	3	2	3	-	IRH312
4	IRH411	Coastal and Harbor Engineering	3	2	3	-	90 CR
5	PWE342	Ground Water Control Systems	3	2	2	-	STE218
6	STE342	Project Resources Management	3	2	2	-	STE224
7	STE452	Information Technology in Construction	3	2	2	-	STE224

Table 6: Elective Courses of Major Requirements, Structural Engineering-G2:

(Select 15 credits, 9.375 % of total 160 credits)

#	Code	Course Title	Cr.H	Lect.	Tut.	Lab	PreReq
1	STE412	Project Management and Evaluation	3	2	2	1	STE322,130 CR
2	STE413	Earth Retaining Structures	3	2	2	1	STE312
٣	STE431	Concrete Durability	2	1	2	-	STE116,130CR
4	STE432	Masonry Structures	3	2	2	-	130 CR
5	STE433	Structural Mechanics and Stability	3	2	2	1	STE315
6	STE435	Introduction to Earthquake Engineering	3	2	2	1	-
7	STE438	Membrane Concrete Structures	2	1	2	-	BAS123, STE052,STE112
8	STE443	Temporary Structures and Form Work Design	2	1	2	-	STE217
9	STE444	Special Concrete Structures	3	2	2	-	STE217
10	STE445	Design of Steel Structures III	3	2	3	-	STE317
11	STE446	Concrete Technology 2	3	2	2	1	STE116, STE214
12	STE447	Deep Excavation and Sides Support	3	2	2	-	STE218
13	STE451	Engineering Risk Analysis	2	1	2		BAS223
14	STE461	Special Topics in Structural Engineering	2	1	2	-	130 CR
15	STE465	Inspection and Maintenance of Structures	3	2	2	-	STE217
16	STE466	Design and Construction of Water and Wastewater Structures	3	2	3	-	STE217
17	STE418	Structural Dynamics and Vibrations	3	2	2	-	-
18	STE318	Special Concretes	3	2	2	1	STE116, STE214
19	STE437	Seismic Design of Structures	3	2	2	1	STE418
20	STE421	Sustainable materials and building physics	3	2	2	-	130 CR

Table 7: Graduation Projects and Training

(6 credit hours, 3.75 % of the total 160 credit hours)

#	Code	Course Title	Cr.H	Lect.	Tut.	Lab	PreReq
1	STE281	Training-1	0	-	-	-	85 CR
2	STE381	Training-2	0	-	-	-	STE281
3	STE481	Graduation Project-1	3	1	-	6	130 CR
4	STE482	Graduation Project-2	3	1	-	6	STE481
			6	2	8	12	

5. Matrix of Competencies and Courses for STE Program

Fig. (2) presents the matrix of Competencies and Courses for Structural engineering program.

Matrix of Graduate Competencies and Courses for Structural Engineering Program (Credit Hours System)																		
Level	Course Code	Course Title	Graduate Competencies According to NARS 2018															
			C2	C1	B4	B3	B2	B1	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
	BAS051	Fundamentals of Engineering Chemistry															√	√
	IRH014	Civil Engineering Drawing							√	√	√			√	√			
	BAS011	Mechanics-1																√
	BAS031	Physics												√	√	√	√	√
	BAS021	Mathematics-1																√
	UNR021	English Language									√							
0	BAS012	Mechanics-2																√
	STE053	Properties and strength of Materials							√					√			√	√
	STE052	Structural Analysis-1								√				√			√	√
	UNR011	History of Technology and Engineering							√		√			√	√			
	PDE012	Manufacturing Engineering Principles													√	√		√
	CSE014	Computers for Engineers							√			√		√	√			
	BAS022	Mathematics-2																√
	STE114	Structure Mechanics							√					√			√	√
	BAS110	Mathematics-3																√
	UNR112	Law and Human Rights							√		√	√		√				
	ARE111	Architectural Design							√	√	√	√	√	√	√	√		
	BAS113	Dynamics of Rigid Bodies							√					√			√	√
100	STE111	Structural Analysis-2								√				√			√	√
	STE115	Building Construction Materials							√					√		√	√	√
	PWE118	Survey for Engineers							√					√			√	√
	STE116	Concrete Technology		√		√		√										
	BAS122	Mathematics-4																√
	ENG111	Technical Reports Writing								√	√			√				
	PDE119	Engineering Economy						√	√									

Fig (2): Matrix of Competencies and Courses for Structural engineering program

	BAS123	Mathematics-5															√	√
	STE224	Construction project Management			√	√			√	√								
	STE211	Design of Structural Concrete I					√		√									
	ENG215	Numerical Analysis with computer						√	√									
	UNR211	Communication and Presentation Skills							√	√	√	√						
	INT213	Mechanical and Electrical Systems					√	√										
200	STE216	Design of Steel Structures I					√		√									
	STE313	Design of Structural Concrete II	√	√			√		√									
	BAS223	Probability and Statistics						√										
	PWE211	Water and Wastewater engineering	√	√			√		√									
	STE218	Soil Mechanics							√									
	STE281	Field Training-1			√				√	√	√	√	√					
	STE214	Modern Building Materials		√		√		√										
	Elective	Elective Course-1: G1																
	UNR311	Profession Ethics							√	√	√	√						
	STE315	Matrix Methods of Structural Analysis	√					√	√									
	PWE311	Highway Engineering	√					√	√									
	STE317	Design of steel Structures II	√	√			√		√									
	STE312	Foundations Engineering-1	√	√			√											
300	Elective	Elective Course-2: G1																
	UNR326	Marketing																
	Elective	Elective Course-3: G1																
	STE322	Construction Planning and Scheduling	√	√														
	STE341	Composite materials	√	√														
	STE414	Mettalic Bridges					√	√										
	STE381	Field Training-2			√				√	√	√	√	√					
	Elective	Elective Course-4: G2																
	STE420	Foundations Engineering-2	√	√														
	Elective	Elective Course-5: G2																
	Elective	Elective Course-6: G2																
	STE418	Structural dynamics and vibration					√	√										
400	STE481	Graduation Project-1	√	√	√	√	√	√	√	√	√	√	√	√	√		√	√
	Elective	Elective Course-7: G2																
	Elective	Elective Course-8: G2																
	STE441	Design of Structural Concrete III	√	√														
	PWE445	GIS and Remote Sensing Applications	√															
	UNR471	Quantity Surveying and Cost Engineering	√	√														
	STE482	Graduation Project-2	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Continue Fig (2): Matrix of Competencies and Courses for Structural engineering program

6. *The Semester Contents of the Structural Engineering Program*

The following tables present the credits units and mark distributions for all levels from Table 8 to Table 20. Also, the suggested study plan is presented in title 6.6.

6.1 LEVEL 000

Table 8: First Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
BAS051	Engineering Chemistry	3	2	2	1	4	9	20	10	10	60	100	-
IRH014	Civil Engineering Drawing	3	2	3	-	4	9	20	20	-	60	100	-
BAS011	Mechanics-1	3	2	3	-	4	9	20	20	-	60	100	---
BAS031	Physics	3	2	1	2	4	9	20	10	10	60	100	---
BAS021	Mathematics-1	3	2	3	--	4	9	20	20	--	60	100	---
UNR021	English Language	2	2	-	-	2	4	20	20	-	60	100	-
Total		17	12	12	3	22	49	120	100	20	360	600	
Total Contact hours = 27 hours/week Total SWL = 49 hours/week													

Table 9: Second Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
BAS012	Mechanics-2	3	2	2	1	4	9	20	10	10	60	100	BAS011
STE053	Properties and Strength of materials	3	2	1	2	3	8	20	10	10	60	100	BAS031
STE052	Structural Analysis-1	3	2	3	-	3	8	20	20	-	60	100	BAS011
UNR011	History of Engineering and Technology	1	1	-	--	1	2	20	20	--	60	100	---
PDE012	Production Engineering	2	1	1	1	3	6	20	10	10	60	100	---
CSE014	Computers for Engineers	2	1	-	3	4	8	20	10	10	60	100	-
BAS022	Mathematics-2	3	2	3	--	4	9	20	20	--	60	100	BAS021
Total		17	11	10	7	22	50	140	100	40	420	700	
Total Contact hours = 28 hours/week, Total SWL = 50 hours/week													

6.2 LEVEL 100

Table 10: Third Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
STE114	Structure Mechanics	3	2	2	-	4	8	20	20	-	60	100	STE053
BAS110	Mathematics-3	3	2	3	--	4	9	20	20	--	60	100	BAS022
UNR112	Law and Human rights	2	2	-	-	2	4	20	20	-	60	100	-
ARE111	Architectural Design	3	2	3	-	4	9	20	10	10	60	100	IRH014
BAS113	Dynamics of Rigid Bodies	2	1	2	-	3	6	20	20	-	60	100	BAS012
STE112	Structural Analysis-2	3	2	3	--	4	9	20	20	--	60	100	STE052
Total		16	11	13	0	21	45	120	110	10	360	600	
Total Contact hours = 24 hours/week, Total SWL = 45 hours/week													

Table 11: Fourth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
STE115	Building and Construction Materials	2	1	2	--	3	6	20	20	--	60	100	STE053
PWE118	Survey for Engineers	3	2	2	1	3	8	20	10	10	60	100	BAS110
STE116	Concrete Technology	3	2	1	2	4	9	20	10	10	60	100	STE053
BAS122	Mathematics-4	3	2	3	--	4	9	20	20	--	60	100	BAS110
ENG111	Technical Reports	2	2	-	-	2	4	20	20	-	60	100	
PDE119	Engineering Economy	2	1	2	--	3	6	20	20	--	60	100	-
Total		15	10	10	3	20	42	120	100	20	360	600	
Total Contact hours = 23 hours/week, Total SWL = 42 hours/week													

6.3 LEVEL 200

Table 12: Fifth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
BAS123	Mathematics-5	3	2	3	--	4	9	20	20	--	60	100	BAS122
STE224	Construction project Management	3	2	3	-	4	9	20	20	-	60	100	54CR
STE211	Design of Structural Concrete I	3	2	3	--	4	9	20	20	--	60	100	STE112, STE114
ENG215	Numerical Analysis with computer	2	1	2	1	4	8	20	10	10	60	100	BAS122
UNR211	Communication and Presentation Skills	2	2	-	-	2	4	20	20	-	60	100	ENG111
INT213	Mechanical and Electrical Systems	1	1	-	-	1	2	20	20	-	60	100	54 CR
Total		14	10	11	1	19	41	120	110	10	360	600	
Total Contact hours = 22 hours/week ,Total SWL = 41 hours/week													

Table 13: Sixth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
STE216	Design of Steel Structures I	3	2	3	--	4	9	20	20	--	60	100	STE112, STE114
STE217	Design of Structural Concrete II	3	2	3	--	4	9	20	20	--	60	100	STE211
BAS223	Probability and	2	1	2	--	3	6	20	20	--	60	100	BAS122
PWE211	Water and Wastewater engineering	2	1	3	-	4	8	20	20	--	60	100	-
STE218	Soil Mechanics	3	2	2	1	4	9	20	10	10	60	100	STE114
STE281	Training-1	-	-	--	-	1	1	--	50	--	50	100	85 CR
STE214	Modern Building Materials	3	2	2	--	4	8	20	20	--	60	100	STE116
Total		16	10	15	1	24	50	120	160	10	410	700	
Total Contact hours = 26 hours/week, Total SWL = 50 hours/week													

6.4 LEVEL 300

Table 14: Seventh Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
Elective	Elective Course-1: G1	3	2	3	--	4	9	20	20	--	60	100	Depends
UNR311	Profession Ethics	2	2	-	--	2	4	20	20	--	60	100	80CR
STE315	Matrix Methods of Structural Analysis	3	2	1	2	4	9	20	10	10	60	100	STE112
PWE311	Highway Engineering	2	1	3	--	4	8	20	20	--	60	100	90CR
STE317	Design of steel Structures	3	2	3	--	4	9	20	20	--	60	100	STE216
STE312	Foundations Engineering-	3	2	3	-	4	9	20	20	-	60	100	STE218
Total		16	11	13	2	22	48	120	110	10	360	600	
Total Contact hours = 26 hours/week, Total SWL = 48 hours/week													

Table 15: Eighth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
Elective	Elective Course-2 :G1	3	2	2	--	3	6	20	20	--	60	100	Depends
UNR326	Marketing	2	2	-	--	2	4	20	20	--	60	100	80CR
Elective	Elective Course-3 :G1	3	2	2	--	3	6	20	20	--	60	100	Depends
STE322	Construction Planning and Scheduling	3	2	2	1	5	10	20	10	10	60	100	STE224
STE341	Composite Materials	3	2	2	--	4	8	20	20	--	60	100	STE214, 130 CR
STE381	Training-2	-	--	--	-	2	4	--	50	--	50	100	STE281
Total		14	10	8	1	19	38	100	140	10	350	600	
Total Contact hours = 19 hours/week, Total SWL = 38 hours/week													

6.5 LEVEL 400

Table 16: Ninth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
Elective	Elective Course-4 :G2	3	2	2	--	3	6	20	20	--	60	100	Depends
Elective	Elective Course-5: G2	3	2	2	--	4	8	20	20	--	60	100	Depends
STE420	Foundations Engineering-2	3	2	3	--	5	10	20	20	--	60	100	STE312
Elective	Elective Course-6: G2	3	2	2	--	4	8	20	20	--	60	100	Depends
STE481	Graduation Project-1	3	1	--	4	5	10	--	50	--	50	100	130CR
STE414	Metallic Bridges	3	2	2	-	4	6	20	20	-	60	100	STE317
Total		17	10	11	4	26	50	100	150	0	350	600	
Total Contact hours = 25 hours/week, Total SWL = 50 hours/week													

Table 17: Tenth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid Term	Semester Work	Lab	Final Exam	Total	
Elective	Elective Course-7: G2	3	2	2	--	4	8	20	20	--	60	100	**Depends**
Elective	Elective Course-8: G2	3	2	2	--	4	8	20	20	--	60	100	Depends
STE441	Design of Structural Concrete III	3	2	3	--	5	10	20	20	--	60	100	STE217
PWE445	GIS and Remote Sensing Applications	2	1	2	-	3	6	20	20	-	60	100	PWE118
STE419	Quantity Surveying and Cost Engineering	3	2	2	-	4	٦	20	20	-	60	100	-
STE482	Graduation	3	1	--	3	4	8	--	50	--	50	100	STE481
Total		17	10	11	3	24	46	100	150	0	350	600	
Total Contact hours = 24 hours/week, Total SWL = 46 hours/week													

Table 18: Elective Courses-G1-3 courses (9 Credits)

Code	Course Name	Marks Distribution					Hours/Week						PreReq.
		Total	Final Exam	Lab	Semester Work	Mid Term	SWL	Free Work	Lab.	Tutorial	Lecture	Credit	
IRH311	Introduction to Water Resources Engineering	100	60	10	10	20	9	4	1	2	2	3	-
IRH312	Hydraulic Engineering	100	60	10	10	20	9	4	1	2	2	3	-
IRH358	Design of Pipelines and Pumping Stations	100	60	--	20	20	9	4	-	3	2	3	IRH312
IRH411	Coastal and Harbor Engineering	100	60	-	20	20	9	4	-	3	2	3	90 CR
PWE342	Ground Water Control Systems	100	60	--	20	20	8	4	-	2	2	3	STE218
STE342	Project Resources Management	100	60	-	20	20	8	4	-	2	2	3	STE224
STE452	Information Technology in Construction	100	60	-	20	20	8	4	-	2	2	3	STE224

Table 19: Elective Courses- 5 courses (15 Credits)-G2

Code	Course Name	Marks Distribution					Hours/Week						PreReq.
		Total	Final Exam	Lab	Semester Work	Mid Term	SWL	Free Work	Lab.	Tutorial	Lecture	Credit	
STE412	Project Management and Evaluation	100	60	10	10	20	9	4	1	2	2	3	STE322,130 CR
STE413	Earth Retaining Structures	100	60	10	10	20	9	4	1	2	2	3	STE312
STE431	Concrete Durability	100	60	-	20	20	6	3	-	2	1	2	STE116,130CR
STE432	Masonry Structures	100	60	-	20	20	9	4	-	2	2	3	130 CR
STE433	Structural Mechanics and Stability	100	60	10	10	20	9	4	1	2	2	3	STE315
STE435	Introduction to Earthquake Engineering	100	60	10	10	20	9	4	1	2	2	3	-
STE438	Membrane Concrete Structures	100	60	-	20	20	6	3	-	2	1	2	BAS123, STE052, STE112
STE443	Temporary Structures and Form Work Design	100	60	-	20	20	6	3	-	2	1	2	STE217
STE444	Special Concrete Structures	100	60	-	20	20	6	3	-	2	2	3	STE217
STE445	Design of Steel Structures III	100	60	-	20	20	9	4	-	3	2	3	STE317

STE446	Advanced Concrete Technology	100	60	10	10	20	8	4	1	2	2	3	STE116, STE214
STE447	Deep Excavation and Sides Support	100	60	-	20	20	8	4	-	2	2	3	STE218
STE451	Engineering Risk Analysis	100	60	-	20	20	6	3	-	2	1	2	BAS223
STE461	Special Topics in Structural Engineering	100	60	-	20	20	6	3	-	2	1	2	130 CR
STE465	Inspection and Maintenance of Structures	100	60	-	20	20	8	4	-	2	2	3	STE217
STE466	Design and Construction of Water and Wastewater Structures	100	60	-	20	20	9	4	-	3	2	3	STE217
STE318	Special concrete	100	60	10	10	20	8	4	1	2	2	3	STE116, STE214
STE418	Structural dynamics and vibrations	100	60	-	20	20	6	4	-	2	2	3	-
STE437	Seismic Design of Structures	100	50	--	30	20	8	4	--	2	2	3	STE418
STE421	Sustainable materials and building physics	100	60	-	20	20	9	4	-	2	2	3	130 CR

Table 20: List of overall data about the program

#	Program	NC	Credits and SWL			Total Contact Hours				4 Requirements %				BS %	EC%
			CH	ECTS	SWL	Lec	Tut	Lab	TT	UR	FR	DR	PR		
1	Specialized Program	60	160	29.248	**731.2**	106	114	25	245	8.125	25	35	31.875	19.375	15

NC	Total number of Courses	UR	University Requirement
CH	Credit Hour	FR	Faculty Requirement
ECTS	European Credit Transfer System	DR	Discipline Requirement
SWL	Student Workload	PR	Program Requirement
Lec	Lectures		
Tut	Tutorials	BS	Basic Sciences Percentage, Credit Hours
Lab	Laboratory	EC	Elective Courses Percentage, by Credit Hours
TT	Total		

6.6 STE's study plan

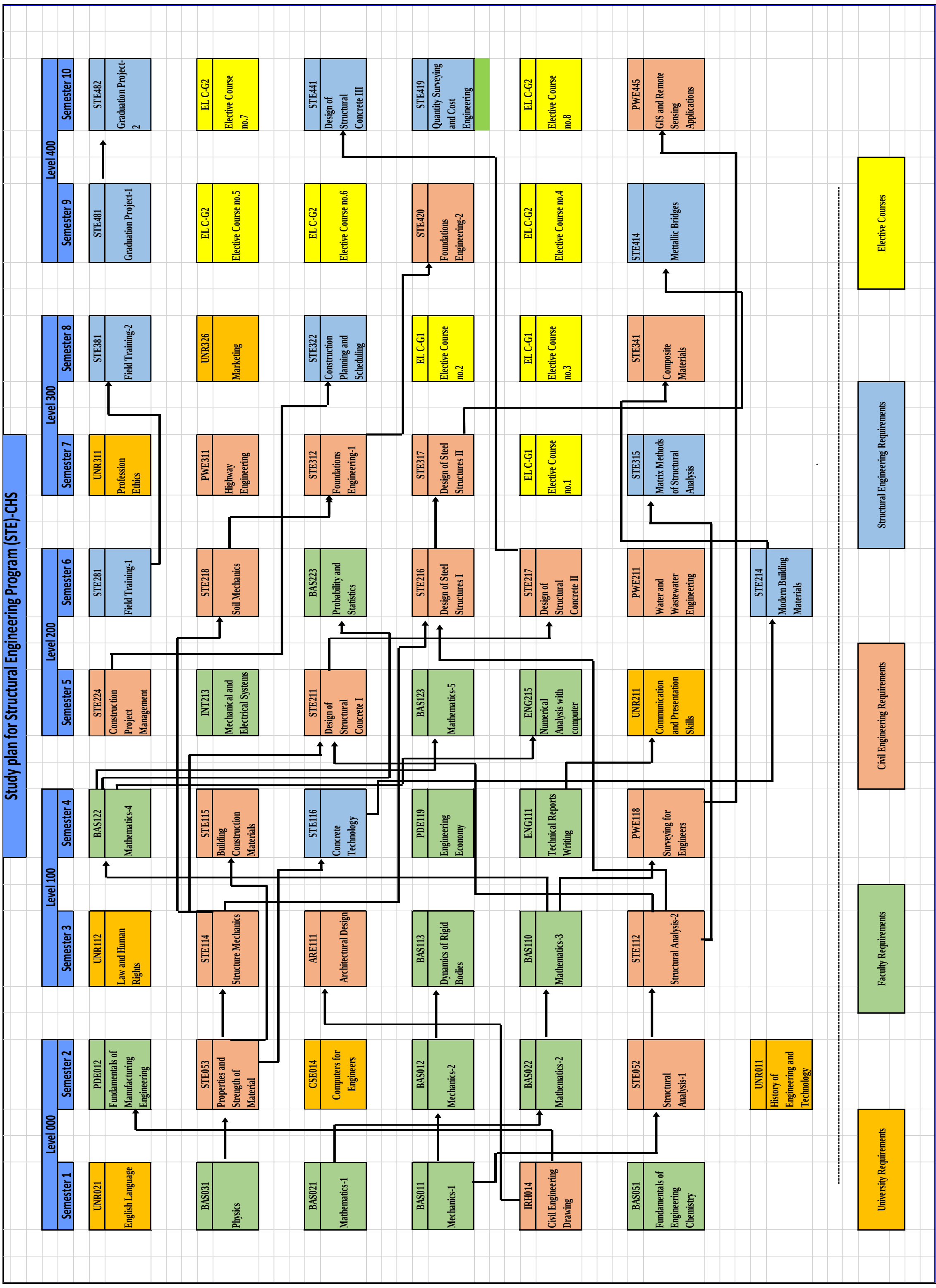

Fig (3): The suggested study plan for all courses from level 000 to level 400.

7. ***Courses Specification for STE Program***

7.1 University requirements

UNR011	History of Engineering and Technology								Prerequisites
1 Cr	Lecture	1	Tutorial	0	Lab.	0	Semester	1st	-

Content:

History of Technology: Engineering and technology in a cultural, social, and historical context. Development of technology as a key to history of civilization in a comparative perspective - Exploring Humanities: Modes of thought found within humanities and social sciences. Humanities for Engineers: Humanities themes of increased complexity - Different work methodologies - Critical analysis of information & choice of argumentation- Work methodologies and pedagogical interest.

References:

- *Roger S. Kirby, Engineering in History, Dover Publications Inc. New York, United States, 1990, ISBN10 0486264122*

UNR112	Law and Human Rights								Prerequisites
2 CR	Lecture	2	Tutorial	٠	Lab.	٠	Semester	2nd	-

Content:

Systems and laws of institutions - Introduction to Accounting - Labor legislation and laws governing engineering professions - Industrial security legislation and environment - Historical philosophical origins of human rights - international sources of human rights - national sources of human rights - global bodies based on the protection of human rights.

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UNR211	Communication and Presentation Skills								Prerequisites
2 CR	Lecture	2	Tutorial	0	Lab.	0	Semester	6th	ENG111

Content:

Analyzing the audience. Selecting presentation topics and objectives. Recognizing different types of speeches and presentations. Overcoming nervousness and developing confidence while addressing an audience. Researching and generating information for informative presentations. Chucking presentation content. Designing effective visual aids. Using explicit and effective transitions throughout a presentation. Creating benefit statements for persuasive presentations. Using persuasive devices such as pathos and logos in speeches. Planning and delivering informative, persuasive, entertaining, and inspiring presentations. Handling question and answer sessions effectively.

References:

- *Joan van Emden, Lucinda Becker, Presentation Skills for Students, 3rd Edition, Red Globe Press, 2016*
- *M. Wa Mutua, S. Mwaniki, P. Kyalo, B. Sugut, Communication Skills: A University Book, Succex Publishers, 2016*
- *Ian Tuhovsky, Wendell Wadsworth, Communication Skills Training, Ian Tuhovsky, 2015*
- *Tabitha Wambui, Alice W. Hibui, Elizaeth Gathuthi, "Communication skills " Vol.1, Students' coursebook, LAP LAMBERT Academic Publishing, 2012*

UNR311	Profession Ethics							Prerequisites
2 Cr	Lecture	2	Tutorial	0	Lab.	0	Semester	7th	80 credits

Content:
Engineering profession: Ethical issues in engineering practice. Conflicts between business demands and professional ideals. Social and ethical Responsibilities of Technologists. Codes of professional ethics. Case studies. Value Crisis in contemporary society. Nature of values: Psychological values, Societal values, Aesthetic values, Moral and ethical values. Work ethics and professional ethics. The legal rule: Mandatory and complementary. Sources of Law. Formal sources: Statutory Law, Custom, the Principles of natural Law and rules of justice. Informal sources: Jurisprudence, Doctrine. Application of Law. Holders of right; Natural persons, Juristic persons. Theory of Obligation; definition, forms. Sources of Obligations. The contract; Parties, Formation, Validity, Effect, and compensation of Damage. Introduction to Engineering Contracts. Contracting Contract.

References:
- *Lizabeth A. Stephan, David R. Bowman, William J. Park, Benjamin L. Sill, Matthew W. Ohland, "Thinking like an engineer", Published by Pearson 2018.*
- *Harris, C. E., Jr., Pritchard, M. S., & Rabins, M. J. Engineering Ethics. Second edition. Belmont, CA: Wadsworth, 2000*

UNR021	English language								Prerequisites
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	7th	-

Content:
The aim of the course is to emphasize the development of student’s communicative skills to speak, listen, read and write in English cultural characteristics of this language from historical, geographical, literature, economic, social viewpoints, and scientific contents. Topics include, but not limited to, the basics of language grammar and mechanics, writing effective sentences and paragraphs, vocabulary building, writing technical engineering documents and writing technical forms: letters, memos, reports, scientific articles, job description, resumes and curriculum vitas.

References:
- *Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011*

UNR326	Marketing								Prerequisites
2 CR	Lecture	2	Tutorial	--	Lab.	--	Semester	8th	80 CR

Content:
Introduction. The Field of Sales; Strategic Sales Force Management. The Personal Selling Process and Sales Force Organization. Profiling and Recruiting Salespeople; Selecting and Hiring Applicants, Developing the Sales Program, Sales Force Motivation, Sales Force Compensation, Expenses and Transportation; Leadership of a Sales Force, Forecasting Sales and Developing Budgets; Sales Territories, Analysis of Sales Volume, Marketing Cost & Profitability Analysis, Performance Evaluation; Ethical and Legal Responsibilities tender writing.

References:
- *Principles of Marketing, University of Minnesota Libraries Publishing, 2015, ISBN 13: 9781946135193*

CSE014	Computers for Engineers								Prerequisites
2 CR	Lecture	1	Tutorial	0	Lab.	3	Semester	3rd	-

Content:
Developing basic concepts of algorithmic thinking to solve problems of relevance in engineering practice and implementing these algorithms using high-level computer language. Using data types, input/output commands, loops, control structures, functions, arrays, and other programming language constructs in a computer program. Evaluating and interpreting the results of programming work.

References:

VG Oklobdzija " The computer engineering handbook"- 2019

7.2 Faculty Requirements

ENG111	Technical Reports Writing								Prerequisites
2 CR	Lecture	2	Tutorial	0	Lab.	0	Semester	4th	-

Content:
Discovering and outlining ideas. Organizing outlines. Ways to begin the three parts of technical writing. Writing abstracts, summaries, and conclusions of long reports. The thesis statements. Forms: letters, memos, reports, scientific articles, job description, CV, references and footnotes. Selection of key words, titles, and subtitles. Editing, revising and proof- reading techniques. Electronic word processing and Technical Reports Writing, vocabulary building, and basic types and patterns of argument.

References:
- *G. J. Alred, W. E. Oliu, The Handbook of Technical Writing, 12th Edition, Bedford/St. Martin's; 2018*
- *K. Hyland, Teaching and researching writing. 3rd edition Routledge academic publisher, 2016*
- *M. Markel, Technical Communication, 11th edition, MacMillan, 2015.*

ENG215	Numerical Analysis with computer								Prerequisites
2 CR	Lecture	1	Tutorial	2	Lab.	1	Semester	5th	BAS122

Content:
This course focuses on problem-solving techniques and skills for civil and structural engineering problems by using spread sheets and software packages such as MATLAB and Mathematica; Topics include roots of nonlinear equations, simultaneous linear equations, interpolation and curve fitting, data approximation, optimization, matrices and eigenvalues, ordinary differential equations, numerical integration/differentiation; Applications emphasize the development of special-purpose codes by the students for structural analysis and design methods.

References:

- Srinivas Chandrasekaran, Advanced Structural Analysis with MATLAB,2018
- Numerical analysis using MATLAB and Excel, Steven T. Karris, 2007

BAS011	**Mechanics-1**							**Prerequisites**
3 CR	Lecture	2	Tutorial	3	Lab.	--	Semester	1st	---

Content:
Statics of particles, forces in three-dimensions, vector algebra; equivalent systems of forces, resultant of a group of forces, moments of forces, moment of a couple, reduction of a system of forces, wrench; equilibrium of rigid bodies in two dimensions, reactions at supports and connections for a 2D structure, 2D trusses, equilibrium of rigid bodies in three dimensions, reactions at supports and connections for a three dimensional structure; centroids and centers of gravity, center of gravity of 2D bodies, centroids of areas and lines, first moments of areas and lines, composite plates and wires; moments of inertia, moments of inertia of areas, second moment, or moment of inertia of an area, polar moment of inertia, radius of gyration of an area, parallel-axis theorem, moments of inertia of composite areas, product of inertia, principal axes and principal moments of inertia, moments of inertia of masses, moment of inertia of a mass, parallel axis theorem, moments of inertia of thin plates, moments of inertia of composite bodies, mass product of inertia, principal axes and principal moments of inertia.

References:

- *R.C. Hibbeler, "Engineering Mechanics: Statics and Dynamics, 14th Edition", Pearson Prentice Hall, New Jersey, 2016.*
- *J. L. Meriam, L. G. Kriage, and J. N. Botton, "Engineering Mechanics: Statics, 8th Edition", John Wiley & Sons, New York, 2016.*

BAS012	Mechanics-2								Prerequisites
3 CR	Lecture	2	Tutorial	2	Lab.	1	Semester	2nd	BAS011

Content:
Kinematics of particles: rectilinear motion of particles, position, velocity and acceleration, uniform rectilinear motion, uniformly accelerated rectilinear motion, curvilinear motion, derivatives of vector functions, rectangular components of velocity and acceleration, relative motion, tangential and normal components of acceleration, motion of a particle in a circular path, velocity and acceleration of a particle in polar coordinates. Kinetics of particles: Newton's second law, linear momentum of a particle, equations of motion with applications in Cartesian coordinates, tangential and normal directions, polar coordinates, free vibrations of particles, simple harmonic motion; energy & momentum methods, work of a force, kinetic energy of a particle, principle of work and energy, applications, power and efficiency, potential energy, conservation of energy, principle of impulse and momentum, impulsive motion, impact, direct central impact and coefficient of restitution, oblique central impact.

References:

- *R.C. Hibbeler, "Engineering Mechanics: Statics, 11th Edition", Pearson Prentice Hall, 2006.*
- *F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg, "Vector Mechanics for Engineering, Statics and Dynamics, 9th Edition", McGraw-Hill, New York, 2010.*

BAS021	Mathematics-1								Prerequisites
3 CR	Lecture	2	Tutorial	3	Lab.	--	Semester	1st	---

Content:
Newton's laws - Types of forces، coplanar forces، Rectangular components of vector (1D, 2D, Space), Forces in space - Equilibrium of a particle - Conditions, Free-body diagram - Moment - Couple moment - Resultant of a system of forces and couples as a force and couple system - General procedure for reducing force and couple systems - Equilibrium of a rigid body - Conditions of equilibrium of a rigid-body، free body diagrams – friction.

References:

- *R.C. Hibbeler, "Engineering Mechanics: Statics and Dynamics, 14th Edition", Pearson Prentice Hall, New Jersey, 2016.*
- *J. L. Meriam, L. G. Kriage, and J. N. Botton, "Engineering Mechanics: Statics, 8th Edition", John Wiley & Sons, New York, 2016.*

BAS022	Mathematics-2							Prerequisites
3 CR	Lecture	2	Tutorial	3	Lab.	--	Semester 1^{st}	BAS021

Content:
Kinematics of a particle: curvilinear motion - Normal and tangential components. - Newton's laws - motion of projectiles - Work and energy of a particle - applications of friction.

References:
- *R.C. Hibbeler, "Engineering Mechanics: Statics, 11th Edition", Pearson Prentice Hall, 2006.*
- *F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg, "Vector Mechanics for Engineering, Statics and Dynamics, 9th Edition", McGraw-Hill, New York, 2010.*

BAS110	Mathematics-3							Prerequisites
3 CR	Lecture	2	Tutorial	3	Lab.	--	Semester 2^{nd}	BAS022

Content:
Applications of partial differentiation - Maximum values of functions in more than one variable and applications - First order differential equations - Second order differential equations - Laplace transform and its applications - Analytical geometry in space.

References:
- *D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.*
- *S. A. Wirkus, and R. J. Swifi, "A Course of Ordinary Differential Equations", Taylor & Francis Group, LLC, 2015*

BAS031	Physics							Prerequisites
3 CR	Lecture	2	Tutorial	1	Lab.	2	Semester 1^{st}	---

Content:
Physics and measurements; elastic properties of solids; universal gravitation and motion of planets; fluid mechanics (statics and dynamics); oscillatory motion; wave motion, sound waves; thermo-dynamics, temperature, heat and the first law of thermodynamics, the kinetic theory of gases, heat engines, entropy and the second law of thermodynamics. Laboratory experiments on course topics.

References:
- *Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 6th Edition, Thomson Brooks/Cole 2014.*
- *Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.*

BAS051	Engineering Chemistry							Prerequisites
3 CR	Lecture	2	Tutorial	2	Lab.	1	Semester 2^{nd}	---

Content:
Gases; Applications to gaseous law; Mass balance and heat balance in combustion processes of fuels; Solutions & separation techniques; Applications to electrochemistry; Corrosion; Water treatment; Building materials; Environmental Engineering; Selected chemical industries: fertilizers, dyes, polymers, sugar, petro-chemicals, semi-conductors, oil and fats, industrial systems; Chemical Vapor deposition.

References:
- *Brown, L. T, LeMay H. E. Jr; Bursten, B. E.; Murphy, C.J., and Woodward, P.; " Chemistry The Central Science", Pearson International Edition (11th edn), Pearson Printice Hall, (2009).*

BAS113	Dynamics of Rigid Bodies							Prerequisite
2 CR	Lectures	1	Tutorials	2	Lab	-	Semester	3rd	BAS012

Content:
Planar kinematics of rigid bodies - center of mass - moment of inertia - planar kinetics of rigid body: linear and angular equations - application of the equations of motion of rigid body, translation, rotation about a fixed axis, and general plane motion - Principle of Work and Kinetic Energy - Conservation of Mechanical Energy - Principle of Impulse and Momentum - Introduction to Vibrations..

References:
- *R.C. Hibbeler, "Engineering Mechanics: Statics, 11th Edition", Pearson Prentice Hall, 2006.*
- *F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg, "Vector Mechanics for Engineering, Statics and Dynamics, 9th Edition", McGraw-Hill, New York, 2010.*

BAS122	Mathematics-4								Prerequisites
3 CR	Lecture	2	Tutorial	3	Lab.	--	Semester	3rd	BAS110

Fourier series – Fourier transform – Complex numbers – Functions of a complex variable – Complex integration – Residue theorem – Direction derivatives – Double integrals – Triple integrals – Line integrals – Surface integrals.

References:
- *J. Brown, and R. Churchill, "Complex Variables and Applications", 9th Edition, McGraw-Hill, 2013.*
- *D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.*

BAS123	Mathematics-5								Prerequisites
3 CR	Lecture	2	Tutorial	3	Lab.	--	Semester	3rd	BAS122

Numerical solution of linear and non-linear systems of equations – Iterative methods – Curve fitting: Least square of (Straight lines, Polynomials), Linearization of nonlinear relationship. Interpolation and polynomial approximation –finite difference operators – Numerical integration and differentiation.

References:
- *Mazumder, Numerical Methods for Partial Differential Equations, Finite Difference and Finite Volume Methods, science direct ,2016.*
- *Sheldon Rose, A First course in probability, Eighth edition, 2010, Pearson Prentice Hall.*

BAS223	Probability and Statistics								Prerequisite
2 CR	Lectures	1	Tutorials	2	Lab	-	Semester	6th	BAS122

Content:
Probability axioms; probability laws; conditional probability; random variables; discrete and continuous distributions; joint distribution; computer simulation; sampling; measures of location and variability; parameter estimation, testing of hypothesis.

References
- *M. Shbegal, G. Sheller, et al., " Probability and Statistics, 1st edition", 2004.*
- *Mary C. Meyer, Probability and Mathematical Statistics: Theory, Applications, and Practice in RSBN-10: 1611975778, SIAM (June 24, 2019)*

PDE012	Production Engineering								Prerequisites
2 CR	Lecture	1	Tutorial	1	Lab.	1	Semester	1st	-

Content:

Engineering Materials - Elements of Manufacturing Processes, material flow, energy flow and information flow - Forming in the liquid state, Casting and molding processes - Forming in the solid state, metal forming, forming of plastics and powder metallurgy - Material Joining processes, welding, soldering and brazing, riveting, joining by mechanical elements, assembly processes - Material removal processes, metal cutting and finishing processes - Computer applications in manufacturing - Term mini-project.

References:

- *Hitomi, Katsundo. Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management, and Industrial Economics. Routledge, 2017.*

PDE119	Engineering Economy								Prerequisites
2 CR	Lecture	1	Tutorial	2	Lab.	0	Semester	5th	-

Contents:

Introduction to Economy, Basic Concepts, Varieties of market structure, the law of supply and demand, different types of economy, accounting income and cash flow, the objectives of the firms, balance sheet (BS).

Introduction to engineering economy: engineering decision making, break - even analysis, production function, payback period method. time value of money: simple interest rate, compound interest, discreet cash flow and economic equivalence, evaluating of the projects (present worth, annual worth, and capitalized costs), nominal and effective interest rate. rate - of Return ROR computations: rate of return calculations using A present worth PW, Rate of Return calculations by using annual worth EAW, Rate of Return Evaluation for Multiple Alternatives. Depreciation Models: nature of depreciation, depreciation conventional methods, methods based on asset usage, switching between depreciation models.

References:

- *D.G. Newnan, J. Whittaker, T.G. Eschenbach and J.P. Lavelle, "Engineering economic Analysis", 3rd edition, Don mills, Toronto, Ontario, 2014.*

INT213	Mechanical and Electrical Systems								Prerequisite
1 CR	Lectures	1	Tutorials	0	Lab	0	Semester	5th	54 CR

Content:

Introduction to electrical circuits; Electrical installation in residential and industrial buildings (illumination networks in rural areas, data lines, telephone lines & antenna, control of air conditioning, lift); Requirements of audio systems; Alarm devices (fire - security - gas); HVAC components and systems; Plumbing elements and features; Essential mechanical systems used in residential & institutional projects

References:

- *Nilsson, J.W. and S.A. Riedel, Electric circuits. 2015: Pearson Upper Saddle River, NJ.*
- *Slade, P.G., Electrical contacts: principles and applications. 2017: CRC press.*

7.3 Requirements for general and specific specialization

7.3.1 Civil engineering requirements

7.3.1.1 Compulsory courses

<table>
<tr><td>ARE111</td><td colspan="8">Architectural Design</td><td>Prerequisite</td></tr>
<tr><td>3 CR</td><td>Lectures</td><td>2</td><td>Tutorials</td><td>3</td><td>Lab</td><td>-</td><td>Semester</td><td>2nd</td><td>IRH014</td></tr>
<tr><td colspan="10">Content:
Developing the ability to perceive architectural formations and their design – design considerations and functional requirements, study functional relationships, guidance, privacy and space configurations – simplified projects that address the aesthetic, cultural, environmental, functional and structural determinants of architectural form and space – the foundations for the use and design of internal and external spaces and services and vertical and horizontal communication – and focus those topics to human needs and its interaction with the surrounding environment ' natural and built – applications of architectural models and methods of studying directing and Manifesting architectural projects</td></tr>
<tr><td colspan="10">References:
- Neufert, E. “Architect’s Data, Crosby Lockwood Staples”, 5th edition, London, 2019.
- Francis D. K. Ching. “Architectural Graphics”, Amazon Digital Services LLC, April 2015.
- Ernest R. Norling. “Perspective Made Easy (Dover Art Instruction)”, 2012.
- Nikolas, D. & Jokiniemi, E. “Dictionary of Architecture and Building Construction”, 1st Ed. 2008.
- Crosbie, Michael J. “Time Saver Standards for Architectural Design Data”, McGraw Hill book company, New York, 2009.</td></tr>
</table>

<table>
<tr><td>IRH014</td><td colspan="8">Civil Engineering Drawing</td><td>Prerequisite</td></tr>
<tr><td>3 CR</td><td>Lectures</td><td>2</td><td>Tutorials</td><td>2</td><td>Lab</td><td>0</td><td>Semester</td><td>2nd</td><td>-</td></tr>
<tr><td colspan="10">Content:
Introduction to civil engineering projects, General Concepts, Legend and symbols, Scales and drawing size, General layout and plans, Longitudinal and cross sections, Detailing, Earthworks and retaining walls, Applications on irrigation and land reclamation projects, Half-earth-removed views, Pitching and protection. Drawing of steel sections and connections, reinforced concrete sections. Projection of beams and columns.</td></tr>
<tr><td colspan="10">References:
• A.M.E. Soliman, "Engineering drawings for engineers and techicians",1st edition, 2016.
• Mcgraw-hill Mint, "Mechanical Drawing Board & CAD Techniques", Student Edition,2011</td></tr>
</table>

PWE211	Water and Wastewater Engineering								Prerequisite
2 CR	Lectures	1	Tutorials	3	Lab	0	Semester	6th	-

Content:
Introduction – Definitions – Fields of Environmental Engineering – Environmental system – Waste cycles – Main Environmental problems – Global problems – Water pollution – Water supply Engineering – Water purification works – Water distribution system and Storage tanks – Sanitary Drainage – Sewerage System – Wastewater Treatment Works.

References:

- Droste, R. L., & Gehr, R. L. (2018). Theory and practice of water and wastewater treatment. John Wiley & Sons.
- Miklos, D. B., Remy, C., Jekel, M., Linden, K. G., Drewes, J. E., & Hübner, U. (2018). Evaluation of advanced oxidation processes for water and wastewater treatment–A critical review. Water research, 139, 118-131.
- Bratby, J. (2016). Coagulation and flocculation in water and wastewater treatment. IWA publishing.

PWE118	Surveying for Engineers								Prerequisite
3 CR	Lectures	2	Tutorials	2	Lab	1	Semester	4th	BAS110

Content:
Engineering principles and applications of surveying sciences (with emphasis on plane surveying) are presented in relation to engineering. Popular techniques and engineering uses of distance, angles and height difference measurements are studied and practiced. Applications in detail mapping, earthwork computations, and setting out engineering structures are covered in this course. Integrated digital surveying and mapping using total station are introduced.

References:

- *Johnson, Aylmer. "Plane and Geodetic Surveying 2nd Edition". CRC Press, 2014.*
- *Bossler, and Moffit. "Surveying 10th Edition". 2004.*

PWE311	Highway Engineering								Prerequisite
2 CR	Lectures	1	Tutorials	3	Lab	0	Semester	7th	90 CR

Content:
Introduction to transport planning and traffic engineering – route study and reconnaissance – functional classification of road network – criteria of geometric design – design of road horizontal & vertical alignments – cross section elements – type of road pavement – vehicle – load and stresses – construction equipment's – method statement & quality control – pavement management and rehabilitation – traffic control during road construction and maintenance. Use of computer simulation for selection of equipment.

References

- *Meyer, Michael D. "Transportation planning handbook", Wiley, 2016.*
- *Ceder, A., "Public Transit Planning and Operation: Theory, Modeling and Practice" Burlington, MA: Elsevier, 2007.*
- *Vuchic, Vukan R. "Urban transit systems and technology", John Wiley & Sons, 2007.*
- *Transit Capacity and Quality of Service Manual", 3rd Edition, Transportation Research Board, 2013.*

STE052	Structural Analysis-1								Prerequisites
3 CR	Lecture	2	Tutorial	3	Lab.	0	Semester	2^{nd}	BAS011

Content:
Types of structures; Loads; Supports and Reactions; Internal Forces; Analysis of Beams, Frames, and Trusses. Influence lines of Statically Determinate Structures, Moving Loads.

References:

- *Kassimali, A. "Structural Analysis (Si Edition)". Stamford USA: Cengage Learning 2011.*
- *Kenneth M. Leet, Chia-Ming Uang, Joel T. Lanning, Anne M. Gilbert. "Fundamentals of Structural Analysis". McGraw-Hill Education, 2018.*

STE112	Structural Analysis-2								Prerequisites
3 CR	Lecture	2	Tutorial	3	Lab.	0	Semester	3^{rd}	STE052

Content:
Deformations: differential equations, virtual work. Indeterminate structures: consistent deformations, moment distribution. Buckling of columns.

References:

- *Kassimali, A. "Structural Analysis (Si Edition)". Stamford USA: Cengage Learning 2011.*
- *Kenneth M. Leet, Chia-Ming Uang, Joel T. Lanning, Anne M. Gilbert. "Fundamentals of Structural Analysis". McGraw-Hill Education, 2018.*
- *McCormac, C.J. "Structural Analysis Using Classical and Matrix Methods". United States of America.: 4th Edition , John Wiley & Sons, Inc, , 2007*

STE053	Properties and Strength of Material								Prerequisites
3 CR	Lecture	2	Tutorial	1	Lab.	2	Semester	3^{rd}	BAS031

Content:
Introduction; Main properties of material; Testing Machines and their calibration; Behavior of metallic material subjected to tension, and compression, bending, shear and torsion: Impact and fatigue; Discussion of basic mechanical and physical properties of a variety of civil engineering materials such as concrete, asphalt, wood and fiber composites; Load-time deformation characteristics; Corrosion of metals; Fracture types and Fracture mechanics.

References:
- *Neville, A.M., "Properties of Concrete",5^{th} ed., Longman, 2010.*

STE114	Structure Mechanics								Prerequisites
3 CR	Lecture	2	Tutorial	2	Lab.	0	Semester	4^{th}	STE053

Content:
Properties of areas, Analysis of stress, strain, and deformation of sections subjected to tension, compression, bending, shear, and torsion. Combined stresses, Principal stresses.

References:

- *George, N. Frantziskonis. "Essentials of the Mechanics of Materials, Second Edition". USA: DEstech Publications, Inc., 2013.*
- *Pytel, A. and Kiusalaas, J. "Mechanics of Materials Second Edition". Cengage Learning2012.*
- *Kelly, Pa. "Solid Mechanics Part I: An Introduction to Solid Mechanics". http://homepages.engineering.auckland.ac.nz/~pkel015/SolidMechanicsBooks/Part_I/. 2018.Edition , John Wiley & Sons, Inc, , 2007*

STE115	Building Construction Materials							Prerequisites
2 CR	Lecture	1	Tutorial	2	Lab.	0	Semester	4th	STE053

Content:

Background of concrete, concrete ingredients, types of cement, chemical and physical properties of cement, properties of aggregates, handling of aggregates, chemical admixtures; Cement replacement materials; New advanced materials; Fresh Concrete Properties (workability-segregation bleeding); Strength of Hardened Concrete (compressive-tensile flexural-shear- bond); Lime; Gypsum; Water; Steel.

References:

- *P. Purushothama Raj, " Building Construction Materials and Techniques". Pearson Education India, ISBN: 9789332579118, 2016.*
- *M L Gambhir and Neha Jamwal, " Building and Construction Materials: Testing and Quality Control, (Lab Manual Series)". McGraw Hill Education (India) Private Limited, ISBN: 1259029662, 2014.*

STE211	Design of Structural Concrete I								Prerequisite
3 CR	Lectures	2	Tutorials	3	Lab	0	Semester	5th	STE112, STE114

Content:

Methods of design; Codes; Structural systems and load distribution; Design using limit states method; Section subjected to bending moments; Section subjected to shear and torsion; Reinforcement details for beams; Limit state of deflection, Working stress design method.

References:

- *Fanella, David A. "Reinforced Concrete Structures: Analysis and Design". McGraw-Hill Professional Publishing, 2010.*
- *Jack C. McCormac, Russell H. Brown. "Design of Reinforced Concrete". 2013.*

STE224	Construction Project Management								Prerequisites
3 CR	Lecture	٢	Tutorial	3	Lab.	0	Semester	5th	54 CR

Content:

Project management definition, project delivery methods, contracting strategies, basic management functions, construction scheduling, bar charts, AOA and AON networks, critical path method, construction resources, material management, labor productivity, construction equipment, design and analysis of construction operations, construction cost, cost estimating, direct and indirect costs, cash flow calculations, introduction to management information systems.

References:

- *Hegazy, T., "Computer-Based Construction Project Management", 2002*
- *Paul Netscher, " Construction Project Management: Tips and Insights", Panet Publications, 2017.*

STE218	Soil Mechanics								Prerequisite
3 CR	Lectures	2	Tutorials	2	Lab	1	Semester	6th	STE114

Content:
Basic properties of soil, Soil classification, Compaction, Permeability, Soil stresses, Consolidation, Shear strength, Lateral earth pressure and one dimension water flow within the soil.

References:

- Soil Mechanics in Engineering Practice. By: Karl Terzaghi, Ralph B. Peck and Gholamreza Mesri
- An introduction to geotechnical engineering. By: Robert D. Holtz and William D. Kovacs
- Craig's Soil Mechanics. By: R.F. Craig
- Soil Engineering: Testing, Design, and Remediation. By: Fu Hua Chen

STE312	Foundations Engineering-1								Prerequisite
3 CR	Lectures	2	Tutorials	3	Lab	0	Semester	8th	STE218

Content:
Basics of soil investigations, Soil bearing capacity, Designs of shallow foundations: wall footings, isolated footings, combined footings and strip footings, Design of retaining walls.

References:

- Analysis and Design of Shallow and Deep Foundations. By: Lymon C. Reese, Shin-Tower Wang, and William M. Isenhower

STE217	Design of Structural Concrete II								Prerequisite
3 CR	Lectures	2	Tutorials	3	Lab	0	Semester	6th	STE211

Content :
Design and reinforcement details: solid slabs, ribbed slabs, paneled beams slab, flat slabs (beamless slabs), stairs; Design of sections under axial forces; Design of sections under eccentric forces; Design and reinforcement details of concrete columns.

References:

- *Fanella, David A. "Reinforced Concrete Structures: Analysis and Design". McGraw-Hill Professional Publishing, 2010.*
- *Jack C. McCormac, Russell H. Brown. "Design of Reinforced Concrete". 2013.*
- *El-behairy, S., "Reinforced Concrete Design Handbook", Fifth edition, Cairo, 2002.*

STE216	Design of Steel Structures I								Prerequisite
3 CR	Lectures	2	Tutorials	3	Lab	0	Semester	5th	STE112 + STE114

Content :
Introduction to structural steel design – Design criteria (materials, loads, and systems) – General layout – Design of tension members – Design of compression members – Design of beams – Design of beam-columns.

References:
- *Alan Williams. "Steel Structures Design (ASD/LRFD)". USA: International Code Council, 2011.*
- *Liang, Q. Q. "Analysis and Design of Steel and Composite Structures". USA: Taylor & Francis, 2015.*
- *"Egyptian code of practice for steel construction and bridges (ASD)", Code No. ECP 205-2001, Edit 2009, Ministry of Housing, Utilities, & Urban Development.*

STE317	Design of Steel Structures II								Prerequisite
3 Cr	Lectures	2	Tutorials	3	Lab	0	Semester	7th	STE216

Content :
Welded connections – Bolted connections (bearing and friction bolts) – Steel details for frames – Steel details for trusses – steel details for wind bracing.

References:
- *Alan Williams. "Steel Structures Design (Asd/Lrfd)". USA: International Code Council, 2011.*
- *Liang, Qing Quan. "Analysis and Design of Steel and Composite Structures". USA: Taylor & Francis Group, 2015.*
- *"Egyptian code of practice for steel construction and bridges (ASD)", Code No. ECP 205-2001, Edit 2009, Ministry of Housing, Utilities, & Urban Development.*

PWE445	GIS and Remote Sensing Applications								Prerequisites
3 Cr	Lecture	2	Tutorial	3	Lab.	0	Semester	Elective	PWE118

Content:
This course provides a conceptual overview and hands-on experience using the GIS software, giving the background knowledge to quickly take advantage of GIS powerful display and query capabilities in such enhanced format supporting decision makers. It Introduce the concepts of GIS, Present GIS different uses, learn basic ArcView functionality, become familiar with the ArcView user interface, and Use ArcView to create charts and layouts. GIS graphic user interface (GUI): Interacting with the application window and its components; using online help, Projects and documents: How projects organize, manage and store documents (view, tables, charts and layouts), Creating and editing themes: Using GIS modules to create and edit shape themes, Tables: Creating tables from a variety of tabular data sources; selecting from a table; joining multiple tables; modifying table structure, Charts: Creating a chart for presenting and analyzing tabular data, Layouts: Combining views, tables, charts and images, as well as, logos and scale bars, to create layouts.

References:
- *Johnson, Aylmer. "Plane and Geodetic Surveying 2nd Edition". CRC Press, 2014.*
- *Bossler, and Moffit. "Surveying 10th Edition". 2004.*

7.3.2 Structural engineering requirements

7.3.2.1 Compulsory courses

STE116	Concrete Technology							Prerequisites
3 CR	Lecture	2	Tutorial	1	Lab.	2	Semester 5th	STE053

Content:
Design mix of different types of concrete: Special concrete; Quality control programs for concrete; Destructive and Non-destructive tests of concrete; Creep and deformation of concrete; Concrete durability.

References:
- *Neville, A.M., "Properties of Concrete", 5th ed., Longman, 2010.*

STE315	Matrix Methods of Structural Analysis							Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	2	Semester 7th	STE112

Content:
Structure idealization and degrees of freedom; Coordinate systems. Equilibrium, compatibility and constitutive relations; Force-displacement relations for bars and beams; Stiffness versus flexibility; Stiffness matrix of bar, beam, and frame members; Global stiffness equations; Inclined members and special topics; Matrix analysis of trusses, beams, frames and grids; Self-strained problems; Approximate analysis of structures; Computer applications.

References:
- *Russell C. Hibbeler Structural analysis, 2014*
- *Igor A. Karnovsky, Olga Lebed, Advanced Methods of Structural Analysis, 2010*

STE214	Modern Building Materials							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	0	Semester 7th	STE116

Content:
Introduction to the technological development of material science; General classification of modern materials in the structure field; Composite materials and their applications; Fibers; Insulation; Polymers; nanomaterial.

References:
- *P. P. Raj, "Building Construction Materials and Techniques". Pearson Education India, 2016.*
- *M L Gambhir, Neha Jamwal, " Building and Construction Materials: Testing and Quality Control, (Lab Manual Series)". McGraw Hill Education (India) Private Limited, ISBN: 1259029662, 2014.*

STE322	Construction Planning and Scheduling							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	1	Semester 9th	STE224

Construction planning, importance of scheduling, scheduling techniques, program evaluation and review technique (PERT), line of balance, schedule updating, project crashing, time cost trade-off, resource scheduling, resource allocation and leveling techniques, project planning and control using commercial software.

References:
- *Kerzner, H. and H.R. Kerzner, Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons, 2017.*

- *Kalpakjian, S., K. Vijai Sekar, and S.R. Schmid, Manufacturing Engineering and technology. Pearson, 2014.*
- *Nigel J. Smith, "Engineering Project Management", 3rd Edition, Wiley-Blackwell, 2008.*

STE341	Composite Materials								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	1	Semester	9th	STE214, 130 CR

Content:
Definition of a composite material; Natural metallic and synthetic fibers; Composite materials under tension; Composite materials under shear; Fiber reinforced polymers; Non-metallic concrete reinforcement – Types of fibers and polymers – Strengthening of concrete elements using composite materials -

References:
- *Neville, A.M., "Properties of Concrete",5th ed., Longman, 2010.*

STE420	Foundations Engineering -2								Prerequisite
3 Cr	Lectures	2	Tutorials	3	Lab	0	Semester	9th	STE312

Content:
Design of deep foundations: pile construction methods, estimation of pile bearing capacity, pile load tests, design of group piles. Considerations for selection of types of foundations, design of secant piles walls and sheet piles walls for dry and wet soil.

References:
- Analysis and Design of Shallow and Deep Foundations. By: Lymon C. Reese, Shin-Tower Wang, and William M. Isenhower
- Piling Engineering. By: Ken Fleming

STE414	Metallic Bridges								Prerequisite
3 CR	Lectures	2	Tutorials	2	Lab	0	Semester	Elective	STE317

Content :
Structural system for bridges; Floor types; Design loads; Design of plate Girders, buckling considerations, fatigue effect, cross-section design, construction details; Design of composite beams; Design of box girders; Design of truss bridges.

References:
- *Unsworth, John F. "Design and Construction of Modern Steel Railway Bridges". CRC Press, 2017.*
- *Lebet, Jean-Paul, Hirt, Manfred A. "Steel Bridges - Conceptual and Structural Design of Steel and Steel-Concrete Composite Bridges". Taylor & Francis, 2013.*
- *"Egyptian code of practice for steel construction and bridges (ASD)", Code No. ECP 205-2001, Edit 2009, Ministry of Housing, Utilities & Urban Development.*

<table>
<tr><td>STE419</td><td colspan="8">Quantity Surveying and Cost Engineering</td><td>Prerequisites</td></tr>
<tr><td>3 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>2</td><td>Lab.</td><td>-</td><td>Semester</td><td>10th</td><td>-</td></tr>
<tr><td colspan="10">Content:
Importance of quantity surveying and pricing for engineering projects; Estimating principles: approximate and detailed estimates, quantity survey, labor & equipment cost, subcontractor cost, purchasing orders, indirect costs; Bidding process, strategy, documents and calculations; Unit cost estimate; Cost planning; Traditional cost control methods; Network base cost control methods; Contract forms and administration.
References:
▪ Datta, B.N., " Estimating and Costing in Civil Engineering: Theory & Practice Including Specifications and Valuation", Sangam Books Ltd, 27 revised edition, 2002.</td></tr>
</table>

<table>
<tr><td>STE441</td><td colspan="8">Design of Structural Concrete III</td><td>Prerequisite</td></tr>
<tr><td>3 Cr
Compulsory</td><td>Lectures</td><td>2</td><td>Tutorials</td><td>3</td><td>Lab</td><td>0</td><td>Semester</td><td>10th</td><td>STE217</td></tr>
<tr><td colspan="10">Content :
Design and details of Frames, Cracking limit state; Design of water tanks; Design of footings, raft foundations and pile caps.</td></tr>
<tr><td colspan="10">References:
▪ Fanella, D. A. "RC Structures: Analysis and Design". McGraw-Hill Professional Publishing, 2010.
▪ Jack C. McCormac, Russell H. Brown. "Design of Reinforced Concrete". 2013.
▪ El-Behairy, S., "Reinforced Concrete Design Handbook", Fifth edition, Cairo, 2002.</td></tr>
</table>

7.3.2.2 Elective Courses-G1

IRH311	Introduction to Water Resources Engineering								Prerequisite
3 CR	Lectures	2	Tutorials	2	Lab	1	Semester	Elective	--

Content:
Hydrologic cycle, precipitation, infiltration, evaporation and vapor-transpiration, rainfall; Runoff relationships (rational method, unit hydrograph, statistical and probability approaches), stream flow hydrographs, types of aquifers, ground-water flow equations, well hydraulics, monitoring of groundwater levels, hydraulic characteristics of aquifers, groundwater management and safe yields.

References:

- *George Tsakiris, “Water resources management”, 2019.*

IRH312	Hydraulic Engineering								Prerequisite
3 CR	Lectures	2	Tutorials	2	Lab	1	Semester	Elective	-

Content:
Open channel flow: types of flow, conservation laws of mass and energy, specific energy concept, flow resistance in channels, sketching and calculations of water surface profile for gradually varied flow, design of cross sections in open channels, momentum equation and specific force, concept, design of stilling basins downstream of gates and pipe outlets; Introduction to river engineering and sediment transport; Pumps: types and characteristics of pumps, pumps and pipeline systems; Hydraulics of groundwater: types of aquifers, groundwater flow, design of wells.

References:

- *Saeid Eslamian, " Handbook of engineering hydrology: environmental hydrology and water management”, Crc Press, 2014.*

IRH358	Design of Pipelines and Pumping Stations								Prerequisite
3 CR	Lectures	2	Tutorials	3	Lab	0	Semester	Elective	IRH312

Content:
Flow in pipes, friction losses, local losses, pump-pipeline systems, pump characteristic curves, system curves, pipe material, fittings and accessories, control valve sizing and selection of air valve design. Basic water-hammer concepts, wave propagation, elastic considerations, wave speed equation, the ΔH equation, fluid compressibility, pipe elasticity. Computation of pressure surge, unsteady flow equation, wave attenuation (method of characteristics), and boundary conditions (valves, reservoir, pipe junction, minor losses).

References:

- *M. W. Kellogg Company “Design of Piping Systems”, martiav publishing, 2011*
- *OBERT L. SANKS, “Pumping Station Design”, Second Edition, Butterworth Heinemann, 1998*

IRH411	Coastal and Harbor Engineering							Prerequisite
3 CR	Lectures	2	Tutorials	3	Lab	0	Semester Elective	90 CR

Content:
Introduction - Wave theory and characteristics - Wave forecasting - Wave transformation - Tides and water levels - Coastal sediment – Harbor planning - Harbor and port facilities - Design of breakwaters - Design of berths - Case studies.

References:

- *Tsinker, Gregory P., ed. "Port engineering: planning, construction, maintenance, andsecurity", John Wiley & Sons, 2004*

PWE342	Ground Water Control Systems							Prerequisite
3 CR	Lectures	2	Tutorials	2	Lab	-	Semester Elective	STE218

Content:
Soil Permeability; Seepage; Groundwater Control Systems; Construction Dewatering; Grout Plugs; Selection of Proper System.

References:

Tang, Y. et. Al " Groundwater Engineering", 2017.

STE342	Project Resources Management							Prerequisites
3 Cr	Lecture	٢	Tutorial	2	Lab.	0	Semester Elective	STE224

Content:
Introduction, critical project resources, material management: planning and control; Procurement and acquisition, costs; Material management information systems; Inventory analysis and inventory factors; Human resources management: manpower planning and organization; Job description and evaluation; Recruiting and training; Wage incentive systems; Labor relations; Site management: selection and layout; Preparation and evacuation; Case study.

References:

- *Hegazy, T., "Computer-Based Construction Project Management", 2002*
- *Paul Netscher, " Construction Project Management: Tips and Insights", Panet Publications, 2017.*

STE452	Information Technology in Construction							Prerequisites
3 CR	Lecture	2	Tutorial	2	Lab.	0	Semester Elective	STE224

Content:
Software systems in construction management: scheduling, cost estimating, material management, documents management and, 4D CAD systems. Introduction to Building Information Modeling. Use and design of databases and programmable spreadsheets for construction applications.

References:

- *A. Galiano Garrigos, L. Mahdjoubi, C. A. Brebbia, R. Laing, "Building Information Systems in the Construction Industry". WIT Press, 2018.*

STE418	Structural Dynamics and Vibrations								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	-	Semester	9th	-

Content:
Dynamic equilibrium; Dynamic equations of motion for single-degree-of-freedom systems; Analysis of free and forced vibration; Response to impulsive loading; Numerical evaluation of dynamic response; Generalized single-degree-of-freedom systems; Dynamic equations of motion for multi-degree-of-freedom structures; Natural vibration properties of structures; Damping in structures; Introduction to response history analysis; Vibrations of bars and beams; Computer applications.

References:

- *ggarwal P., Shrikhande, M., "Earthquake Resistant Design of Structures", Prentice Hall India Learning Private Limited; 1 edition, 2006.*
- *Anil K. Chopra, " Dynamics of structures", Prentice Hall, UUSA; 4th edition, 2012.*
- *Ray W. Clough, J. Penzien "Dynamics of structures", Computers & Structures, Inc, USA; 1st Ed., 2003.*
- *Roy and G. V. Rao, Elements of Structural Dynamics. Chichester, UK: John Wiley& Sons, Ltd, 2012.*
- *M. Paz and W. Leigh, Structural Dynamics. Boston, MA: Springer US, 2004*

7.3.2.3 Elective Courses-G2

STE412	Project Management and Evaluation							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	1	Semester	Elective	STE322,130 CR

Content:
Topics of project management and evaluation including the project planning process, resources analysis, feasibility and economic analysis, project evaluation techniques, project safety, sustainability and public policy, the use of information technology in project management, applications, and case studies.

References:

- *Kerzner, H. and H.R. Kerzner, Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons, 2017.*
- *Kalpakjian, S., K. Vijai Sekar, and S.R. Schmid, Manufacturing Engineering and technology. Pearson, 2014.*
- *Nigel J. Smith, "Engineering Project Management", 3rd Edition, Wiley-Blackwell, 2008.*
- *Knut Samset, " Project Evaluation: Making Investments Succeed", Fagbokforlaget, 2003.*

STE318	Special Concretes								Prerequisites
3 CR	Lecture	2	Tutorial	2	Lab.	1	Semester	8th	STE116, STE214

Content:
Purpose of using special concretes – types of special concrete – Design methods of special concretes – Types of lightweight concretes – Self compacting concrete tests – Radiation resistant concrete – fiber reinforced concrete and its applications – Polymer concrete – High strength concrete – Ultra high performance concrete – High temperature resistant concrete – Effect of high temperature and fire exposure on concrete properties – Technical and economic feasibility of special concretes.

References:

- *P. Kumar Mehta, Paulo J. M. Monterio, Concrete: microstructure, properties and materials, McGraw Hill, 2013.*

- *Edward G. Nawy,Concrete construction engineering handbook, Taylor & Francis Group, Second edition 2008*

STE413	Earth Retaining Structures								Prerequisite
3 Cr	Lectures	2	Tutorials	2	Lab	1	Semester	Elective	STE312

Content:
Earth pressure theories; Choice of backfill material and backfill drainage; Gravity and cantilever walls; Sheet pile walls: cantilever and anchored pipes; Free and fixed earth support methods; Braced excavations and diaphragm walls; Earth embankment dams: settlements, stability, design, and protection of upstream and downstream slopes; Methods of site investigation, sampling, and borehole logs; Computer applications.

References:

- Soil Mechanics in Engineering Practice. By: Karl Terzaghi, Ralph B. Peck and Gholamreza Mesri
- Groundwater Lowering in Construction. By: P. M. Cashman and M. Preene
- Deep excavation: Theory and practice. By: Chang-Yu Ou

STE431	Concrete Durability								Prerequisite
2 CR	Lectures	1	Tutorials	2	Lab	0	Semester	Elective	STE116, 130 CR

Content:
Pore Structure; Permeability measurements, porosity and absorptivity: Transport mechanisms; Chloride ion ingress, acid, fresh water and soft water attack; Design for durability and service life estimation.

References:

- *Neville, A.M., "Properties of Concrete", 5th ed., Longman, 2010.*

STE432	Masonry Structures								Prerequisite
3 CR	Lectures	2	Tutorials	2	Lab	-	Semester	Elective	130 CR

Content:
Masonry Materials, Development of Building Structures, Elements, Systems. Types of Masonry Construction (Un-reinforced, Reinforced, Restressed), Structural Design, Structural Requirements, Mortar – Grout – Reinforcement – Masonry Assemblages – Strength; Flexural, Axial compression, Combined axial compression and Flexure, and Shear. Beams and Lintels. Axial and out of Plane loads, Columns and Pilasters, Shear Walls, Construction Considerations and Details.

References:

- *Egyptian Committee for codes," Design and construction of masonry works", EC 204,2005.*

STE433	**Structural Mechanics and Stability**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	1	Semester	Elective	STE315

Content:
Mechanics of load-carrying members: 3D stress-strain relations, work and energy, boundary-value problems; Stresses in cable structures; Bending of thin-walled structures and curved beams; Circular and rectangular plates; Membrane stresses in shell structures; Theories of structural stability and buckling modes of bars and beams; Computer applications.

References:

- *G Simitses, "Fundamentals of structural stability"DH Hodges – 2006*
- *KD Hjelmstad "Fundamentals of structural mechanics" - 2007*

STE435	Introduction to Earthquake Engineering								Prerequisite
3 CR	Lectures	2	Tutorials	2	Lab	1	Semester	Elective	-

Content:
Basic elements of engineering seismology; Concepts of seismic hazard and seismic risk; Causes of structural failure during earthquakes; Governing equations of motion; Time-history analysis; Modal analysis; Response spectra and their use in seismic analysis of structures; Computer applications.

References:
- *Aggarwal P., Shrikhande, M., "Earthquake Resistant Design of Structures", Prentice Hall India Learning Private Limited; 1 edition, 2006.*
- *Anil K. Chopra, " Dynamics of structures", Prentice Hall, United States of America; 4th edition, 2012*
- *Ray W. Clough, J. Penzien "Dynamics of structures", Computers & Structures, Inc., USA; 1st Ed., 2003*

STE438	Membrane Concrete Structures								Prerequisite
2 CR	Lectures	1	Tutorials	2	Lab	0	Semester	Elective	BAS123, STE052, STE112

Content:
This course covers the theory and design aspects of concrete shells. This includes the following types of shells: hyperbolic paraboloid, elliptical paraboloid, conoids, circular cylindrical shells; folded plates, shells of revolution and any other additional topics.

References:

- *Maria Radwańska, Anna Stankiewicz, Adam Wosatko, Jerzy Pamin, " Plate and Shell Structures: Selected Analytical and Finite Element Solutions 1st Edition", Wiley, 2017.*

STE443	Temporary Structures and Form Work Design								Prerequisite
2 CR	Lectures	1	Tutorials	2	Lab	0	Semester	Elective	STE217

Introduction to construction applications of concrete; Economy and safety of formwork; Material properties and allowable stresses; Design loads of formwork (vertical loads, lateral pressure); Method of analysis; Forms for footings; Forms for walls and columns; Forms for beams and floor slabs; Failures of formwork; Shores and scaffolding.

References:

- *Leonhard E. B., " Construction Equipment and Methods: Planning, Innovation, Safety", Wiley, 2013.*

STE421	Sustainable materials and building physics								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	-	Semester	Elective	130 CR

Content:

The basic principles of sustainability – environmental impacts of construction materials - concepts of building physics – heat and mass transfer – recycled construction materials – natural resources saving in construction – thermal and moisture insulation –thermal properties of construction materials - thermal comfort in buildings– fire safety - optimization of material use – green materials and buildings – materials selection for sustainable construction – waste materials utilization in construction materials.

References:

- *Jamal Khatib, Sustainability of construction materials,2nd edition, Woodhead publishing 2016.*
- *Hugo S. L Hen, Building physics – heat, air and moisture, John Wiley & Sons , 2017.*

STE444	Special Concrete Structures								Prerequisite
3 CR	Lectures	2	Tutorials	2	Lab	0	Semester	Elective	STE217

Content:
Lateral loads, earthquake, and wind; Lateral load resisting systems, analysis, design, and detailing. Prestressed concrete design; Reinforced concrete bridges, loads, types and systems, analysis, design, detailing, special considerations.

References:
- *Anil K. Chopra, " Dynamics of structures", Prentice Hall, United States of America; 4th edition, 2012*
- *Antoine E. Naaman, "Prestressed Concrete Analysis and Design 3rd Edition", Techno Press 3000, 2012.*

STE445	Design of Steel Structures III								Prerequisite
3 CR	Lectures	2	Tutorials	3	Lab	0	Semester	Elective	STE317

Content :
Steel bridges; Special steel structures (Tanks, silos, and towers); Steel fabrication and erection (inspection procedures and tolerances); Shop drawings.

References:
- *Unsworth, John F. "Design and Construction of Modern Steel Railway Bridges". CRC Press, 2017.*
- *Lebet, Jean-Paul, Hirt, Manfred A. "Steel Bridges - Conceptual and Structural Design of Steel and Steel-Concrete Composite Bridges". Taylor & Francis, 2013.*
- *Alan Williams. "Steel Structures Design (Asd/Lrfd)". USA: International Code Council, 2011.*
- *"Egyptian code of practice for steel construction and bridges (ASD)", Code No. ECP 205-2001, Edit 2009, Ministry of Housing, Utilities & Urban Development.*

STE446	Advanced Concrete Technology								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	1	Semester	Elective	STE116, STE214

Content:

Hardening and microstructure of Portland cement and different types of cement – Creep and shrinkage in concrete – sustainable construction materials - Water reducing admixture in concrete (plasticizer and

superplasticizer) – Air entraining admixtures – accelerators and retarders of cement hydration – permeability reducing admixtures – Silica fume – Fly ash – Natural pozzolanic materials – Blast furnace slag – Nanomaterials – Admixtures applications - technical properties of admixtures
References: ▪ *Pierre-Claude Aitcin, Science and technology of concrete admixture, 1st Edition, Elsevier 2015.* ▪ *V. H. Dodson, Concrete admixtures, Springer Science 2013.*

STE447	Deep Excavation and Side Support							Prerequisite
3 Cr	Lectures	2	Tutorials	2	Lab	0	Semester Elective	STE218

Content:
Introduction to deep excavation – Slope stability – Construction of: sheet pile walls - Selection of proper Retaining system – Insulation.

References:

- *Soil Mechanics in Engineering Practice. By: Karl Terzaghi, Ralph B. Peck and Gholamreza Mesri*
- *Groundwater Lowering in Construction. By: P. M. Cashman and M. Preene*
- *Deep excavation: Theory and practice. By: Chang-Yu Ou*

STE451	Engineering Risk Analysis								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	0	Semester	Elective	BAS223

Content:
Applications of probability and statistics in the analysis and design of civil structures; Development of probabilistic models for risk and reliability assessment; Analysis of uncertainties; Occurrence models; Extreme value distributions; Reliability-based optimal design; Application of decision-making and statistical theories in civil and structural engineering problems.

References:

- *Nigel J. Smith, Tony Merna, Paul Jobling, " Managing Risk in Construction Projects, 3rd Edition", Wiley blackwell, 2014*

STE461	Special Topics in Structural Engineering								Prerequisites
2 CR	Lecture	1	Tutorial	2	Lab.	0	Semester	Elective	130 CR

Content:
One or more topics in the specialization of Structural Engineering that are not covered by the other program courses and/or present recent or advanced development of interest to the structural engineers in the areas of building materials, solid mechanics, analysis and design of structures.

References:

- *B Berge "The ecology of building materials"- 2009*
- *CL Dym, IH Shames "Solid mechanics"- 1973 - Springer*
- *Y Fung, P Tong, X Chen "Classical and computational solid mechanics" 2017*
- *Kelly, Pa. "Solid Mechanics Part I: An Introduction to Solid Mechanics". http://homepages.engineering.auckland.ac.nz/~pkel015/SolidMechanicsBooks/Part_I/. 2018.Edition, John Wiley & Sons, Inc,, 2007*
- *Russell C. Hibbeler Structural analysis, 2014*

<table>
<tr><td>STE465</td><td colspan="8">Inspection and Maintenance of Structures</td><td>Prerequisites</td></tr>
<tr><td>3 CR</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>2</td><td>Lab.</td><td>0</td><td>Semester</td><td>Elective</td><td>STE217</td></tr>
<tr><td colspan="10">Content:
Introduction - Causes of Deterioration and needs for Repair - Methodology and strategy of repair - Symptoms, Diagnosis, Treatment - Strength assessment of concrete structures - Repair: materials, methods, strengthening - Brick walls: inspection and repair.
References:
▪ Bakhoum, M.M., and Juan A. Sobrino. "Case Studies of Rehabilitation, Repair, Retrofitting, and Strengthening of Structures". IABSE, 2010</td></tr>
</table>

<table>
<tr><td>STE437</td><td colspan="8">Seismic Design of Structures</td><td>Prerequisite</td></tr>
<tr><td>3 Cr Elective</td><td>Lectures</td><td>2</td><td>Tutorials</td><td>2</td><td>Lab</td><td>0</td><td>Semester</td><td>10th</td><td>STE418</td></tr>
<tr><td colspan="10">Content:
Conceptual design of structures to resist earthquakes; Ductility concepts and capacity design; Structural configurations and irregularities; Lateral force resisting systems; Methods of analysis: equivalent static forces, response spectra and code design procedures; Design of steel and RC structures; Computer applications.</td></tr>
<tr><td colspan="10">References:
▪ Aggarwal P., Shrikhande, M., "Earthquake Resistant Design of Structures", Prentice Hall India Learning Private Limited; 1 edition, 2006.
▪ Anil K. Chopra, " Dynamics of structures", Prentice Hall, United States of America; 4th edition, 2012
▪ Ray W. Clough, J. Penzien "Dynamics of structures", Computers & Structures, Inc., USA; 1st Ed., 2003</td></tr>
</table>

<table>
<tr><td>STE466</td><td colspan="8">Design and Construction of Water and Wastewater Structures</td><td>Prerequisite</td></tr>
<tr><td>3 Cr</td><td>Lectures</td><td>2</td><td>Tutorials</td><td>3</td><td>Lab</td><td>-</td><td>Semester</td><td>Elective</td><td>STE217</td></tr>
<tr><td colspan="10">Content:
Cracking limits, Design of watertight sections, Water pipe sections, Design of water structures; underground circular and rectangular tanks and swimming pools, elevated circular and rectangular deep and shallow tanks, Detailed design and construction of reinforced concrete water and wastewater treatment.</td></tr>
<tr><td colspan="10">References:
• Soliman M., “ high and ground water tanks”,1992.</td></tr>
</table>

7.3.2.4 Training and projects

<table>
<tr><td>STE281</td><td colspan="8">Training-1</td><td>Prerequisites</td></tr>
<tr><td>0 CR</td><td>Lecture</td><td>0</td><td>Tutorial</td><td>0</td><td>Lab.</td><td>0</td><td>Semester</td><td>6th</td><td>85 CR</td></tr>
<tr><td colspan="10">Content:
Training on industrial establishments relevant to the program. Training lasts for minimum total of 60 hours, during a period about three weeks. The program training advisor schedules at least one follows up visit to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an</td></tr>
</table>

external examiner appointed from industry or other colleges of engineering. The course is graded as Pass/Fail grade- system.

STE381	Training-2								Prerequisites
0 CR	Lecture	0	Tutorial	0	Lab.	0	Semester	8th	STE281

Content:

Training on industrial establishments relevant to the program. Training lasts for minimum total of 60 hours, during a period of about three weeks. The program training advisor schedules at least two follow-up visits to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. The course is graded as Pass/Fail grade- system.

STE481	Graduation Project-1								Prerequisites
3 Cr	Lecture	1	Tutorial	0	Lab.	6	Semester	9th	130 credits

Content:

Students undertake a major project as part of the program. The aim of the project is to provide the students, who work in groups, with an opportunity to implement appropriate concepts and techniques to a design. Students are required to select and research the expected project to be designed and implemented in the following course Graduation Project-2. The student should give an oral presentation to be approved. *The course is graded as Pass/Fail grade-system*.

STE482	Graduation Project-2								Prerequisites
3 Cr	Lecture	1	Tutorial	0	Lab.	6	Semester	10th	STE481

Content:

All students undertake a major project as part of the program. The aim of the project is to provide the students, who work in groups, with an opportunity to implement the appropriate concepts and techniques to a design. A dissertation on the project is submitted on which the student is examined orally.

Chapter Twelve:

A B. Sc. Program in Materials Engineering for Advanced Technology with Credit Hours System

1. INTRODUCTION

The development of many technologies that make mankind existence so comfortable has been intimately associated with the accessibility of suitable materials. An advancement in the understanding of a material type is often the forerunner to the stepwise progression of a technology. Therefore, engineering new materials with advanced properties represent the cornerstone of the new technological drive of this century. Electronic, polymers, Biomaterials, nanocomposites, and smart materials are examples of new material developments where the technological applications and impact on society are enormous. Moreover, research, development and training in this area is strong worldwide since it forms the basis for future economic development.

The Materials Engineering for Advanced Technology (MET) program provides academic excellence in advanced material sciences and technologies through an interdisciplinary education that covers materials from various perspectives. The MET program will provides unique and high impact opportunity to its graduates to be involved in many Hi-Tech industries. This proposed BSc degree program is designed to meet the needs for graduates with specialist skills in materials science and engineering to source this emerging industry.

The MET program shares a common foundation with all engineering programs delivered at Faculty of Engineering - Mansoura University during the first year. Such a foundation guarantees that all students master basic sciences. After getting a solid foundation in chemistry, physics and mathematics, the students start to explore advanced techniques for material modeling, synthesis and characterization. Additionally, students will focus on studying advanced types of materials and the application of these materials in the modern industries. These concentrations are supported strongly with advanced research facilities. Students will gain hands on experience in the development and characterization of novel materials along with applications that have potential social, environmental and economic benefits. The program is preparing students for careers in industry, education and research, with the capability to compete and excel in the ever-expanding world of materials science and engineering.

2. Basic Information of Materials Engineering for Advanced Technology (MET) Program

2.1 MET Program Vision

Achieve leadership in the field of advanced materials engineering and gain the confidence of the national, regional and international communities in the program graduates.

2.2 MET Program Mission

Preparing distinguished engineering cadres and competent pioneers in the field of materials engineering, able to compete in the national, regional and international labor market and conduct scientific research to serve the community and develop the environment.

2.3 MET Program Objectives

The Materials Engineering for Advanced Technology (MET) Program aims at providing its graduates with:

1) In-depth knowledge: Acquire the necessary in-depth knowledge of the requirements of mathematics, physics and natural sciences for the solution of engineering problems.
2) Broad specialized science: Acquisition of specialized science for materials engineering, including knowledge of various contemporary engineering issues related to disciplines.
3) Professional: Use practical and managerial skills to design systems, conduct experiments, analyze data, manage projects, identify and solve engineering problems necessary for productive occupations in the public and private sectors, or to pursue higher education.
4) Professionalism: Identify communication, presentation and language skills to ensure effective communication, demonstrate professional and ethical responsibilities, and engage in lifelong self-learning so that graduates are prepared for a modern and complex work environment
5) Creativity: Providing an environment that enables students to pursue their goals in an innovative, rigorous, developed and supportive program.
6) Leadership & teamwork skills: Acquire the skills necessary for effectively working as an individual and as a team member.
7) Lifelong learning: Acquire the skills important for scientific thinking and continuous learning as well as the ability to contribute in trends for future developments in technology that support material engineering careers.

2.4. Program Graduate Attribute

The Materials Engineering for Advanced Technology (MET) academic program is keen to graduate distinguished and qualified engineers for the labor market. The program graduate will be able to:

1. Apply knowledge of mathematics, science, engineering and/or technical topics to areas relevant to material engineering discipline.

2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.
3. Develop, design and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions.
4. Formulate or design a system, process, procedure or material to meet desired needs.
5. Recognize his/her role in promoting the engineering field and contribute in the development of the profession and the community.
6. Use the techniques, skills and modern engineering tools necessary for engineering practice.
7. Recognize the ability to understand ethical and professional responsibilities and the impact of technical and/or scientific solutions in global, economic, environmental, and societal contexts.
8. Use the skills and techniques necessary for modern materials science and engineering discipline.
9. Deal with academic/professional challenges in a critical and creative manner.
10. Communicate and work effectively within multi-disciplinary teams.
11. Demonstrate leadership qualities, business administration and entrepreneurial skills.
12. Assume full responsibility for own learning and self-development, engage in life-long learning and acquire the knowledge of contemporary issues.

2.5 Graduate Competencies in Accordance with the National Academic Standards

According to NARS 2018, a graduate must be able to:

A1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.

A2. Develop and conduct appropriate experimentation and/or simulation, analyse and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

A3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

A4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

A5. Practice research techniques and methods of investigation as an inherent part of learning.

A6. Plan, supervise and monitor implementation of engineering projects.

A7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams.

A8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

A9. Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10. Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.

In addition to the competencies of most engineering programs, the engineering MET program has some special competencies, which are as follows:

B1. Design, analyze and measure the performance of materials and evaluating their suitability for a specific application

B2. Engage in the recent technological changes and emerging fields relevant to materials engineering to respond to the challenging role and responsibilities of a professional materials engineer.

B3. Apply numerical modeling methods and/or computational techniques appropriate to materials engineering.

B4. Adopt suitable national and international standards and codes to: design, operate, inspect and maintain materials engineering systems.

C1. Designing and simulating materials behavior for different applications

3. Materials Engineering for Advanced Technology (MET) Program Plan Description

The study plan of the Materials Engineering for Advanced Technology (MET) Program at the Faculty of Engineering, Mansoura University involves different requirements for the university, the faculty, and the department, as well as courses which satisfy these requirements. Also, the study plan includes the credit units for all courses and the distribution of these credit units on the five studying levels (Years)..

To prepare the student for the abovementioned targeted educational objectives, a set of program outcomes, that describes what students are expected to know and able to do by the time of graduation, has been adopted. The student must successfully pass a number of courses totaling 160 credit hours in order to obtain a bachelor's degree in Materials Engineering for Advanced Technology based on credit hours systems (CHS) from the Faculty of Engineering, Mansoura University.

3.1 Courses Coding System

Figure (1) presents the courses coding system according to reference framework NARS 2018, where the course code is composed of three letters and three digits. The letters indicate the course specialization department. The first digit indicates the year 0, 1, 2, 3, or 4. The second digit between 1 and 9 displays the discipline in the major. The third digit is the course sequence in each discipline. The following points must be considered:-

1. The letters indicate the majors in which the degree is given but some of these represent university requirements, college requirements, or specialized courses.
2. Course descriptions refer to the semester in which this course is usually given, but these dates are subject to change, as not all courses are taught every semester, and before the start of each semester, college affairs show the tables of courses that will be taught in this semester, their teaching times and those in charge of teaching.

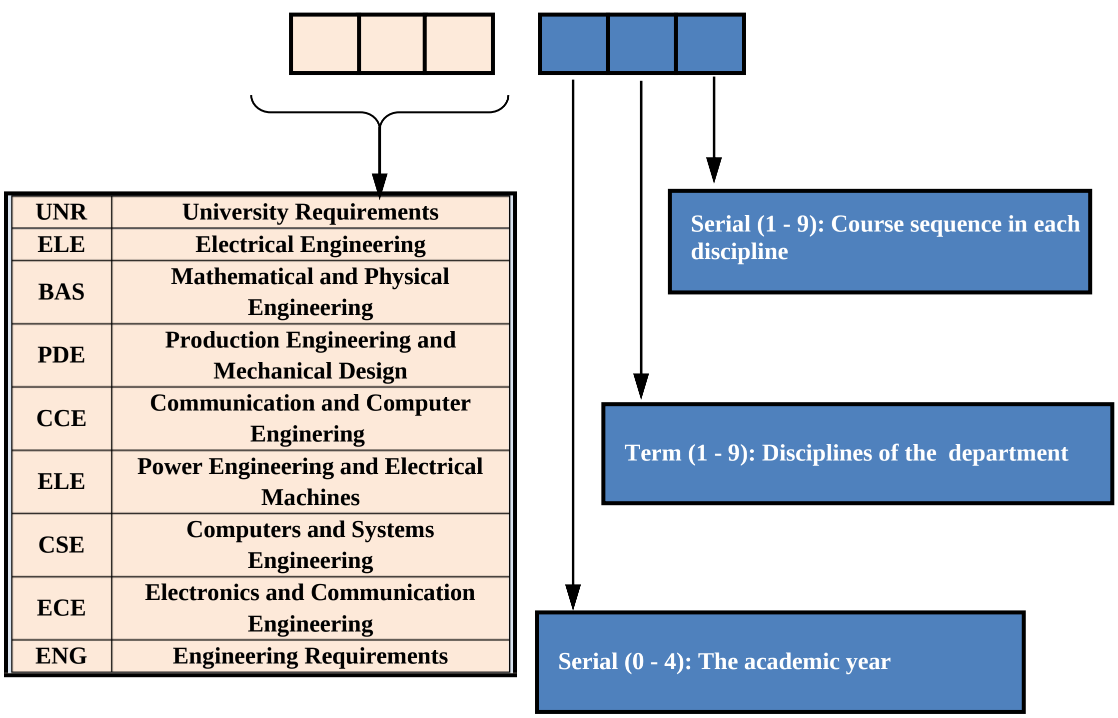

Figure (1): Courses coding system

4.1 University Requirements

The main purpose of university education is not only to prepare students for successful careers but also to provide them with the knowledge and skills necessary to develop a rational and successful personal identity. In addition, Mansoura University assists students in gaining an appreciation of the natural and cultural environments in which they live and their roles in society and community services. The university's requirements for bachelor's programs consist of first: 11 credit hours (6.8% of the total 162 credit hours), which are met by completing six (6) mandatory courses as listed in Table (1), Second: 2 credit hours (1.2% of the total 162 credit hours), which are met by completing one (1) elective course as listed in Table (1*)

Table (1): The University Requirements (6 mandatory courses)
(11 Credit Hours, 6.8% of the total 162 Credit Hours)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	Semester Works	Lab	Final Term
UNR061	English (1)	2	5	20	30	--	50
UNR062	English (2)	2	5	20	30	--	50
UNR171	History of Engineering and Technology	1	2	20	30	--	50
UNR281	Law and Human Rights	2	4	20	30	--	50
UNR461	Ethics and Morals of The Profession	2	4	20	30	--	50
UNR471	Marketing	2	4	20	30	--	50
Total		**13**	**29**				

Table (1*): The University Requirements (one elective courses)
(2 Credit Hours, 1.2% of the total 162 Credit Hours)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	Semester Works	Lab	Final Term
UNR241	Communication and presentation skills	2	5	20	30	--	50
UNR251	Research and analysis skills	2	5	20	30	--	50
UNR261	negotiation skills	2	5	20	30	--	50

4.2 College Requirements

The college requirements provide students with the knowledge and skills necessary to develop a successful engineer. The core of the college is applied to all credit hour programs. The standard requirement of the core courses in the college includes basic knowledge courses for all engineering graduates such as mathematics, physics, mechanics, engineering drawing, design, manufacturing, and chemistry. The college requirements for the Materials Engineering for Advanced Technology (MET) Program for the undergraduate degree consist of 47 credit hours (29.01% of the total 162 credit hours), which are completed by completing seventeen (17) mandatory courses, as listed in Table 2.

Table (2): The College Requirements

(47 Credit Hours, 29.01% of the total 162 Credit Hours)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	Semester Works	Lab	Final Term
BAS011	Mathematics (1)	3	8	20	30	--	50
BAS012	Mathematics (2)	3	8	20	30	--	50
BAS113	Mathematics (3)	3	8	20	30	--	50
BAS114	Mathematics (4)	3	8	20	30	--	50
BAS215	Mathematics (5)	3	8	20	30	--	50
BAS021	Mechanics (1)	3	8	20	30	--	50
BAS022	Mechanics (2)	3	8	20	30	--	50
BAS031	Physics (1)	3	9	20	20	10	50
BAS032	Physics (2)	3	9	20	20	10	50
BAS041	Engineering Chemistry	3	9	20	20	10	50
BAS115	Statistics and Probabilty Theory	2	6	20	30	--	50
PDE051	Production Engineering	3	8	20	20	10	50
PDE052	Engineering Drawing	3	10	20	30	--	50
PDE183	Monitoring Systems and Quality Control	3	8	20	30	--	50
ENG111	Technical Reports Writing	2	6	20	30	--	50
ENG311	Enviromental Impact of Projects	2	6	20	30	--	50
ENG412	Project Management	2	6	20	30	--	50
Total		**47**	**133**				

4.3 Program Requirements (Core Courses)

The Program Requirements for the Materials Engineering for Advanced Technology (MET) Program for the undergraduate degree consist of 102 credit hours (62.96% of the total 162 credit hours), which are completed by completing (24) mandatory courses equal to 72 credit hours and 8 elective cources equal to 24 credit hours, in addition to both field training and graduation projects equal to 6 credit hours as listed in the following tables.

Tables (3), (4) and (5) show the courses distribution according to the specializations in MET which include:

- Compulsory Courses
- Elective Courses
- Field Training and Graduation Projects

Table 3: Compulsory Courses for Specialization Requirements

(72 Credit Hours, 44.4% of the total 162 Credit Hours)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	Semester Works	Lab	Final Term
CSE042	Introduction to Computer Systems	3	8	20	30	--	50
MET151	Materials Science (1)	3	8	20	30	--	50
PDE181	Strength of Materials	3	8	20	30	--	50
MPE171	Thermodynamics of Materials	3	8	20	30	--	50
MET152	Materials Science (2)	3	9	20	20	10	50
PDE182	Fundamental of Materials Processing	3	9	20	20	10	50
MET153	Polymeric Engineering Materials	3	9	20	20	10	50
MET251	Introduction to Composite Materials	3	9	20	30	--	50
MET252	Stress Analysis	3	9	20	20	10	50
MET253	Powder Metallurgy and Processing	3	8	20	30	--	50
MPE271	Transport Phenomena in Materials Science	3	8	20	30	--	50
MET254	Electrochemistry and Corrosion	3	9	20	20	10	50
MET255	Ceramic and Glasses	3	9	20	20	10	50
MET256	Material Selection	3	8	20	30	--	50
MET257	Biomaterials	3	9	20	30	--	50
MET351	Nanomaterial for Engineers	3	9	20	20	10	50
MET352	Semiconductor Materials	3	8	20	30	--	50
MET353	Smart Materials	3	9	20	30	--	50
MET356	Materials Characterization	3	9	20	20	10	50
MET357	Thin Film Technology	3	9	20	20	10	50
MET358	Material for Energy Applications	3	9	20	20	10	50
MET452	Micro Electro-Mechanical Systems (MEMS)	3	9	20	20	10	50
MET454	Recycling and Processing of Engineering Materials	3	9	20	20	10	50
MET455	Materials Advanced Manfacturing Processes	3	9	20	20	10	50
Total		**72**	**208**				

Table 4: Elective Courses for Specialization Requirements

In Materials Engineering for Advanced Technology (MET) Program

(24 Credit Hours 14.81% of the total 162 Credit Hours)

Level	Code	Course Name	Credit	Total SWL	Marks Distribution			
					Mid Term	Semester Works	Lab	Final Term
300	MET391	Introduction of Advanced	3	8	20	30	--	50
	MET392	Advanced Physical Metallurgy	3	8	20	30	--	50
	MET393	Heat Treatment	3	8	20	30	--	50
	MET394	Continuum Mechanics	3	8	20	30	--	50
	MET395	Non-destructive Evaluation of Structures and Materials	3	8	20	30	--	50
	MET396	Design of Experiments	3	8	20	30	--	50
	MET397	High Temperature Materials	3	8	20	30	--	50
	MET398	Modeling and Simulation of Materials Processing	3	8	20	30	--	50
	PDE391	Machine Design	3	8	20	30	--	50
	PDE392	Mechanisms and Robot Kinematics	3	8	20	30	--	50
400	MET491	Functionally Graded Materials	3	8	20	30	--	50
	MET492	Porous Materials	3	8	20	30	--	50
	MET493	Introduction to Nano-mechanics of Materials	3	8	20	30	--	50
	PDE491	Fracture and Fatigue of Engineering Materials	3	8	20	30	--	50
	PDE492	Additive Manufacturing	3	8	20	30	--	50
	MET494	Electrical Energy Storage	3	8	20	30	--	50
	MET495	Dielectric Materials Science	3	8	20	30	--	50
	MET496	Semiconductor Optoelectronics	3	8	20	30	--	50
	MET497	Introduction to Displays	3	8	20	30	--	50
	MET498	Solar photovoltaic	3	8	20	30	--	50
	MET499	Electron Microscopy and	3	8	20	30	--	50
	PDE493	Tribology	3	8	20	30	--	50

Table 5: Field training and graduation projects

(6 Credit Hours, 3.70% of the total 162)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	Semester Works	Lab	Final Term
MET258	Training (1)	0	3	--	--	--	--
MET359	Training (2)	0	3	--	--	--	--
MET451	Graduation Project (1)	3	8		50	--	50
MET453	Graduation Project (2)	3	9	--	50	--	50
Total		**6**	**23**				

5. MET Program Curriculum

The curriculum presents the credit units, weekly contact hours either for lectures, tutorial and practical work for all courses. The curriculum also presents SWL and Marks distribution in addition to the senior project and the summer training according to **NARS 2018**. It is clear from the table that the total contact hours (lectures + tutorial+ practical) in addition to the hours of self-learning range from 40 to 50 hours per week for all levels with an average of 46.5 hours per week.

LEVEL 000

First Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
BAS011	Mathematics (1)	3	2	2	-	4	8	20	30	-	50	100	-
BAS021	Mechanics (1)	3	2	2	-	4	8	20	30	-	50	100	-
BAS031	Physics (1)	3	2	1	1.5	4.5	9	20	20	10	50	100	-
BAS041	Engineering Chemistry	3	2	1	1.5	4.5	9	20	20	10	50	100	-
PDE052	Engineering Drawing	3	2	2	-	6	10	20	30	-	50	100	-
UNR061	English (1)	2	1	2	-	2	5	20	30	-	50	100	-
Total		17	11	10	3	25	49					600	-
Total Contact hours = 24 hrs/week, Total SWL = 49 hrs/week													

Second Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
BAS012	Mathematics (2)	3	2	2	-	4	8	20	30	-	50	100	BAS011
BAS022	Mechanics (2)	3	2	2	-	4	8	20	30	-	50	100	BAS021
BAS032	Physics (2)	3	2	1	1.5	4.5	9	20	20	10	50	100	-
CSE042	Introduction to Computer Systems	3	2	1	1.5	4.5	9	20	20	10	50	100	-
PDE051	Production Engineering	3	2	-	3	3	8	20	20	10	50	100	-
UNR062	English (2)	2	1	2	-	2	5	20	30	-	50	100	UNR061
Total		17	11	8	6	22	47					600	
Total Contact hours = 25 hrs/week, Total SWL = 47 hrs/week													

LEVEL 100

Third Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
BAS113	Mathematics (3)	3	2	2	-	4	8	20	30	-	50	100	BAS012
UNR171	History of Engineering and Technology	1	1	-	-	1	2	20	30	-	50	100	-
MET151	Materials Science (1)	3	2	2	-	4	8	20	30	-	50	100	BAS031
PDE181	Strength of Materials	3	2	2	-	4	8	20	30	-	50	100	BAS021 BAS031
ENG111	Technical Reports Writing	2	1	2	-	3	6	20	30	-	50	100	UNR061
MPE171	Thermodynamics of Materials	3	2	2	-	4	8	20	30	-	50	100	BAS031
Total		15	10	10	-	20	40					600	
Total Contact hours = 20 hrs/week, Total SWL = 40 hrs/week													

Fourth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
BAS114	Mathematics (4)	3	2	2	-	4	8	20	30	-	50	100	BAS113
MET152	Materials Science (2)	3	2	1	1.5	4.5	9	20	20	10	50	100	MET151
BAS115	Statistics and Probability Theory	2	1	2	-	2	5	20	30	-	50	100	BAS012
PDE182	Fundamental of Materials Processing	3	2	1	1.5	4.5	9	20	20	10	50	100	PDE051
MET153	Polymeric Engineering Materials	3	2	2	1	4	9	20	20	10	50	100	-
PDE183	Monitoring Systems and Quality Control	3	2	2	-	4	8	20	30	-	50	100	-
Total		17	11	10	4	23	48					600	
Total Contact hours = 25 hrs/week, Total SWL = 48 hrs/week													

LEVEL 200

Fifth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
BAS215	Mathematics (5)	3	2	2	-	5	9	20	30	-	50	100	BAS114
MET251	Introduction to Composite Materials	3	2	1	2	4	9	20	30	-	50	100	-
MET252	Stress Analysis	3	2	-	3	4	9	20	20	10	50	100	PDE181
MET253	Powder Metallurgy and Processing	3	2	2	-	4	8	20	30	-	50	100	MET152
MPE271	Transport Phenomena in Materials Science	3	2	2	-	4	8	20	30	-	50	100	-
Elective Table (1*)	Elective course (1)	2	1	2	-	3	6	20	30	-	50	100	-
Total		17	11	9	5	24	49					600	
Total Contact hours = 25 hrs/week, Total SWL = 49 hrs/week													

Sixth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
MET254	Electrochemistry and Corrosion	3	2	1	1.5	4.5	9	20	20	10	50	100	-
MET255	Ceramic and Glasses	3	2	1	1.5	4.5	9	20	20	10	50	100	-
MET256	Material Selection	3	2	2	-	4	8	20	30	-	50	100	MET152
MET257	Biomaterials	3	2	2	-	5	9	20	30	-	50	100	-
UNR281	Law and Human Rights	2	2	-	-	2	4	20	30	-	50	100	-
MET2٥٨	Training (1)	0	-	-	-	-	3	-	-	-	-	-	95 Cr
Total		14	10	6	3	20	42					500	
Total Contact hours = 19 hrs/week, Total SWL = 42 hrs/week													

LEVEL 300

Seventh Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
MET351	Nanomaterial for Engineers	3	2	-	2	5	9	20	20	10	50	100	-
MET352	Semiconductor Materials	3	2	2	-	4	8	20	30	-	50	100	-
MET353	Smart Materials	3	2	2	-	5	9	20	30	-	50	100	-
Elective Table 4	Elective course (2)	3	2	2	-	4	8	20	30	-	50	100	-
Elective Table 4	Elective course (3)	3	2	-	2	4	8	20	20	10	50	100	-
ENG311	Enviromental Impact of Projects	2	1	2	-	3	6	20	30	-	50	100	-
Total		17	11	8	4	25	48					600	
Total Contact hours = 23 hrs/week, Total SWL = 48 hrs/week													

Eighth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
MET356	Materials Characterization	3	2	1	1.5	4.5	9	20	20	10	50	100	-
Elective Table 4	Elective course (4)	3	2	2	-	4	8	20	30	-	50	100	Course Specs.
	Elective course (5)	3	2	2	-	4	8	20	30	-	50	100	
MET357	Thin Film Technology	3	2	1	1.5	4.5	9	20	20	10	50	100	-
MET358	Material for Energy Applications	3	2	2	-	5	9	20	20	10	50	100	-
MET3٠٩	Training (2)	0	-	-	-	-	3	-	-	-	-	-	MET258
Total		15	10	8	3	22	46					500	
Total Contact hours = 21 hrs/week, Total SWL = 46 hrs/week													

LEVEL 400

Ninth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
MET451	Graduation Project (1)	3	1	2	3	6	12	-	50	-	50	100	125 Cr
Elective Table 4	Elective course (6)	3	2	2	-	4	8	20	30	-	50	100	Course Specs.
	Elective course (7)	3	2	2	-	4	8	20	30	-	50	100	
MET452	Micro Electro-Mechanical Systems (MEMS)	3	2	2	-	5	9	20	20	10	50	100	
UNR461	Ethics and Morals of The Profession	2	2	-	-	4	6	20	30	-	50	100	-
ENG412	Project Management	2	1	2	-	2	5	20	30	-	50	100	-
Total		16	10	10	3	25	48					600	
Total Contact hours = 23 hrs/week, Total SWL = 48 hrs/week													

Tenth Semester

Code	Course Name	Hours/Week						Marks Distribution					Prerequisites
		Credit	Lecture	Tutorial	Lab.	Free work	SWL	Mid Term	Semester Work	Lab	Final Term	Total	
MET453	Graduation Project (2)	3	1	-	6	3	10	-	50	-	50	100	MET451
Elective Table 4	Elective course (8)	3	2	2	-	4	8	20	30	-	50	100	Course Specs.
	Elective course (9)	3	2	2	-	4	8	20	30	-	50	100	
MET454	Recycling and Processing of Engineering Materials	3	2	1	1.5	4.5	9	20	20	10	50	100	-
MET455	Materials Advanced Manfacturing Processes	3	2	1	1.5	4.5	9	20	20	10	50	100	-
UNR471	Marketing	2	2	-	-	4	6	20	30	-	50	100	-
Total		17	11	6	9	24	50					600	
Total Contact hours = 26 hrs/week, Total SWL = 50 hrs/week													

#	Program	NC	Credits and SWL			Total Contact Hours				4 Requirements %				BS %	EC%
			CH	ECTS	SWL	Lec	Tut	Lab	TT	UR	FR	DR	PR		
1	Materials Engineering for Advanced Technology (MET)	58	162	29.89	747.2	106	85	40	231	8.02	29.01	37.4	25.4	19.75	16.05

Figure (2) Courses Dependency for MET Program

Level	Course Name	MET Graduate Competencies According to NARS 2018														
		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	C1
000	Mathematics (1)	√														
	Mechanics (1)	√														
	Physics (1)	√	√													
	Engineering Chemistry	√	√													
	Engineering Drawing	√		√												
	English (1)								√							
	Mathematics (2)	√														
	Mechanics (2)	√														
	Physics (2)	√	√													
	Introduction to Computer Systems	√				√										
	Production Engineering	√	√		√											
	English (2)								√							
100	Mathematics (3)	√														
	History of Engineering and Technology				√	√			√		√					
	Materials Science (1)	√	√									√		√		
	Strength of Materials	√	√	√								√		√		
	Technical Report Writing					√			√							
	Thermodynamics of Materials	√	√									√				
	Mathematics (4)	√														
	Materials Science (2)	√	√	√								√	√	√		
	Probability Theory and Statics	√	√				√									
	Fundamental of Materials Processing	√	√		√			√						√		
	Polymeric Engineering Materials	√	√	√				√				√		√		
	Monitoring Systems and Quality Control	√	√	√	√		√		√			√			√	
200	Mathematics (5)	√	√													
	Introduction to Composite Materials	√	√	√		√		√	√			√		√		
	Stress Analysis	√	√			√				√	√	√		√		
	Powder Metallurgy and Processing	√	√	√	√							√	√			
	Transport Phenomena in Materials Science	√	√	√						√	√	√				
	Elective course (1)						√	√	√	√	√					
	Electrochemistry and Corrosion	√	√	√	√						√			√		
	Ceramic and Glasses	√	√	√		√					√			√		
	Material Selection	√	√	√	√	√					√	√		√	√	
	Biomaterials	√	√	√	√	√					√	√		√	√	
	Law and Human Rights	√				√		√	√		√					
	Training (1)		√	√	√	√	√	√	√	√	√	√	√	√	√	√
300	Nanomaterial for Engineers	√	√	√	√	√						√		√	√	
	Semiconductor	√	√	√		√	√			√	√	√	√	√	√	

	Materials															
	Smart Materials	√	√	√		√	√			√	√	√	√	√	√	
	Elective course (2)	√	√		√	√						√	√	√	√	√
	Elective course (3)	√	√		√	√						√	√	√	√	√
	Modeling and Simulation of Materials Processing	√	√	√				√	√	√	√	√		√	√	
	Environmental Impact of Projects	√	√	√			√					√			√	
	Materials Characterization	√	√		√	√	√	√	√				√			
	Elective course (4)	√	√		√	√						√	√	√	√	√
	Elective course (5)	√	√		√	√						√	√	√	√	√
	Thin Film Technology	√	√	√	√	√						√		√		
	Material for Energy Applications	√	√	√		√				√		√	√	√	√	
	Training (2)		√	√	√	√	√	√	√	√	√	√	√	√	√	√
400	Graduation Project (1)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Elective course (6)	√	√		√	√						√	√	√	√	√
	Elective course (7)	√	√		√	√						√	√	√	√	√
	Micro Electro-Mechanical Systems (MEMS)	√	√	√		√				√		√	√	√	√	
	Ethics and Morals of the Profession	√			√	√		√	√	√	√					
	Project Management	√	√	√	√	√	√	√	√	√						
	Graduation Project (2)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Elective course (8)	√	√		√	√						√	√	√	√	√
	Elective course (9)	√	√		√	√						√	√	√	√	√
	Recycling and Processing of Engineering Materials	√	√	√		√	√	√	√			√	√		√	
	Materials Advanced Manufacturing Processes	√	√	√		√	√	√	√			√	√		√	
	Marketing	√	√		√	√	√	√	√	√	√					

7. MET Program Courses Syllabi
7.1. University Requirements:

UNR061	English (1)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	1st	---
Main skills of the English language - listening to short and long conversations - reading scientific passages - writing reports, summaries, and scientific articles - speaking and presenting new ideas									
References: ▪ *Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011*									

UNR062	English (2)								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	2nd	UNR061
Analysis and interpretation of engineering issues - summarizing engineering issues - preparation for language tests.									
References: ▪ *Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011*									

UNR171	History of Engineering and Technology								Prerequisites
1 Cr	Lecture	1	Tutorial	--	Lab.	--	Semester	3rd	---
Engineering history: Art, Science, Engineering and technology - Role of engineering and technology in development and establishment of civilizations -Technology and environment - Examples on development of engineering activity.									
References: ▪ *Roger S. Kirby, Engineering in History, Dover Publications Inc. New York, United States, 1990, ISBN10 0486264122*									

UNR241	Communication and Presentation Skills								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	5th	---
Communication skills - Presentation planning and preparation - Delivery skills such as eye contact, voice control, gestures, body language and appearance - Presenter's characteristics - Using visuals - Presentation structure - Elevator Pitch									
References: ▪ *Joan van Emden, Lucinda Becker, Presentation Skills for Students, 3rd Edition, Red Globe Press, 2016* ▪ *M. Wa Mutua, S. Mwaniki, P. Kyalo, B. Sugut, Communication Skills: A University Book, Succex Publishers, 2016* ▪ *Ian Tuhovsky, Wendell Wadsworth, Communication Skills Training, Ian Tuhovsky, 2015* ▪ *Tabitha Wambui, Alice W. Hibui, Elizaeth Gathuthi, "Communication skills " Vol.1, Students' coursebook, LAP LAMBERT Academic Publishing, 2012*									

UNR251	Research and analysis skills								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	5th	---
Defining characteristics of thinking (scientific research) - Report writing skills. - Data collection skills - Skills of analyzing data from various sources - Finding information via the Internet - Critical thinking skills - Planning and organizing skills - Interviewing skills - Critical analysis skills.									
References: ▪ *Bernard C. Beins, Maureen A. McCarthy,* Research Methods and Statistics, Pearson Education *,2012*									

<table>
<tr><td>UNR261</td><td colspan="8">Negotiation skills</td><td>Prerequisites</td></tr>
<tr><td>2 Cr</td><td>Lecture</td><td>1</td><td>Tutorial</td><td>2</td><td>Lab.</td><td>--</td><td>Semester</td><td>5th</td><td>---</td></tr>
<tr><td colspan="10">Introduction to negotiation management - negotiation principles - negotiation approaches - negotiating team - conflict resolution skills - preparation for negotiations - negotiation strategies - negotiation tactics - qualities of a good negotiator</td></tr>
<tr><td colspan="10"><u>References:</u>
▪ Sebenius, J. K., 2004. Mapping Backward: Negotiating in the Right Sequence., Harvard Business School Publication Corp., USA</td></tr>
</table>

<table>
<tr><td>UNR281</td><td colspan="8">Law and Human Rights</td><td>Prerequisites</td></tr>
<tr><td>2 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>--</td><td>Lab.</td><td>--</td><td>Semester</td><td>6th</td><td>---</td></tr>
<tr><td colspan="10">Systems and laws of institutions - Introduction to Accounting - Labor legislation and laws governing engineering professions - Industrial security legislation and environment - Historical philosophical origins of human rights - international sources of human rights - national sources of human rights - global bodies based on the protection of human rights.</td></tr>
</table>

<table>
<tr><td>UNR461</td><td colspan="8">Ethics and Morals of The Profession</td><td>Prerequisites</td></tr>
<tr><td>2 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>--</td><td>Lab.</td><td>--</td><td>Semester</td><td>9th</td><td>---</td></tr>
<tr><td colspan="10">General principles of professional ethics - Commitments to society - Responsibilities of the engineer - Detection of violations - Behavior - Case studies and general issues.</td></tr>
<tr><td colspan="10"><u>References:</u>
▪ Lizabeth A. Stephan, David R. Bowman, William J. Park, Benjamin L. Sill, Matthew W. Ohland, "Thinking like an engineer", Published by Pearson 2018.
▪ Harris, C. E., Jr., Pritchard, M. S., & Rabins, M. J. Engineering Ethics. Second edition. Belmont, CA: Wadsworth, 2000</td></tr>
</table>

<table>
<tr><td>UNR471</td><td colspan="8">Marketing</td><td>Prerequisites</td></tr>
<tr><td>2 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>--</td><td>Lab.</td><td>--</td><td>Semester</td><td>10th</td><td>---</td></tr>
<tr><td colspan="10">Principles of products marketing - Marketing research - Customers buying behavior - Marketing mix - Plotting marketing strategy - Building marketing plan - Pinpointing the target market - Marketing on the world wide web - Branding strategy - Developing new products - Advertising and promotions - Costing and pricing strategies - Case studies on products marketing</td></tr>
<tr><td colspan="10"><u>References:</u>
▪ Principles of Marketing, University of Minnesota Libraries Publishing, 2015, ISBN 13: 9781946135193</td></tr>
</table>

4.2. Faculty Requirements:

BAS011	Mathematics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Calculus: Function (definition - theorems) - Basic functions - limits - Continuity - Derivation - definition - theorems - types - higher orders - Applications on derivatives - partial derivatives - indefinite integral - theories and properties of integration.
Algebra: Binomial theorem (with any exponent and applications) - Partial Fractions - Theory of Equations - Matrices - System of linear equations - Gauss elimination method.

References:

- *Akhtar & Ahsan, Textbook of Differential Calculus, second edition, 2009, PHI Learning Private Limited.*
- *Alan Jeffrey, Matrix operations for Engineers and Scientists, 2010, Springer Science & Business Media.*

BAS012	Mathematics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2nd	**BAS011**

Integral Calculus: Definite integral - Methods of integration - Applicationson definite integral (plane area - volume of revaluation - length of a plane curve - area of surfaces of revolution) - improper integral.
Analytic Geometry: Equations of second degree - Equation of pair of straight lines - Translation of axes - Conic sections - parabola - ellipse - hyperbola) Equation of plane - Equation of sphere.

References:

- *Jumarie, G., Fractional Differential Calculus for Non-Differentiable Functions: Mechanics, Geometry, Stochastics, Information Theory. 2013: LAP Lambert Academic Publishing.*
- *Hestenes, D. and G. Sobczyk, Clifford algebra to geometric calculus: a unified language for mathematics and physics. Vol. 5. 2012: Springer Science & Business Media.*
- *Grossman, S.I., Multivariable calculus, linear algebra, and differential equations. 2014: Academic Press.*

BAS113	Mathematics (3)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	3rd	**BAS012**

Applications of partial differentiation - Maximum values of functions in more than one variable and applications - First order differential equations - Second order differential equations - Laplace transform and its applications - Analytical geometry in space.

References:

- *D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.*
- *S. A. Wirkus, and R. J. Swifi, "A Course of Ordinary Differential Equations", Taylor & Francis Group, LLC, 2015.*

BAS114	Mathematics (4)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	4th	**BAS113**

Fourier series - Fourier transform - Complex numbers - Functions of a complex variable - Complex integration - Residue theorem - Direction derivatives - Double integrals - Triple integrals - Line integrals - Surface integrals.

References:

- *J. Brown, and R. Churchill, "Complex Variables and Applications", 9th Edition, McGraw-Hill, 2013.*
- *D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.*

BAS215	Mathematics (5)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	5th	BAS114

Numerical solution of linear and non-linear systems of equations - Iterative methods - Curve fitting: Least square of (Straight lines, Polynomials), Linearization of nonlinear relationship. Interpolation and polynomial approximation -finite difference operators - Numerical integration and differentiation.

References:

- *Mazumder, Numerical Methods for Partial Differential Equations, Finite Difference and Finite Volume Methods, science direct ,2016.*
- *Sheldon Rose, A First course in probability, Eighth edition, 2010, Pearson Prentice Hall.*

BAS021	Mechanics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Newton's laws - Types of forces، coplanar forces، Rectangular components of vector (1D, 2D, Space), Forces in space - Equilibrium of a particle - Conditions, Free-body diagram - Moment - Couple moment - Resultant of a system of forces and couples as a force and couple system - General procedure for reducing force and couple systems - Equilibrium of a rigid body - Conditions of equilibrium of a rigid-body، free body diagrams – friction

References:

- *R.C. Hibbeler, "Engineering Mechanics: Statics and Dynamics, 14th Edition", Pearson Prentice Hall, New Jersey, 2016.*
- *J. L. Meriam, L. G. Kriage, and J. N. Botton, "Engineering Mechanics: Statics, 8th Edition", John Wiley & Sons, New York, 2016.*

BAS022	Mechanics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	2nd	BAS021

Kinematics of a particle: curvilinear motion - Normal and tangential components. - Newton's laws - motion of projectiles - Work and energy of a particle - applications of friction.

References:

- *R.C. Hibbeler, "Engineering Mechanics: Statics and Dynamics, 14th Edition", Pearson Prentice Hall, New Jersey, 2016.*
- *F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg, "Vector Mechanics for Engineering, Statics and Dynamics, 9th Edition", McGraw-Hill, New York, 2010.*

BAS031	Physics (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Material properties: Physical quantities - Standard units and dimensions - Mechanical properties for materials - Fluid properties - Periodic motion - Mechanical waves - Sound waves - Waves in elastic media.

Heat and thermodynamics: Temperature measurements and thermometers - Thermal expansion - Specific and latent heat - Heat transfer - Gas motion theory - First law of thermodynamics - Entropy and second law of thermodynamics.

References:

- *Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 6th Edition, Thomson Brooks/Cole 2014.*
- *Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.*

BAS032	Physics (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2nd	---

Electricity and Magnetism: Electric charge - Electric force - Electric field- Column's law- Electric flux- Gauss law- Electric potential- Electric capacitance and Dielectrics - Ohm's law and simple circuits- Magnetic field - Baiot and Savart laws.
Optics and Modern physics: Nature of light and laws of geometric optics - Interference - Diffraction - polarization - optical fiber - laser - photoelectric effects - principle of quantum theory - special theory of relativity.

References:

- *Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 9th Edition, Thomson Brooks/Cole 2014.,*
- *Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.*

BAS041	Engineering Chemistry								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	1st	---

Equations of state-chemical thermodynamics - Material and energy balance in chemical processes- properties of solutions - Basic principles in electrochemistry and it's applications- selected topics in chemical industry.

References:

- *Brown, L. T, LeMay H. E. Jr; Bursten, B. E.; Murphy, C.J., and Woodward, P.; " Chemistry The Central Science", Pearson International Edition (11th edn), Pearson Printice Hall, (2009).*

BAS115	Statistics and Probabilty Theory								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	4th	**BAS012**

Measures of tendency and dispersion - Probability distributions - Sampling theorem - tests of hypothesis - non-parametric tests - regression and correlation - time series.

References:

- *Mary C. Meyer, Probability and Mathematical Statistics: Theory, Applications, and Practice in RSBN-10: 1611975778, SIAM (June 24, 2019)*

PDE051	Production Engineering								Prerequisites
3 Cr	Lecture	2	Tutorial	--	Lab.	3	Semester	2nd	---

Introduction to the following processes (Casting- Forging- Metal filing - Machining- Forming- Woodworking)

References:

- *Hitomi, Katsundo. Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics. Routledge, 2017.*

PDE052	Engineering Drawing								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	1st	---

Two-dimensional drawings - Free-hand sketching - Sectional views - Auxiliary views and conventions - Computer-aided drawing (CAD) of 2D and 3D figures.

References:

- *Mcgraw-hill Mint, "Mechanical Drawing Board & CAD Techniques", Student Edition,2011*

PDE183	Monitoring Systems and Quality Control								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	4th	---

Monitoring fundamentals - Project monitoring - Monitoring reports - Fundamentals of statistical quality control - Control charts for variables and attributes - Process capability analysis - Sampling plans and techniques - Introduction to design of experiments.

References:

- *B. S. Ramírez, and J. G. Ramírez, "Statistical Quality Control," SAS Institute, 2018.*
- *J. R. S.C. Mateo, "Management Science, Operations Research and Project Management: Modelling, Evaluation, Scheduling, Monitoring", 2015.*

ENG111	Technical Reports Writing								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	3rd	UNR062

Technical writing definition - audience analysis - technical writing styles - technical document characteristics - automated document organization - official and unofficial document types - structure of different types of technical documents.

References:

- *G. J. Alred, W. E. Oliu, The Handbook of Technical Writing, 12th Edition, Bedford/St. Martin's; 2018*
- *K. Hyland, Teaching and researching writing. 3rd edition Routledge academic publisher, 2016*
- *M. Markel, Technical Communication, 11th edition, MacMillan, 2015.*

ENG311	Enviromental Impact of Projects								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	7th	---

Importance of Industry - Overview of Industrial fields - Basic Industrial problems-Conventional and unconventional reserves and resources - Manufacturing processes and equipments - Sustainable manufacturing - Remanufacturing, reuse and recycling - Innovative energy conversion – Green supply chain and transportation - Environmental Engineering Planning and Impact Analysis – Solid waste management - Air pollution and noise control - Radiation uses and protection.

References:

- *Gu¨nther Seliger, "Sustainable Manufacturing: Shaping Global Value Creation," Springer-Verlag, 2012.*
- *Josepha A. Salvato, P.E.,Dee, "Environmental Engineering," 5th Edition, Wiley, 2003.*

ENG412	Project Management								Prerequisites
2 Cr	Lecture	1	Tutorial	2	Lab.	--	Semester	9th	---

Basics of project management - basic administrative functions - planning, preparatory for different engineering applications. Elements of human resources management: recruitment, mentoring, and control - Total quality management, continuous improvement. - Integration management - Domain management - Time management - Cost management - Communication management - Risk management - Procurement management

References:

- *Kerzner, H. and H.R. Kerzner, Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons, 2017.*
- *Kalpakjian, S., K. Vijai Sekar, and S.R. Schmid, Manufacturing Engineering and technology. Pearson, 2014.*
- *Nigel J. Smith, "Engineering Project Management", 3rd Edition, Wiley-Blackwell, 2008.*

5.3. MET Program Requirements

5.3.1. MET Program Compulsory courses

CSE042	Introduction to Computer Systems							Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	2nd	---

Introduction to the design and operation of digital computers: types of data and its representation and number systems - the basic components of the computer and the organization of the computer and the ways of transfer of information- programming with Visual Basic - Introduction to information networks
Introduction to Programming: Program Structure and Command Types - Presentation of key commands - simple software development
Training Fundamentals: Dealing with Common Operating Systems (Windows – Linux) - Software Development and Desktop Software

References:

- *Roy, P., S. Haridi, "Concepts, Techniques, and Models of Computer Programming" The MIT Press (February 20, 2012)*

MET151	Materials Science (1)								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	3rd	BAS 031

Introduction - Atomic bonding and material properties - Crystal structure - Crystallographic directions and planes - Macromolecular structure - Imperfections in solids - Diffusion - Mechanical properties of metals - Dislocations and strengthening mechanisms - Phase equilibria - Phase transformations - Microstructure control in metals - Applications and processing of metal alloys.

References:

- *W.D. Callister, Jr. and D. G. Rethwisch, Materials Science and Engineering, An Introduction, 9th ed., John Wiley & Sons, Inc., 2014.*

MET181	Strength of Materials								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	3rd	BAS021, BAS031

Types of loads acting on mechanical components - Force analysis of simple mechanical elements - Axial forces, shear forces, bending and twisting moments – Stress, strain and Hook's law - Design stresses and factor of safety - Stress concentrations - Thermal stresses - Bearing stresses - Direct and torsional shear stresses - Bending stress and eccentric loading - Bending stresses and shear stresses in beams - Stress and strain analysis - Stresses in two dimensions - principal stresses and maximum shear stresses – Mohr’s circle - Power transmission shafts - Eccentric loads - Column buckling theory - Thin walled vessels.

References:

- *Beer, Ferdinand, John DeWolf, E. Russell Johnston Jr, David Mazurek, "Mechanics of materials.", 2014.*
- *R. K. Bansal, "A Text Book of Strength of Materials", Laxmi Publications, 4th edition , 2010.*

MPE171	Thermodynamics of Materials								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	--	Semester	3rd	BAS031

Laws of thermodynamic – Functions of state – Internal energy, heat and work – Types of paths (isobaric, isochoric, isothermal, adiabatic) – Enthalpy, heat capacity, heat of formation, phase transformations – Changes in composition – Chemical potential – Maxwell equations – Gibbs free energy – Multi-component (ternary, quaternary) phase diagrams – Kinetics of phase transformations – Activation free energy barrier – Driving force for phase transformation – Mechanisms of nucleation – Solidification and growth morphologies – Phase transformation detection and monitoring.

References:

- *O. F. Devereux, Topics in Metallurgical Thermodynamics. NY: John Wiley and Sons, 1983.*
- *E. Fermi, Thermodynamics. New York: Dover Publications, 1936.*
- *D. R. Gaskell, Introduction to Metallurgical Thermodynamics. NY: McGraw-Hill, 2nd edition, 1981.*

MET152	Materials Science (2)								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	4th	MET151

Structures and properties of ceramics - Applications and processing of ceramics - Polymer structures - Characteristics, applications and processing of polymers - Composite materials - Corrosion and degradation of materials - Electrical, thermal, magnitec and optical properties of materials.

References:

- *W.D. Callister, Jr. and D. G. Rethwisch, Materials Science and Engineering, An Introduction, 9th ed., John Wiley & Sons, Inc., 2014.*

PDE182	Fundamental of Materials Processing								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	4th	PDE051

Casting process – Metal forming – Characterization of mechanical properties of materials - Materials deformation methods – Wire drawing - Rod drawing- deep drawing – Stretch forming- complex stampings- Forging –Extrusion- Cold and hot rolling – Hot pressing – Coining– Spinning process – Welding processes – Powder metallurgy – Sintering – Coating techniques – Ceramics and glass fabrication processes.

References:

- *F. C. Campbell, Metal Fabrication, ASM International, 2013.*
- *J. R. Groza, and J. F. Shackelford, Materials Processing Handbook, Taylor & Francis, 2007.*
- *W. F. Smith, Principles of Materials Science and Engineering, 3rd edition, Mcgraw Hill Series in Materials Science and Engineering, 1999.*

MET153	Polymeric Engineering Materials								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	1	Semester	4th	---

Chemical structures - Polymerization, molar masses - Chain conformations - Rubber elasticity – Polymer solutions – Glass state and aging Mechanical properties – Fracture mechanics and viscoelasticity – Dielectric properties – Polymer liquid crystals – Semi-crystalline polymers-Polymer melts – Rheology and processingThermal analysis- Microscopy – Diffractometry and spectroscopy of polymers. Computer simulations of polymer-based.

References:

- *R.J. Young, Introduction to Polymers, 2nd Edition, Chapman and Hall, 1991.*
- *G. W. Ehrenstein, Polymeric Materials: Structure – Properties – Applications, 1st Edition, Hanser Gardner,*

2001.
- *L.H. Sperling, Introduction to Physical Polymer Science, 3rd Edition, John Wiley & Sons, 2001*
- *I. M. Ward, and J. Sweeney, An Introduction to Mechanical Properties of Solid Polymers, 2nd Edition, John Wiley & Sons, 2004.*

MET251	**Introduction to Composite Materials**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	1	Lab.	2	Semester	5th	---

Definition and types of composite materials – Fibers and tissues used to strengthen plastics - Methods of manufacturing composite materials - Analysis of composite materials using properties of their components - Selection techniques of composite materials - Mechanical design with composite materials.

References:
- *Ever J. Barbero, "Introduction to Composite Materials Design," CRC Press, 2017.*
- *R. M. Jones, "Mechanics of Composite Materials", 2nd Edition, CRC Press, 2014.*
- *B. Harris, Engineering Composite Materials, The Institute of Metals, London, 1986.*
- *D. Hull, and T.W. Clyne, An Introduction to Composites Materials, Cambridge University Press, 1996.*

MET252	**Stress Analysis**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	---	Lab.	3	Semester	5th	PDE181

Stress and strain relation - Stress and strain transformation in 2D and 3D - Principal stresses and strains - Mohr's circle for 2D and 3D stresses and strains – Theories of failure - Stress and strain analysis using finite element programs - Stress and strain measuring apparatus - Electrical resistance strain gauges - Photoelasticity methods - Moire method - Coating methods.

References:
- *M. Hetenyi, "Handbook of Experimental Stress Analysis", Forgotten Books, United States, 2018.*
- *W. M. Hosford, Mechanical Behavior of Materials, 2nd Edition, Cambridge University Press, 2009.*
- *N. E. Dowling, Mechanical Behavior of Materials, 4th Edition, Pearson, 2013.*
- *T. H. Courtney, Mechanical Behavior of Materials, 2nd Edition, McGraw Hill, 2005.*
- *R. W. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, 4th Edition, John Wiley, 1996.*

MET253	**Powder Metallurgy and Processing**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	5th	MET152

Introduction to Powder Metallurgy, Definition of Powder, Why Powder Metallurgy – Powder Fabrication: Mechanical & Chemical fabrication – Powder Fabrication: Electrolytic fabrication & Atomization – Microstructure control, Powder Characterization – Powder Characterization: Particle size measurement, BET surface area, Interparticle friction – Powder packing, mixing and blending and Compaction – Slurry techniques, Cold Isostatic Pressing (CIP) – Sintering: Sintering theory, Solid state sintering – Activated and Liquid phase Sintering – Full density processing – Hot Isostatic Pressing (HIP), Spark Plasma Sintering (SPS).

References:
- *Isaac Chang, Yuyuan Zhao, "Advances in powder metallurgy: Properties, processing and applications", Woodhead Publishing, 2013*
- *R. M. German, Powder Metallurgy Science, 2nd Ed. Metal Powder Industries Federation, 1994.*

MPE271	Transport Phenomena in Materials Science								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	5^{th}	---

Fluid Mechanics: Fluids – fluid statics. What are transport phenomena. Conservation principles. Elements of vector and tensor analysis - Viscosity and mechanisms of momentum transport. Microscopic momentum balances gia steady laminar flow. Macroscopic momentum balances. Mechanical energy.
Heat and mass transport: Heat conduction and mechanisms of thermal energy transport. Microscopic balances in laminar flow - Macroscopic balances - Diffusion and mechanisms of mass transport - Microscopic balances in laminar flow - Macroscopic balances.

References:
- *Venkanna, B. K. Fundamentals of heat and mass transfer. PHI Learning Pvt. Ltd., 2010.*
- *Rajput, R. K. "a Text Book of Fluid Mechanics and Hydraulics Machines." (2020).*

MET254	Electrochemistry and Corrosion								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	6^{th}	---

Basic electrochemical thermodynamics – Kinetics – Electrochemical techniques – Electrodes reactions – Electrodeposition – Electrochemical Efficiency - Energy balance – Kinetics of corrosion; Corrosion rates-Types of Corrosion; General, and Localized Corrosion – Corrosion control; Cathodic and Anodic protection – Hightemperature corrosion – Corrosion testing.

References:
- *N. Perez, Electrochemistry and Corrosion Science, Springer International Publishing, 2016.*
- *C. D. Fernández-Solis et al., Fundamentals of Electrochemistry, Corrosion and Corrosion Protection. In: Lang P., Liu Y. (eds) Soft Matter at Aqueous Interfaces. Lecture Notes in Physics, vol 917. Springer, Cham, 2016.*

MET255	Ceramics and Glasses								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	6^{th}	---

Definition & scope of ceramics and ceramic materials – Classification of ceramic materials – Conventional and advanced areas of applications – Bonding in Ceramics – Structures of Ceramics – Structure of Covalent Ceramics – Structure of Silicates – Lattice Parameters and Density – Ceramic Fabrication Processes – Gas-Phase Reactions – Chemical/Physical Vapor Deposition – Directed Metal Oxidation – Reaction Bonding, Liquid Precursor Methods, Sol–Gel Processing, Polymer Pyrolysis – Fabrication from Powders – Powder Consolidation and Forming of Ceramics – Diffusion and Electrical Conductivity – Diffusion – Electrical Conductivity – Ambipolar Diffusion – Defect Diffusion Coefficients – Phase Equilibria of some ceramics systems – Binary Systems, Ternary Systems – Mechanical Properties: Fracturing: Brittleness – Fracture Toughness – Strength of Ceramics – Toughening Mechanisms.

References:
- *R. H. Doremus, Glass Science, John Wiley & Sons Inc., New York, 1994.*
- *M. Barsoum, Fundamentals of Ceramics, McGraw Hill, New York, 1997.*

MET256	Material Selection								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	6^{th}	MET152

Aspects of selecting and comparing different materials from the viewpoints of functionality, manufacturing aspects, costs and environmental aspects of the product – Future trends in materials science – Some environmental aspects of material selection from the viewpoints of

LCC and LCA and the basics of MIPS calculations – Principles to solve the materials solution tasks based on systematic approaches staring from the product's requirement list – Basic rules to improve the DFMA-properties (design for manufacturability and assembly) of a product are presented and applied to typical energy technology applications.
References: ▪ *M. Ashby, Materials Selection in Mechanical Design, 3rd Edition, Elsevier Butterworth-Heinemann, Oxford, 3rd edition, 2004.*

MET257	**Biomaterials**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	6^{th}	---
Series of implant materials; metals, ceramics, glass ceramics, polymers, and composites-comparison with natural materials – Mechanical properties – Biocompatibility – Degradation of materials by biological systems – Biological response to artificial materials – Materials for the total hip prosthesis – Dental restoration- Hydroxyapatite – Filler materials – Implantable medical devices – Surface treatment of metallic biomaterials and surgical tools – Steps for new biomaterials approval.									
References: ▪ *C. M. Agrawal, An Introduction to Biomaterials Basic Theory with Engineering Applications, Part of Cambridge Texts in Biomedical Engineering, 2013.*									

MET351	**Nanomaterial for Engineers**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	---	Lab.	2	Semester	7^{th}	---
Nanometer length scale - Classes of nanomaterials with applications ranging from information technology to biotechnology - Synthesis of nanomaterials; including top down and bottom-up techniques –Solution chemistry – Nanofabrication methods; Characterization of nanomaterials; x-ray techniques, scanning probe microscopy and electron microscopy; electronic, magnetic, optical and mechanical properties of nanomaterials – Size effects in controlling the properties of nanomaterials – Challenges (including environmental, health and ethical concerns) that must be confronted in modern and future engineering applications of nanomaterials.									
References: ▪ *D. Vollath, Nanomaterials: An Introduction to Synthesis, Properties and Applications, 2nd Edition, Wiley, 2013.*									

MET352	**Semiconductor Materials**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	7^{th}	---
Interatomic bonding, Crystal structure, and Defects in solids – Band theory of solids - Basic properties of semiconductors - Applications of semiconductors –Semiconductor in equilibrium – Carrier transport phenomena – Nonequilibrium excess carriers in semiconductors – Optical effects, Semiconductor devices: p-n junction, transistor and solar cells – Emerging exotic semiconductors.									
References: ▪ *A. Rockett, The Materials Science of Semiconductors, Springer, 2008.*									

MET353	Smart Materials								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	7th	---

Characteristics of composites and ceramics materials – Dynamics and controls – concepts-Electro-magnetic materials and shape memory alloys – Processing and characteristics – Principles of electromagnetic – Acoustics – Chemical and mechanical sensing and actuation-Types of sensors and their applications – Signal processing – Design of shape memory alloys-Types of MR fluids – Principles of MR fluid value designs – Magnetic circuit design-MR Dampers-Design issues – Principles of optical fiber technology – characteristics of active and adaptive optical system and components – design and manufacturing principles.

References:

- *K. Hitomi, Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics, Routledge, 2017.*

MET354	High Temperature Materials								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	7th	---

Overview of materials for high temperature applications – Phenomena and problems associated with the use of materials at high temperatures – High Temperature behaviour of Materials: Plasticity, Fatigue, Creep, Oxidation and Corrosion – Refractory Metals, Inter-metallic, Stainless Steel, Nickel and Cobalt-based Superalloys, Ceramics and Cermets for High Temperature Applications – Alloy Theory – Heat Treatment and Hardening Mechanisms – Oxidation Resistant and Thermal Barrier Coatings.

References:

- *The Superalloys: Fundamentals and Applications, Roger C. Reed Cambridge University Press, New York, NY, 2006.*

MET355	Modeling and Simulation of Materials Processing								Prerequisites
3 Cr	Lecture	2	Tutorial	---	Lab.	2	Semester	7th	---

Modeling of various materials processes using finite volume techniques – Introduction to finite difference and finite element methods – Simulation of microstructural evolution using cellular automata – Links between microscopic and macroscopic modeling – Approximate modeling, uncertainty analysis, and sensitivity analysis as aids to numerical simulation – Limitations on numerical modeling in practical problems – Project work drawn from current problems in materials processing.

References:

- *S. Kobayashi, S.I. Oh, and T. Altan, Metal Forming and the Finite-Element Method, Oxford University Press, 1989.*
- *D. R. Poirier, G. H. Geiger, Transport Phenomena in Materials Processing, TMS, 1994.*

MET356	Materials Characterization								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	8th	---

Principles and experimental methods of optical, electron, and X-ray examination of engineering materials – Emphasis on use of X-ray analysis – Nano-indentation – Radiographic Testing, Auger spectroscopy- Electron microscopy – X-ray photo spectroscopy – Atomic force microscopy– XPS and microanalysis – FTIR – DSC – TG characterization techniques.

References:

- *D. Goodhew, F. Humphreys, and R. Beanland, Electron Microscopy & Analysis, 3rd Edition, Taylor & Francis,*

2001.
- *B. Wilson, and Evans, Encyclopedia of Materials Characterization, Butterworth-Heineman, 1992.*
- *Goldstein, et al., Scanning Electron Microscopy & X-Ray Analysis, 2nd edition, Plenum Press, 1992.*

MET357	Thin Film Technology							Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	8^{th}	---

Nucleation, growth, kinetics and thermodynamics of materials – Physical vapor deposition, Chemical vapor deposition – Plasma/Ion beam deposition – Epitaxial thin films: LPE, MBE, MOCVD – Film formation – Thin film characterization –Interdiffusion and reaction in thin films – Film formation, structural and physical properties: thickness, composition, morphology, mechanical properties, uniformity, grain size – Electrical, optical and magnetic properties of thin films – Electrical conduction in thin films – Size effects – Interface properties – Electromigration – Applications and emerging technologies – Thin films for microelelctronics – MEMS Optical coatings-Photodetectors – Smart sensors-Switching devices-Anti abrasive coatings –Solar cells – Superconducting and GMR devices – Integrated optics – Thin film superlattices-Quantum and Nano devices – Bioelectronics devices .

References:

- *M. Ohring, Materials Science of Thin Films: Deposition and Structure, 2nd Edition, Elsevier, 2001.*
- *K-N Tu, J. W. Mayer and L. C. Feldman, Electronic Thin Film Science for Electrical Engineers and Materials Scientists, Macmillan Publishing Company, 1992.*

MET358	Materials for Energy Applications							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	8^{th}	---

Unconventional geologic fuels and biofuels – Photovoltaic materials and solar energy conversion – Materials for future wind energy needs – Thermoelectric materials for solid state energy conversion – Materials for electrical energy storage – Materials for hydrogen production, storage, and use – Solid-state lighting materials – Materials challenges in nuclear energy.

References:

- *W. Callister, and D. Rethwisch, Materials science and engineering : an introduction, 10th Edition, John Wiley & Sons, 2017.*
- *D. Ginley, S. David, D. Cahen, Fundamentals of materials for energy and environmental sustainability, Cambridge University Press, 2011.*

MET452	Micro Electro-Mechanical Systems (MEMS)							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	9^{th}	---

Introduction to MEMS & Microsystems. Introduction to Microsensors, Evaluation of MEMS, Microsensors, Market Survey, Application of MEMS. MEMS Materials. MEMS Materials Properties, Microelectronic Technology for MEMS. Micromachining Technology for MEMS. Etch Stop Techniques and Microstructure. Surface and Quartz Micromachining. Fabrication of Micromachined Microstructure. Microstereolithography. MEMS Microsensors Thermal. Micromachined Microsensors Mechanical. Piezoresistive Accelerometer Technology. MEMS Gyro Sensor. Polymer MEMS & Carbon Nano Tubes CNT. Interface Electronics for MEMS, MEMS for Biomedical Applications (Bio-MEMS).

References:

- *S. Senturia (Editor in chief), MEMS Reference Shelf, Springer, 2010 and later.*
- *T. Jones, N. Nenadic, Electromechanics and MEMS, Cambridge University Press, 2013.*

MET454	Recycling and Processing of Engineering Materials								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	10th	---

Introduction - Principles of recycling processes - Waste characterization - Size reduction and classification – hand-sorting, optical, gravity separation, magnetic and electrostatic separation - Chemical and bacterial leaching - Recycling of metals - Recycling of concrete - Recycling of polymers and composites - Recycling of paper and glass - Environmental impact and economics of recycling.

References:

- *Marc J. Rogoff, "Solid Waste Recycling and Processing. Planning of Solid Waste Recycling Facilities and Programs", 2014.*
- *Fernando Pacheco-Torgal, Jorge de Brito, Joao Labrincha, Vivian W.Y. Tam, Yining Ding , "Handbook of recycled concrete and demolition waste", Woodhead Publishing, 2013.*
- *V. Goodship, "Management, Recycling and Reuse of Waste Composites", Woodhead Publishing, 2010.*

MET455	Materials Advanced Manfacturing Processes								Prerequisites
3 Cr	Lecture	2	Tutorial	1	Lab.	1.5	Semester	10th	---

Introduction to non-traditional machining processes with classifications - Mechanical non-traditional machining processes - Electrical non-traditional machining processes - Thermal non-traditional machining processes - Chemical non-traditional machining processes.

References:

- *El-Hofy, H., and Youssef, H.A., "Machining Technology: Machine Tools and Operations", CRC Press Taylor & Francis Group, ISBN-13: 978-1-4200-4339-6, (2008).*

5.3.2. Elective Courses for Specialization Requirements

MET391	Introduction of Advanced Materials								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---
Recent progresses in material science – New biomaterials – Superconductors – Advanced magnetic materials – Super alloys – Gas sensors – Strain gauge materials – Bulk nanostructured materials – Carbon fiber – High entropy alloys – Shape memory alloys – Nuclear engineering materials – New metallic materials and natural raw materials – The methods of material analysis.									
References: ▪ *James K. Wessel, "The Handbook of Advanced Materials", Wiley-Interscience Publisher, 2004.*									

MET392	Advanced Physical Metallurgy								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---
Crystal defects-. – Dislocation energy; stress fields; movement of dislocations - Extended dislocations and stacking faults in close –packed crystals – Yield Strength, critical resolved shear stresses, relationship to dislocation motion – Surfaces, Grain Boundaries and Interfaces - Strengthening and hardening mechanisms in non-ferrous materials and steels – Dispersion-hardened alloys – Work Hardening and Annealing – Recovery and recrystallization mechanisms – Metallic creep mechanisms – Creep-resistant alloy design – Deformation mechanism maps – Engineering aspects of fatigue – Structural changes accompanying fatigue – Fatigue Crack mechanism and fatigue failure – Fatigue at elevated temperatures – Grain size effects on electrical properties, strength (Hall-Petch effect), creep, fatigue and fracture.									
References: ▪ *R. E. Smallman, R J Bishop, "Modern physical metallurgy and materials engineering: science, process, applications", Butterworth Heinemann Publisher, 1999.* ▪ *R. E. Smallman, A.H.W. Ngan, "Physical Metallurgy and Advanced Materials", Butterworth Heinemann Publisher, 2007.*									

MET393	Heat Treatment								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---
Introduction - Thermal properties of materials: metallic and nonmetallic - Basics of heat treatment - Heat treatment units - Heat treatment techniques - Heat treatment processes - Development of heat treatment systems - Benefits and difficulties of heat treatment - Design and management of heat treatment systems - Heat treatment of metallic products - Heat treatment of nonmetallic products - Heat treatment of steel and alloy steels - Heat treatment of tool steels - Heat treatment of cast irons - Heat treatment of alloys: ferrous and nonferrous - Heat treatment of castings - Heat treatment of rotational parts of machines - Thermochemical treatment of metals - Using laser in heat treatment - Deformation reduction - Heat treatment effects on materials properties - Safety systems for heat treatment - Quality control of heat treatment processes.									
References: ▪ *Bryson, William E., "Heat treatment : master control manual", Hanser Fachbuchverlag Publisher, 2015.* ▪ *Ashok Sharma, C. P. Sharma, and T. V. Rajan, "Heat Treatment Principles and Techniques", 2nd Edition, 2011.*									

<table>
<tr><td>MET394</td><td colspan="8">Continuum Mechanics</td><td>Prerequisites</td></tr>
<tr><td>3 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>2</td><td>Lab.</td><td>---</td><td>Semester</td><td>Elective</td><td>---</td></tr>
<tr><td colspan="10">Fundamentals of cartesian tensors -Tensor derivatives – Green-gauss theorem – Definition of strain – Eulerian and Lagrangian coordinate systems – Polar decomposition-Theorem, Rate of deformation - Principal strain – Linear compatibility equations – Definition of stress-Cauchy and nominal stresses - Balance laws: Mass-Linear and Angular – Momentum-Energy-Principal stresses – Deviatoric and hydrostatic Stress-Reynolds transport theorem-Singular surfaces in a continuum – First and second Laws of thermodynamics for a continuum-Equations of state – coupled thermos-mechanics – Boundary condition – Fundamental restrictions on constitutive laws – (Equipresence, Local Action, Objectivity, etc.) – Fundamentals of linear elastic behavior of solids-Material symmetries – Variational principals – Fundamentals of continuum damage Mechanics using internal state variables.</td></tr>
<tr><td colspan="10"><u>References:</u>
▪ Reddy J.N., “An Introduction to Continuum Mechanics”, Cambridge University Press, 2013.
▪ Ahmed A. Shabana, ”Computational Continuum Mechanics”, 3rd Edition, Wiley Publisher, 2018.</td></tr>
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<table>
<tr><td>MET395</td><td colspan="8">Non-destructive Evaluation of Structures and Materials</td><td>Prerequisites</td></tr>
<tr><td>3 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>2</td><td>Lab.</td><td>---</td><td>Semester</td><td>Elective</td><td>---</td></tr>
<tr><td colspan="10">Introduction to non-destructive Evaluation (NDE) – Review of linear elasticity – Review of fracture mechanics – Visual and dye-penetrant inspections – Magnetic particle inspection – Radiographic inspection – Ultrasonic inspection – Eddy current inspection – Introduction to structural health monitoring (SHM) – Dynamic SHM – Embedded sensor SHM.</td></tr>
<tr><td colspan="10"><u>References:</u>
▪ Grandt, A. F. (2004). Fundamentals of structural integrity: Damage tolerant design and nondestructive evaluation. London: Wiley.</td></tr>
</table>

<table>
<tr><td>MET396</td><td colspan="8">Design of Experiments</td><td>Prerequisites</td></tr>
<tr><td>3 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>2</td><td>Lab.</td><td>---</td><td>Semester</td><td>Elective</td><td>---</td></tr>
<tr><td colspan="10">Introduction - Statistical basics for experimental design: basic statistical tests, analysis of variance, and analysis of covariance - Fundamentals of experimental design: measurements, quality characteristics, randomization, replication, and blocking - Interactions in processes - Phases of experimental design: planning phase, design phase, conducting phase, and analyzing phase - Analytical tools for experimental design - Screening designs - Completely randomized designs - Block designs: randomized block design, incomplete block designs, Latin’s square designs, Graeco–Latin’s square designs, Youden’s square designs - Full factorial designs - Fractional factorial designs - Nested designs - Robust designs - Split-unit designs - Split-lot designs - Response surface designs - Repeated measures designs - Multiple responses - Engineering cases.</td></tr>
<tr><td colspan="10"><u>References:</u>
▪ Douglas C. Montgomery, “Design and Analysis of Experiments”, 9th Edition, Wiley Publishers, 2017.
▪ A. Dean, M. Morris, J. Stufken, D. Bingham, “Handbook of design and analysis of experiments”, CRC Press, 2015.</td></tr>
</table>

MET397	High Temperature Materials							Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	7th	---

Overview of materials for high temperature applications – Phenomena and problems associated with the use of materials at high temperatures – High Temperature behaviour of Materials: Plasticity, Fatigue, Creep, Oxidation and Corrosion – Refractory Metals, Inter-metallic, Stainless Steel, Nickel and Cobalt-based Superalloys, Ceramics and Cermets for High Temperature Applications – Alloy Theory – Heat Treatment and Hardening Mechanisms – Oxidation Resistant and Thermal Barrier Coatings.

References:

- *The Superalloys: Fundamentals and Applications, Roger C. Reed Cambridge University Press, New York, NY, 2006.*

MET398	Modeling and Simulation of Materials Processing								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	7th	---

Modeling of various materials processes using finite volume techniques – Introduction to finite difference and finite element methods – Simulation of microstructural evolution using cellular automata – Links between microscopic and macroscopic modeling – Approximate modeling, uncertainty analysis, and sensitivity analysis as aids to numerical simulation – Limitations on numerical modeling in practical problems – Project work drawn from current problems in materials processing.

References:

- *S. Kobayashi, S.I. Oh, and T. Altan, Metal Forming and the Finite-Element Method, Oxford University Press, 1989.*
- *D. R. Poirier, G. H. Geiger, Transport Phenomena in Materials Processing, TMS, 1994.*

PDE391	Machine Design								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---

Design methods, factors affecting design and construction details, static and dynamic loading conditions, factor of safety, permissible stresses, Design of detachable connections: threaded joints, blades, keys and spline shafts - Permanent joint design: welded joint, rivets, adhesive joints - Design of some machine parts: springs, power screws, thin-wall pipes and vessels, seals - design and construction of hydraulic and pneumatic cylinders - computer applications in design calculations.

References:

- *R. Budynas, K. Nisbett, “Shigley's Mechanical Engineering Design,”, 11th Edition, McGraw-Hill Education; 2019.*

PDE392	Mechanisms and Robot Kinematics								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---

Fundamentals of kinematics - introduction to mechanisms and robots - Kinematic analysis of mechanisms: position, velocity and acceleration - Gear groups: simple, compound, planetary - kinematics of belts and chains, and power screws - cams - robot kinematics - applications and case studies – computer applications used the analysis mechanisms, project.

References:

- *R. Norton, “Design of Machinery”, ٦th Edition, McGraw-Hill Education, 201٩.*

MET491	Functionally Graded Materials								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---

History of Functionally graded materials (FGM) – comparison with traditional materials – Characterization and Properties of FGM – Graded Microstructures – Processing and Fabrication of FGM – Applications, fracture and contact problems of functionally graded materials – FGMs obtained by combustion synthesis techniques – thermoplastic simulation of FGMs – thermal buckling analysis of functionally graded arbitrary straight-sided quadrilateral plates – the mechanical response of metal-ceramic FGMs – Simulation of quasi-static crack propagation in FGMs – Functionally graded materials for orthopedic applications.

References:

- *Rasheedat Modupe Mahamood, Esther Titilayo Akinlabi, "Functionally Graded Materials", Springer International Publishing, 2017.*
- *Isaac Elishakoff, Demetris Pentaras, Christina Gentilini, "Mechanics of Functionally Graded Material Structures", World Scientific Publishing, 2015.*
- *Ebrahimi F., "Advances in Functionally Graded Materials and Structures", 2016.*

MET492	Pourous Materials								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---

Introduction – Fabricating porous metals - Application of porous metals - Special porous metals - Fabricating porous ceramics - Applications of porous ceramics - Producing polymer foams - Applications of polymer foams - Characterization methods: Basic factors and physical properties.

References:

- *Peisheng Liu Ph.D., Guo-Feng Chen, "Porous Materials: Processing and Applications", Butterworth Heinemann Publisher, 2014*
- *Pascal Van Der Voort, Karen Leus, Els de Canck, "Introduction to Porous Materials", Wiley Publisher, 2019.*

MET493	Introduction to Nano-mechanics of Materials								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---

Introduction to Nanomechanics – High resolution force spectroscopy – Additional nanomechanics instrumentation components – Force versus distance curves – Atomic force microscope (AFM) imaging – AFM imaging II: Artifacts and applications – Single cell mechanics – Qualitative introduction to intra and intermolecular forces – Quantitative description of intra and intermolecular forces – Molecule - surface interactions – Colloids and interparticle potentials – Van der Waals forces at work: Gecko feet adhesion – The electrical double layer (EDL) – Theoretical aspects of nanoindentation.

References:

- *Bhushan, B. (2018). Nanotribology and Nanomechanics An Introduction. Cham: Springer International Publishing.*

PDE491	Fracture and Fatigue of Engineering Materials								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---

Introduction- Mechanics of Fracture – Micromechanics of Fracture – Microstructural Effects - Interface Fracture Mechanics and Toughness Locus – Toughening Mechanisms – Micromechanisms of Fatigue Crack Initiation in Ductile and Brittle Solids – Total Life Approaches to Fatigue – Fatigue Crack Growth in Ductile Metals and Alloys – Fatigue Crack Growth in Brittle Solids – Fatigue Crack Growth in Polymeric Materials – Corrosion Fatigue

and Creep Fatigue – Fatigue at Interfaces – Case Studies.
References: ▪ *Campbell, F. C. (2012). Fatigue and fracture understanding the basics. Materials Park, OH: ASM International.*

PDE492	**Additive Manufacturing**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---
Definition of additive manufacturing (AM) – Key Elements of AM – Uses of AM Parts – Industries Using AM – Computer Aided Design (CAD) Tools – AM Processes – ASTM Standards – Current Technologies that Support each Method/Process – Key AM Terminology – ASTM Standard – AM Materials – Secondary Processes –AM advantages over Traditional Manufacturing – Input Sources and Characteristics – Creation of Slice Files – File Manipulation – Vat Photopolymerization – Powder Bed Fusion – Material Extrusion – Material Jetting – Binder Jetting – Sheet Lamination – Hybrid Systems – Directed Energy Deposition – Direct Write – AM Design – AM Business & Economics – Am Quality Systems – Emerging Topics/Issues in AM.									
References: ▪ *Gibson, Ian, Rosen, David, and Strucker, Brent. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Second Edition. Springer, 2015.*									

MET494	**Electrical Energy Storage Materials**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---
Introduction to Electrical Energy Storage – Battery Background– Electrochemical vs. thermal energy sources – Battery Construction: Cell mechanical structure – Major Battery Chemistries – Lead Acid Batteries – Nickel-Metal Hydride Batteries – Battery System Integration – Analysis and Simulation of Batteries–Secondary Use, Recycling, and Disposal Issues of Batteries – Battery Chargers–Battery State Estimation –Battery Standards and Testing – Safety: Fundamental failure modes – Automotive Battery Application Performance – Future Electrical Energy Storage Technology.									
References: ▪ *Passerini, S. (2020). Batteries: Present and future energy storage challenges. Weinheim, Germany: Wiley-VCH.*									

MET495	**Dielectric Materials Science**								**Prerequisites**
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---
Physics of dielectric – Physics of charged dielectric – Dielectric relaxation in polymeric materials – Space charge – Dielectric materials under electron irradiation in a scanning electron microscope – Precursory phenomena and dielectric breakdown of solids – Response of an insulating material to an electric charge.									
References: ▪ *C. Kittel, Introduction to solid state physics, Wiley, 2004..*									

MET496	Semiconductor Optoelectronics								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---

Energy bands in solids, the E-k diagram, Density of states, Occupation probability, Fermi level and quasi Fermi levels, p-n junctions, Schottky junction and Ohmic contacts. Semiconductor optoelectronic materials, Bandgap modification, Heterostructures and Quantum Wells. Rates of emission and absorption, Condition for amplification by stimulated emission, the laser amplifier. Electroluminescence. The LED: Device structure, materials and characteristics. The Semiconductor Laser: Basic structure, theory and device characteristics; direct current modulation. Quantum-well lasers; DFB-, DBR- and vertical-cavity surface-emitting lasers (VCSEL); Laser diode arrays. Device packages and handling. Semiconductor optical amplifiers (SOA), SOA: characteristics and some applications, Quantumconfined Stark Effect and Electro-Absorption Modulators. Types of photodetectors, Photoconductors, Single junction under illumination. Noise in photodetection; Photo-transistors, solar cells, and CCDs. Optoelectronic integrated circuits – OEICs.

References:

- *B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., 2nd Ed. (2007), Ch.16, 17, and 18.*

MET497	Introduction to Displays								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---

The course will cover the basics of electronic display devices, including liquid crystals, electroluminescent, plasma, organic light emitting diodes, and electrowetting based displays. At the end of this course learners will be able to select a display technology and perform basic design of the display and have a thorough grasp of basic principles that drive display operation. Module 1 will cover the fundamentals of liquid crystal displays, used in most computer monitors.

References:

- *Robert Chen, Liquid Crystal Displays: Fundamental Physics and Technology, 2011.*

MET498	Solar photovoltaic								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---

This course is an introductory course on solar photovoltaics materials and devices covering basic physics of materials as well as devices, various solar photovoltaic technologies and their status with a brief discussion of the fabrication aspects of the devices followed by discussion of the pending materials and technologies issues and measurement techniques. Introduction and Solar radiation fundamentals - Basic physics of semiconductors - Carrier transport, generation and recombination in semiconductors - Semiconductor junctions - Essential characteristics of solar photovoltaic devices - First Generation Solar Cells - Second Generation Solar Cells - Third Generation Solar Cells.

References:

- *Peter Würfel , Physics of Solar Cells: From Basic Principles to Advanced Concepts 2nd ed., 2010.*

MET499	Electron Microscopy and Diffraction Theory								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---

Electron microscopy-Imaging theory – SEM – TEM- HREM – STEM- Dynamical diffraction – Two-dimensional channeling model – Electron crystallography – Surface structure – Bulk structures – Measurements of charge densities.

References:

- *Brent Fultz, James M. Howe, "Transmission Electron Microscopy and Diffractometry of Materials", Springer Publisher, 2007.*

PDE493	Tribology								Prerequisites
3 Cr	Lecture	2	Tutorial	2	Lab.	---	Semester	Elective	---

Introduction - Engineering surfaces - Hertzian contact - Elliptical hertzian contact - Rough surfaces contact - Actual contact area - Metals friction - Solid Lubricants - Wear mechanism - Lubrication systems: mixed, hydrodynamic, and elastic hydrodynamic - Rynolds' equations: first order and second order - Polymers tribology - Ceramics tribology - Composites tribology - Applications.

References:

- *Ian Hutchings, Philip Shipway, "Tribology. Friction and Wear of Engineering Materials", 2nd Edition, Butterworth-Heinemann Publisher, 2017.*

5.3.3. Training and Graduation Projects

MET258	Training (1)								Prerequisites
0 Cr	Lecture	--	Tutorial	--	Lab.	--	Semester	Summer	95 Cr

Training on industrial establishments relevant to the program. Training lasts for total of 120 hours, during a period about four weeks. The program training advisor schedules at least one follow up visit to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. The course is graded as Pass/Fail grade- system.

MET359	Training (2)								Prerequisites
0 Cr	Lecture	--	Tutorial	--	Lab.	--	Semester	Summer	MET258

Training on industrial establishments relevant to the program. Training lasts for total of 120 hours, during a period about four weeks. The program training advisor schedules at least one follow up visit to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. The course is graded as Pass/Fail grade- system.

MET451	Graduation Project (1)								Prerequisites
3 Cr	Lecture	1	Tutorial	2	Lab.	3	Semester	9th	125 Cr
A supervised project in groups of students aimed at providing practical experience in some aspects of materials engineering. Students in teams apply knowledge and skills they have learned in early courses to solve real engineering problems. Students are expected to define the project, state its objectives, complete a literature survey, set project specifications and select a design method. They are also expected to do some preliminary modeling and analysis and to acquire the necessary material needed for the completion of the project. A professional report is presented and defended by the students at the end of the project.									

MET453	Graduation Project (2)								Prerequisites
3 Cr	Lecture	1	Tutorial	---	Lab.	6	Semester	10th	MET451
A supervised project in groups of students aimed at providing practical experience in some aspects of materials engineering. Students in teams apply knowledge and skills they have learned in early courses to solve real engineering problems. Students are expected to define the project, state its objectives, complete a literature survey, set project specifications and select a design method. They are also expected to do some preliminary modeling and analysis and to acquire the necessary material needed for the completion of the project. A professional report is presented and defended by the students at the end of the project.									

Chapter Thirteen:

A B. Sc. Program in Artificial Intelligence Engineering with Credit Hours System

1) Program Definition

The Faculty of Engineering, Mansoura University seeks to keep pace with the era of digital transformation, within a framework that keeps pace with the 2030 sustainable development plan. Since the impact of artificial intelligence has extended to almost all areas of life, the Artificial Intelligence Engineering Program offers a sophisticated specialization for those who want to combine the disciplines of advanced electronics, computers, software and systems Advanced control, as the program aims to give the student appropriate basic information in the various engineering disciplines mentioned, and the program also provides the student with the ability to self-learning, to complete the information he/she may need in any specialty in order to deal with a specific applied problem**.**

Artificial intelligence helps to enhance business capabilities in all areas, and gives companies the ability to demonstrate all their potential and raise them to the highest levels; It increases the efficiency and speed of implementation of the business, increases its value, contributes to the continuous development of the business, and increases the number of interacting with these businesses, due to the continuous development of tools and software related to it. the use of artificial intelligence applications has made a great revolution in the automotive industry; For example, autonomous driving programs from Google use artificial intelligence techniques, and logistical transport companies use them to reduce the rate of accidents and reduce traffic congestion. artificial intelligence applications are used in e-commerce sites, to obtain a clear picture of customer behavior in the purchase processes across the sites. Also, social networks use artificial intelligence applications to detect the presence of a penetration of user images. In addition to the above mentioned, artificial intelligence applications have been used to reduce challenges in the field of health care, such as forecasting ICU conversions, medical examination, improving clinical workflow and predicting hospital-acquired diseases.

Within the framework of the competition to keep pace with future sciences, confront challenges, and develop smart solutions for them, the Faculty of Engineering Mansoura University has integrated this program into its new program system. This achieves the supreme goal of its establishing an integrated engineer within the framework that serve this interdisciplinarity.

Last but not least, the program focuses on learning through case studies and multiple projects aimed at solving specific problems in life, not satisfied with one graduation project as is the case in a number of other engineering disciplines, which represents another component of excellence.

2) Basic Information

2.1 Program Vision

Reaching the rank of innovation and leadership locally and regionally in the field of artificial intelligence engineering (AIE) and its applications.

2.2 Program Mission

Preparing a distinguished engineer in the field of artificial intelligence engineering (AIE) and its applications. Also, forming scientifically and professionally qualified engineering cadres capable of competing in major institutions whose field of work depends on advanced technology. In addition to service of society and developing the environment.

2.3 Program Objectives

- Providing the student with high capabilities and skills in solving problems at the academic and professional levels.
- Developing the engineer's analytical and logical thinking skills.
- Creating a generation of engineers with a good background in the field of artificial intelligence to work in the design and implementation of complex systems that depend on artificial intelligence.
- Achieving integration between engineering disciplines in the research and applied fields.
- Work to develop engineering research for amending and improving the technological foundations in artificial intelligence engineering applications.
- Serving the community through artificial intelligence applications in various life fields.

2.4 Graduate Attributes:

A graduate of the **Artificial Intelligence Engineering (AIE)** program must be able to:

- Apply general and specialized knowledge and theories in the field of AIE.
- Use critical thinking to solve problems that can or cannot be predicted in the context of AIE specialization taking into account all variables.
- Master an expanded set of specialized skills in the field of AIE Engineering.
- Carry out critical evaluation of the results of completed tasks and building technical expertise.
- Identify occupational risks and ways to reduce them.

- Apply cost-effectiveness measures.
- Manage the usual and unusual contexts in the field of AI engineering.
- Use digital and media tools to tackle professional and academic challenges in an innovative way.
- Study and work independently under the general rules and regulations.
- Make correct decisions in the context of medical engineering.
- Take responsibility for himself and the team.
- Carry out optimal exploitation and development of workplace resources.
- Apply work ethics.
- Apply quality assurance standards in all procedures related to AI engineering.

Competencies of a Graduate According to NARS 2018

(A1) Be able to define, configure and solve complex engineering problems

(A2) Develop, analyze and evaluate results of experiments and simulations and use statistical analysis to extract results

(A3) Apply engineering design processes to produce innovative solutions at low cost to meet the needs of society

(A4) Optimal utilization of contemporary technology, health and safety requirements and principles of crisis management

(A5) Implement research techniques as an integral part of learning

(A6) Plan, supervise and follow up the implementation of engineering projects

(A7) Work efficiently as a member of a multicultural and multicultural team

(A8) Communicate effectively with listeners through contemporary means

(A9) Use innovative, critical thinking and gain leadership skills to confront new situations

(A10) Acquire and apply new knowledge and other learning strategies

In addition to the competencies of most engineering programs, the AIE program has some special competencies, which are as follows:

(B1) Prepare and refine data for use in artificial intelligence applications

(B2) Measure the performance of artificial intelligence systems for the purpose of their development

(C1) Design artificial intelligence systems to solve complex problems in various fields

(C2) Build artificial intelligence systems using modern tools

(C3) Application of artificial intelligence systems in various applications

3) The Course Coding System

The following figure shows courses coding system according to reference framework NARS 2018, where the course code is composed of three letters and three digits. The letters indicate the course specialization department. The first digit indicates the year 0, 1, 2, 3, or 4. The second digit between 1 and 9 displays the discipline in the major. The third digit is the course sequence in each discipline. Figure (1) explains this

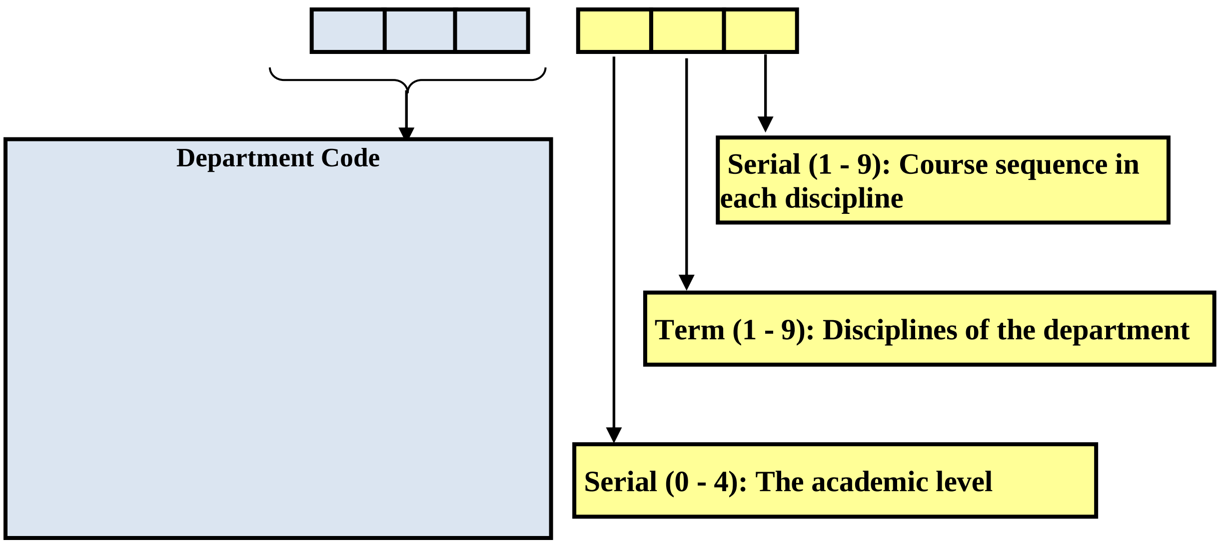


Figure (1): Courses coding system

1. The letters indicate the majors in which the degree is given but some of these represent university requirements, college requirements, or specialized courses.
2. Course descriptions refer to the semester in which this course is usually given, but these dates are subject to change, as not all courses are taught every year.
3. The student must successfully pass a number of courses totaling 160 credit hours in order to obtain a bachelor's degree in artificial intelligence engineering from the Faculty of Engineering, Mansoura University.

4) The structure and contents of the artificial intelligence engineering program

The structure of the Artificial Intelligence Engineering program consists of 160 credit hours distributed over 56 courses as follows:

University Requirements

The main purpose of undergraduate education is not only to prepare students for successful careers but also to provide them with the knowledge and skills needed to develop a rational and successful personal identity. Moreover, Mansoura University helps students gain an appreciative understanding of the natural and cultural environments in which they live and their roles in society and community services. The university's requirements for undergraduate programs consist of 13 credit hours (8% of the total 160 credit hours), which are fulfilled by completing seven (7) courses which are illustrated in Table (1).

Table (1): The University Mandotary Courses (UNR)(13 credit hours)

Code	Course Name	Credit	Total SWL	Marks Distribution		
				Mid Term	semester Works	Final Term
UNR 061	English (1)	2	5	20	30	50
UNR 021	History of Engineering and Technology	1	2	20	30	50
UNR 181	Law and Human Rights	2	4	20	30	50
UNR 121	Research and Critical Thinking	2	5	20	30	50
UNR 241	Communication and Presentation Skills	2	5	20	30	50
UNR 261	Ethics and Morals of The Profession	2	4	20	30	50
UNR 471	Marketing	2	4	20	30	50

Faculty of Engineering Requirements

College requirements provide students with the knowledge and skills to develop a successful engineer. The Shared College core is applied across all credit hour programs. The unified requirement from the basic courses in the college contains basic knowledge courses for all engineering graduates such as mathematics, physics, mechanics, engineering drawing, design, manufacturing and chemistry. The college requirements for the AIE program for the undergraduate level consist of 45 credit hours (28.125% of the total 160 credit hours), which are completed by completing sixteen (16) mandatory courses. They are illustrated in Table (2).

Table (2): The Faculty Requirements (45 credit hours)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	**Lab**	**semester Works**	Final Term
BAS 011	Mathematics (1)	3	8	20	0	30	**50**
BAS 021	Mechanics (1)	3	8	20	0	30	**50**
BAS 012	Mathematics (2)	3	8	20	0	30	**50**
BAS 022	Mechanics (2)	3	8	20	0	30	**50**
BAS 031	Physics (1)	3	9	20	10	20	**50**
BAS 032	Physics (2)	3	9	20	10	20	**50**
BAS 041	Engineering Chemistry	3	9	20	10	20	**50**
PDE 051	Production Engineering	3	8	20	10	20	**50**
PDE 052	Engineering Drawing	3	10	20	0	30	**50**
ENG 111	Technical Reports Writing	2	6	20	0	30	**50**
BAS 115	Linear Algebra	3	8	20	0	30	**50**
BAS 116	Mathematical Methods for Engineering	3	8	20	0	30	**50**
BAS 216	Statistical data Analysis	2	6	20	0	30	**50**
ELE 151	Electrical Power and Machines	3	8	20	0	30	**50**
BAS 217	Discrete Mathematics	3	8	20	0	30	**50**
ENG 312	Project Management	2	5	20	0	30	**50**

Requirements for AI Specialization (Core courses)

The courses distribution according to the specializations in AIE consists of 102 credit hours (63.75% of the total 160 credit hours), which are met by completing 26 compulsory courses equivalent to 78 credit hours, 5 elective courses equivalent to 15 credit hours in addition to 3 graduate projects and field training courses equivalent to 9 credit hours as shown In the following tables:

Table (3): AIE Requirements (78 credit hours + 15 elective credit hours)

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	Lab	semester Works	Final Term
CSE 042	Introduction to Computer Systems	3	9	20	0	30	**50**
CSE 151	Introduction to Artificial Intelligence	3	8	20	0	30	**50**
ECE 121	Electric Circuits	3	9	20	10	20	**50**
ECE 122	Electronics	3	9	20	10	20	**50**
CSE 141	Digital Design	3	9	20	10	20	**50**
CSE 112	Algorithms and Data Structures	3	9	20	0	30	**50**
CSE 111	Programming (1)	3	8	20	0	30	**50**
BAS 218	Advanced Engineering Mathematics	3	8	20	0	30	**50**
CSE 221	Automatic Control	3	6	20	10	20	**50**
ECE 223	Instrumentation and Measurements	3	9	20	10	20	**50**
ECE 234	Signals and Systems	3	8	20	0	30	**50**
CSE 251	Machine Learning	3	8	20	10	20	**50**
CSE 212	Database Systems	3	8	20	0	30	**50**
ECE 235	Digital Signal Processing	3	8	20	0	30	**50**
ECE 224	Sensors, actuators and Sensor Networks	3	8	20	0	30	**50**
ECE 332	Neural Networks	3	9	20	10	20	**50**
ECE 333	Digital Image Processing	3	9	20	10	20	**50**
CSE 351	Deep Learning	3	9	20	0	30	**50**
CSE 313	Data Management	3	9	20	0	30	**50**
CSE 317	Computer Architecture	3	8	20	0	30	**50**
CSE 311	Programming (2)	3	9	20	0	30	**50**
ECE 321	Communication Networks	3	8	20	0	30	**50**
CSE 315	Embedded Systems	3	8	20	0	30	**50**
CSE 423	Robotics	3	9	20	10	20	**50**
CSE 451	Big Data	3	8	20	0	30	**50**
CSE 452	AI Applications	3	8	20	0	30	**50**

Table (3) Continued: List of Elective Courses (Student chooses 5 courses)

Elective course Level 300

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	**Lab**	**semester Works**	Final Term
CSE 316	Decision-Making Systems	3	9	20	0	30	**50**
ECE 334	Pattern Recognition	3	9	20	0	30	**50**
BAS 315	Optimization Methods	3	9	20	0	30	**50**
CSE 319	Bioinformatics	3	9	20	0	30	**50**
CSE 318	Human Computer Interaction (HCI)	3	9	20	0	30	**50**
BAS 311	Statistical Learning	3	9	20	0	30	**50**
ECE 335	Data Analysis and Visualization	3	9	20	0	30	**50**
CSE 352	Cognitive science	3	9	20	0	30	**50**

Elective courses Level 400

Code	Course Name	Credit	Total SWL	Marks Distribution			
				Mid Term	**Lab**	**semester Works**	Final Term
ECE 432	Internet of Things (IOT)	3	9	20	0	30	**50**
CSE 454	Advanced Deep Learning	3	9	20	0	30	**50**
CSE 455	Natural Language Processing	3	9	20	0	30	**50**
ECE 435	Computer Vision	3	9	20	0	30	**50**
CSE 412	Soft Computing	3	9	20	0	30	**50**
CSE 413	High Performance Computing	3	9	20	0	30	**50**
CSE 456	Biomedical Applications of AI	3	9	20	0	30	**50**
CSE 457	Reinforcement Learning	3	9	20	0	30	**50**
CSE 414	Data Mining	3	9	20	0	30	**50**
CSE 458	AI applications in signal and Audio processing	3	9	20	0	30	**50**
CSE 459	Applications of AI in Art	3	9	20	0	30	**50**
CSE 411	Cloud Computing	3	9	20	0	30	**50**

Table (4) Projects and Practical Training (9 credit hours)

Code	Course Name	Credit		Total SWL	Marks Distribution			
					Mid Term	Lab	semester Works	Final Term
ARI 171	Practical Training in AI	--	Mandatory	3	--	--	--	--
ARI 271	Training (1) in AI	--	Mandatory	3	--	--	--	--
ARI 371	Training (2) in AI	--	Mandatory	3	--	--	--	--
ARI 381	Project (1) in AI	3	Mandatory	12	--	--	50	50
ARI 481	Project (2) in AI	3	Mandatory	12	--	--	50	50
ARI 482	Project (3) in AI	3	Mandatory	14	--	--	50	50

5) Suggested Curriculum for the Student

The curriculum presents the credit units, weekly contact hours either for lectures, tutorial and practical work for all courses. The curriculum also presents SWL and Marks distribution in addition to the projects and training according to NARS 2018. The student must successfully pass a number of courses totaling 160 credit hours in order to obtain a bachelor's degree in Aritificial Intelligence engineering from the Faculty of Engineering, Mansoura University.

Level 000

First Semester

Course Code	Course Title	Hours/Week						Marks Distribution					Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BAS 011	Mathematics (1)	3	2	2	--	4	8	20	30	--	50	100	----
BAS 021	Mechanics (1)	3	2	2	--	4	8	20	30	--	50	100	----
BAS 031	Physics (1)	3	2	1	1.5	4.5	9	20	20	10	50	100	----
BAS 041	Engineering Chemistry	3	2	1	1.5	4.5	9	20	20	10	50	100	----
PDE 052	Engineering Drawing	3	2	2	--	6	10	20	30	--	50	100	----
UNR 061	English (1)	2	1	2	--	2	5	20	30	--	50	100	----
Total		17	11	10	3	25	49					600	
Total Contact hours = 24 hrs/week Total SWL = 49 hrs/week													

Second Semester

Course Code	Course Title	Hours/Week						Marks Distribution					Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BAS 012	Mathematics (2)	3	2	2	--	4	8	20	30	--	50	100	BAS 011
BAS 022	Mechanics (2)	3	2	2	--	4	8	20	30	--	50	100	BAS 021
BAS 032	Physics (2)	3	2	1	1.5	4.5	9	20	20	10	50	100	BAS 031
CSE 042	Introduction to Computer Systems	3	2	1	1.5	4.5	9	20	30	--	50	100	----
PDE 051	Production Engineering	3	2	--	3	3	8	20	20	10	50	100	----
UNR 021	History of Engineering and Technology	1	1	--	--	2	3	20	30	--	50	100	----
Total		16	11	6	6	22	45					600	
Total Contact hours = 23 hrs/week Total SWL = 45 hrs/week													

Level 100

Third Semester

Course Code	Course Title	Hours/Week					Marks Distribution						Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BAS 115	Linear Algebra	3	2	2	--	4	8	20	30	--	50	100	BAS 012
CSE 151	Introduction to Artificial Intelligence	3	2	2	--	4	8	20	30	--	50	100	---
CSE 141	Digital Design	3	2	1	1.5	4.5	9	20	20	10	50	100	CSE 042
UNR 181	Law and Human Rights	2	2	--	--	2	4	20	30	--	50	100	---
ECE 121	Electrical Circuits	3	2	2	--	4	8	20	30	--	50	100	BAS 032
ENG 111	Technical Reports Writing	2	1	2	--	3	6	20	30	--	50	100	UNR 061
Total		16	11	9	1.5	21.5	43					600	
Total Contact hours = 21.5 hrs/week Total SWL = 43 hrs/week													

Fourth Semester

Course Code	Course Title	Hours/Week					Marks Distribution						Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BAS 116	Mathematical Methods for Engineering	3	2	2	---	4	8	20	30	--	50	100	BAS 115
ECE 122	Electronics	3	2	1	1.5	4.5	9	20	30	--	50	100	ECE 121
CSE 111	Programming (1)	3	2	--	3	4	9	20	20	10	50	100	CSE 141
CSE 112	Algorithms and Data Structures	3	2	1	1.5	4.5	9	20	30	--	50	100	CSE 042
ELE 151	Power & Electrical Machines	3	2	2	---	4	8	20	30	--	50	100	ECE 121
UNR 121	Research and Critical Thinking	2	1	2	-	3	6	20	30	--	50	100	---
ARI 171	Practical Training in AI	0	0	0	0	3	3	0	0	0	0	0	---
Total		17	11	8	6	27	52					600	
Total Contact hours = 25 hrs/week Total SWL = 52 hrs/week													

Level 200

Fifth Semester

Course Code	Course Title	Hours/Week						Marks Distribution					Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BAS 216	Statistical Data Analysis	2	1	2	--	4	7	20	30	--	50	100	BAS 115
ECE 234	Signals and Systems	3	2	2	--	4	8	20	30	--	50	100	BAS 116
UNR 241	Communication and Presentation Skills	2	1	2	--	2	5	20	30	--	50	100	---
ECE 223	Instrumentation & Measurements	3	2	1	1.5	4.5	9	20	30	--	50	100	ECE 122
CSE 251	Machine Learning	3	2	2	--	4	8	20	30	--	50	100	CSE 151
CSE 221	Automatic Control	3	2	2	--	4	8	20	30	--	50	100	BAS 116
Total		16	10	11	1.5	22.5	45	120	180	--	300	600	
Total Contact hours = 22.5 hrs/week Total SWL = 45 hrs/week													

Sixth Semester

Course Code	Course Title	Hours/Week						Marks Distribution					Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
BAS 217	Discrete Mathematics	3	2	2	---	4	8	20	30	--	50	100	BAS 216
ECE 224	Sensors, actuators & Sensor Networks	3	2	2	---	4	9	20	30	--	50	100	ECE 223
BAS 218	Advanced Engineering Mathematics	3	2	2	---	4	8	20	30	--	50	100	BAS 216
UNR 261	Ethics and Morals of the Profession	2	2	0	0	2	4	20	30	-	50	100	---
CSE 212	Database Systems	3	2	0	3	4	9	20	30	--	50	100	CSE 112
ECE 235	Digital Signal Processing	3	2	1	1.5	4.5	9	20	30	--	50	100	CSE 234
ARI 271	Training (1) in AI	0	0	0	0	3	3	0	0	0	0	0	ARI 171
	Total	17	12	7	4.5	25.5	50					600	
Total Contact hours = 23.5 hrs/week Total SWL = 50 hrs/week													

Level 300

Seventh Semester

Course Code	Course Title	Hours/Week					Marks Distribution						Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
Elective	Elective Course (1)	3	2	2	--	4	9	20	30	--	50	100	According to Course Specs
ECE 332	Neural Networks	3	2	1	1.5	4.5	9	20	30	--	50	100	BAS 218
CSE 311	Programming (2)	3	2	--	3	5	9	20	30	--	50	100	CSE 111, CSE 212
CSE 313	Data Management	3	2	--	3	4	9	20	30	--	50	100	CSE 212
CSE 317	Computer Architecture	3	2	2	--	4	8	20	30	--	50	100	CSE 141
ECE 333	Digital Image Processing	3	2	1	1.5	4.5	9	20	30	--	50	100	ECE 235
	Total	18	12	6	9	26	53					600	
Total Contact hours = 27 hrs/week Total SWL = 53 hrs/week													

Eighth Semester

Course Code	Course Title	Hours/Week					Marks Distribution						Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
CSE 351	Deep Learning	3	2	0	3	4	9	20	30	--	50	100	ECE 332
CSE 315	Embedded Systems	3	2	1	1.5	4.5	9	20	30	--	50	100	CSE 317
Elective	Elective Course (2)	3	2	2	--	5	9	20	30	--	50	100	According to Course Specs
ECE 321	Communication Networks	3	2	2	--	4	8	20	30	--	50	100	ECE 234
ENG 312	Project Management	2	1	2	--	2	5	20	30	--	50	100	---
ARI 381	Project (1) in AI	3	1		6	5	12	--	50	--	50	100	Reaching level 300
ARI 371	Training (2) in AI	0	0	0	0	3	3	0	0	0	0	0	ARI 271
	Total	17	10	7	10.5	24.5	55					600	
Total Contact hours = 27.5 hrs/week Total SWL = 55 hrs/week													

Level 400

Ninth Semester

Course Code	Course Title	Hours/Week					Marks Distribution						Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
Elective	Elective Course	3	2	2	-	5	9	20	30	-	50	100	According to Course Specs
Elective	Elective Course	3	2	2	-	5	9	20	30	-	50	100	According to Course Specs
CSE 423	Robotics	3	2	1	1.5	4.5	9	20	30	-	50	100	CSE 221
UNR 471	Marketing	2	2	--	-	2	4	20	30	--	50	100	--------
ARI 481	Project (2) in AI	3	1	--	6	5	12	-	50	--	50	100	Reaching Level 400
Total		14	9	5	7.5	21.5	43					600	
Total Contact hours = 21.5 hrs/week Total SWL = 43 hrs/week													

Tenth Semester

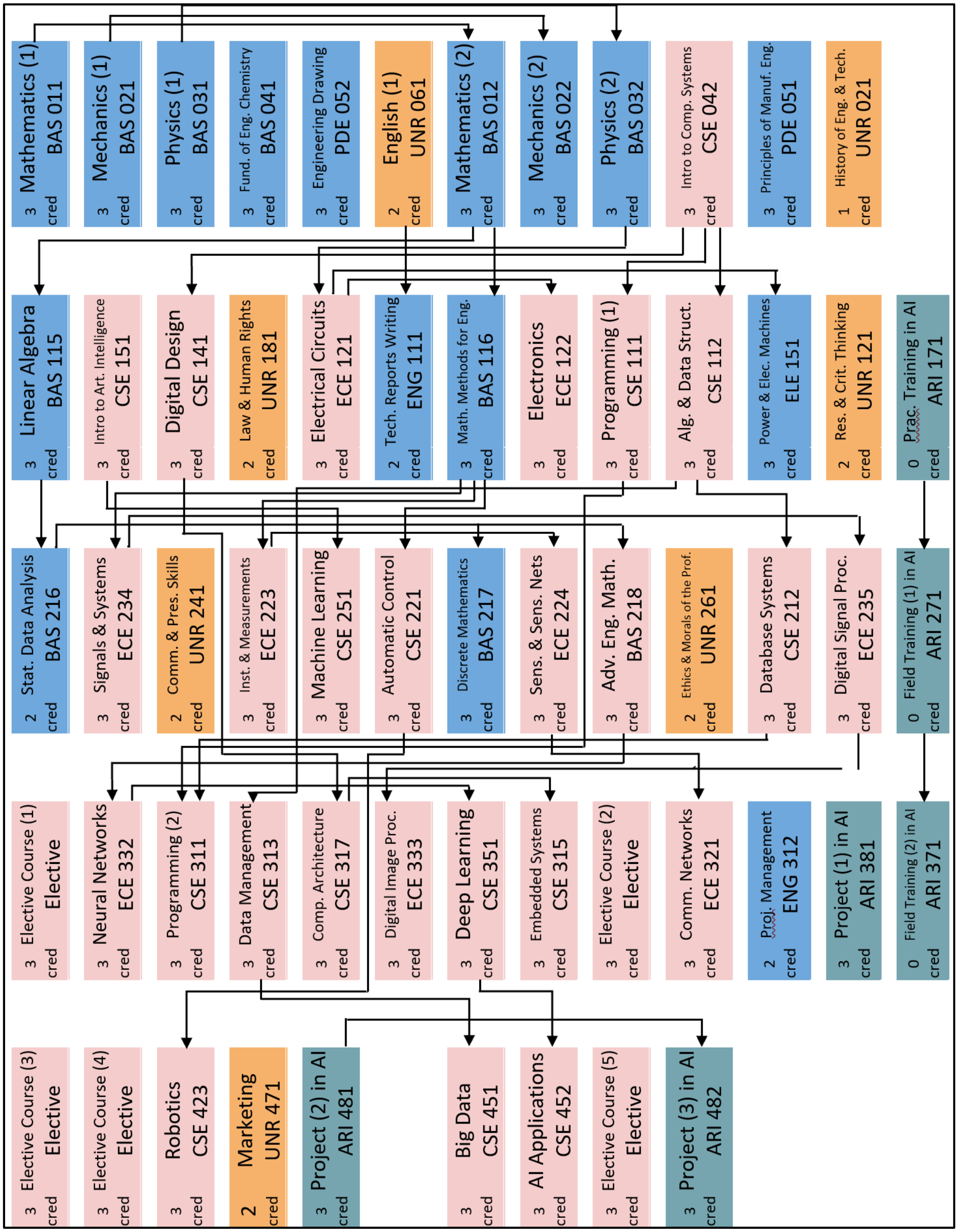
Course Code	Course Title	Hours/Week					Marks Distribution						Pre-requisites
		Credit	Lecture	Tutorial	Lab.	Free Work	SWL	Mid-term	Semester Work	Lab.	Final	Total	
CSE 451	Big Data	3	2	--	3	4	9	20	30	--	50	100	CSE 313
CSE 452	AI Applications	3	2	0	3	4	9	20	30	--	50	100	CSE 351
Elective	Elective Course (4)	3	2	2	--	5	9	20	30	--	50	100	According to Course Specs
ARI 482	Project (3) in AI	3	1		6	7	14		50	--	50	100	ARI 481
Total		12	7	2	12	20	41					400	
Total Contact hours = 21 hrs/week Total SWL = 41hrs/week													

List of overall data about the program

#	Specialized Program	NC	Credits and SWL			Total Contact Hours				4 Requirements %				BS %	EC%
			CH	ECTS	SWL	Lec	Tut	Lab	TT	UR	FR	DR	PR		
1	Artificial Intelligence Engineering (AIE)	57	160	29.824	745.6	105	71	58	234	8	28	39	25	30	15

NC	Total number of Courses	UR	University Requirement
CH	Credit Hour	FR	Faculty Requirement
ECTS	European Credit Transfer System	DR	Discipline Requirement
SWL	Student Workload	PR	Program Requirement
Lec	Lectures		
Tut	Tutorials	BS	Basic Sciences Percentage, Credit Hours
Lab	Laboratory	EC	Elective Courses Percentage, by Credit Hours
TT	Total		

Figure (2) shows the program tree. Moreover, the matrix that relates courses to competencies is shown.



Matrix of Competencies for Artificial Intelligence Engineering Program

Level	Course Title	Course Code	Courses Competencies According to NARS 2018														
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	C1	C2	C3
000	Mathematics (1)	BAS 011	√														
	Mechanics (1)	BAS 021	√														
	Physics (1)	BAS 031	√	√													
	Engineering Chemistry	BAS 041	√		√												
	Engineering Drawing	PDE 052	√		√	√											
	English Language (1)	UNR061								√							
	Mathematics (2)	BAS 012	√														
	Mechanics (2)	BAS 022	√														
	Physics (2)	BAS 032	√	√													
	Introduction to Computer Systems	CSE 042	√			√	√										
	Production Engineering	PDE 051	√	√		√											
	History of Engineering and Technology	UNR021				√	√						√				
100	Linear Algebra	BAS 115	√										√				√
	Introduction to Artificial Intelligence	CSE 151					√	√			√	√					
	Digital Design	CSE 141	√	√													
	Law and Human Rights	UNR181							√	√		√					
	Electric Circuits	ECE 121	√	√											√		
	Technical Report Writing	ENG111					√			√							
	Mathematical Methods for Engineering	BAS 116	√											√			
	Electronics	ECE 122			√	√								√		√	√
	Programming (1)	CSE 111		√		√			√		√					√	
	Algorithms and Data Structures	CSE 112	√	√									√				
	Electric Power and Machines	ELE 151	√		√	√											
	Research and Critical Thinking	UNR121					√			√	√						

	Practical Training in AI	**ARI 171**	√	√	√	√	√	√	√	√							
200	Statistical Data Analysis	**BAS 216**	√	√									√				
	Signals and Systems	**ECE 234**	√	√									√				√
	Communication and Presentation Skills	**UNR241**						√		√	√	√					
	Instrumentation and Measurements	**ECE 223**				√							√	√			√
	Machine Learning	**CSE 251**										√		√	√	√	√
	Automatic Control	**CSE 221**	√											√	√		
	Discrete Mathematics	**BAS 217**	√	√										√			
	Sensors and Sensor Networks	**ECE 224**			√	√								√		√	√
	Advanced Engineering Mathematics	**BAS 218**	√											√	√		
	Ethics and Morals of the Profession	**UNR261**						√	√	√	√						
	Database Systems	**CSE 212**				√							√		√		
	Digital Signal Processing	**ECE 235**											√		√	√	
	Training (1) in AI	**ARI 271**	√	√	√	√	√	√	√	√	√		√				
300	Elective (1)	**Elective**															
	Neural Networks	**ECE 332**	√												√	√	√
	Programming (2)	**CSE 311**						√				√		√	√	√	√
	Data Management	**CSE 313**											√		√	√	√
	Computer Architecture	**CSE 317**				√											√
	Digital Image Processing	**ECE 333**											√				√
	Deep Learning	**CSE 351**									√		√	√	√	√	√
	Embedded Systems	**CSE 315**										√			√	√	
	Elective (2)	**Elective**															

	Communication Networks	**ECE 321**											√				√
	Project Management	**ENG312**						√	√	√	√	√					
	Project (1) in AI	**ARI 381**						√	√	√	√	√	√	√	√	√	√
	Training (2) in AI	**ARI 371**	√	√	√	√	√	√	√	√	√		√				√
400	Elective (3)	**Elective**															
	Elective (4)	**Elective**															
	Robotics	**CSE 423**															
	Marketing	**UNR471**															
	AI Engineering Project (2)	**ARI 481**						√	√	√	√	√	√	√	√	√	√
	Big data	**CSE 451**											√			√	
	AI Applications	**CSE 452**									√		√	√	√	√	√
	Elective (5)	**Elective**															
	AI Engineering Project (3)	**CSE 482**						√	√	√	√	√	√	√	√	√	√

5. AIE Program Courses Syllabi

University Requirements:

UNR 061	**English (1)**								**2 Cr**
A	**Lectures**	**1**	**sections**	**2**	**Lab**	**0**	**semester**	**1**	**mandatory**
Prerequisites: ---									
Content: Basic language skills – listening to short and long conversations- listening to diverse scientific articles – writing reports and summaries for scientific articles – speaking and presenting ideas in proper English language.									
References: • *Mark Ibbotson, Cambridge English for Engineering Student's book free, Cambridge press 2011*									

UNR 121	**Research and critical thinking**								2 cr
A	Lectures	2	section	0	Lab	0	semester	2	Mandatory
Prerequisites: ---									
Content: Methods of scientific research – data/ sample acquisition – questionnaire design – data analysis techniques									
References: • *Allison, Brian, et al. Research skills for students. Routledge, 2016*									

UNR 021	History of Engineering and Technology								1 cr
A	1	Lectures	0	section	0	Lab	2	semester	Mandatory
Prerequisites: ---									
Content: History of engineering, science, and technology – role of engineering and technology in the development of civilization – technology and environment – examples of the development of the engineering activities – history of artificial intelligence									
References: • *Roger S. Kirby, Engineering in History, Dover Publications Inc. New York, United States, 1990, ISBN10 0486264122*									

UNR 181	Law and Human Rights								2 cr
A	Lectures	2	section	0	Lab	0	semester	1	Mandaory

Prerequisites: ---

Content: Corporate law (types of corporates from the legal standpoint – overview of administrative architecture – introduction to accounting – contracts and specs) -

References:

- *Roger S. Kirby, Engineering in History, Dover Publications Inc. New York, United States, 1990, ISBN10 0486264122*

UNR 241	Communications and Presentation Skills								2 cr
A	1	Lectures	2	section	0	Lab	1	semester	Mandatory

Prerequisites: ---

Content: Communications skills – planning and preparing a presentation – communication skills via body language, controlling the tone of the voice and choosing the right appearance for the presentation- best practices in using visual aids – proper structure of a presentation – presentation skills when pitching ideas to investors and stake holders.

References:

- *Joan van Emden, Lucinda Becker, Presentation Skills for Students, 3rd Edition, Red Globe Press, 2016*
- *M. Wa Mutua, S. Mwaniki, P. Kyalo, B. Sugut, Communication Skills: A University Book, Succex Publishers, 2016*
- *Ian Tuhovsky, Wendell Wadsworth, Communication Skills Training, Ian Tuhovsky, 2015*
- *Tabitha Wambui, Alice W. Hibui, Elizaeth Gathuthi, "Communication skills " Vol.1, Students' coursebook, LAP LAMBERT Academic Publishing, 2012*

UNR 261	Ethics and Critical Thinking								2 cr
A	2	Lectures	0	section	0	Lab	2	semester	Mandatory

Prerequisites: ---

Content: Basic principles of ethical values in engineering – social responsibility – engineer's responsibility – conduct surveillance – case studies. Effects of AI on ethics and politics

References:

- Lizabeth A. Stephan, David R. Bowman, William J. Park, Benjamin L. Sill, Matthew W. Ohland, "Thinking like an engineer", Published by Pearson 2018.
- Harris, C. E., Jr., Pritchard, M. S., & Rabins, M. J. Engineering Ethics. Second edition. Belmont, CA: Wadsworth, 2000

UNR 471	Marketing								2 cr
A	2	Lectures	0	section	0	Lab	1	semester	Mandatory

Prerequisites: ---

Content: Basic principles of marketing – market research – buying patterns for customers – hybrid marketing – strategic planning for marketing – defining the target customer market – E-marketing – branding – development of new products – advertising and promotions – cost estimates and strategies for defining retail prices -

References:

- *Principles of Marketing, University of Minnesota Libraries Publishing, 2015, ISBN 13: 9781946135193*

Requirements for the faculty of Engineering

BAS 011	Mathematics (1)								3 cr
B	2	Lectures	2	section	0	Lab	1	semester	Mandatory
Prerequisites: ---									
Content: **Differentiation**: Basic functions and their properties – physical meaning of derivatives and how to compute them – partial differentiation – differentiation applications – introduction to integration - integrals properties and theorems. **Algebra:** Introduction to algebra – basic concepts in algebra – linear equations – matrices and their applications – basic applications in algebra									
References: ● *Ron Larson and Bruce Edwards, Textbook of Calculus, 10th edition, 2020, Cengage Learning.* ● *Calculus by James Stewart, 2020, Cengage Learning.* ● *Ron Larson, David Falvo: Elementary Linear Algebra, cengage learning.*									

BAS 021	Mechanics (1)								3 cr
B	2	Lectures	2	section	0	Lab	1	semester	Mandatory
Prerequisites: ---									
Content: Newton's laws – vectors and forces in space – torque - balance – net force – center of mass and geometric center – distributed forces – friction									
References: ● R.C. Hibbeler, "Engineering Mechanics: Statics and Dynamics, 14th Edition", Pearson Prentice Hall, New Jersey, 2016. ● J. L. Meriam, L. G. Kriage, and J. N. Botton, "Engineering Mechanics: Statics, 8th Edition", John Wiley & Sons, New York, 20163									

BAS 012	Mathematics (2)								3 cr
B	2	Lectures	2	section	0	Lab	2	semester	Mandatory
Prerequisites: Math 011									
Content: Integration: indefinite integrals and their properties – methods of computing integrals – definition of definite integrals and their physical meaning – applications to definite integrals – introduction to numbers and composite functions. **Analytical geometry:** geometric representation of second order equations – geometric shapes and their properties -									
References: ● R.C. Hibbeler, "Engineering Mechanics: Statics and Dynamics, 14th Edition", Pearson Prentice Hall, New Jersey, 2016. ● J. L. Meriam, L. G. Kriage, and J. N. Botton, "Engineering Mechanics: Statics, 8th Edition", John Wiley & Sons, New York, 20163									

BAS 022	**Mechanics (2)**								**3 Cr**
B	**Lectures**	**2**	**sections**	**2**	**Lab**	**0**	**semester**	**2**	**mandatory**
Prerequisites: Mechanics (1) **BAS 021**									
Kinematics of a particle: curvilinear motion - Normal and tangential components. - Newton's laws - motion of projectiles - Work and energy of a particle - applications of friction.									
References: ● R.C. Hibbeler, "Engineering Mechanics: Statics, 11th Edition", Pearson Prentice Hall, 2006. ● F. P. Beer, and E. R. Johston, Jr., D. F. Mazurek, P. J. Cornwell, E. R. Eisenberg, "Vector Mechanics for Engineering, Statics and Dynamics, 9th Edition", McGraw-Hill, New York, 2010.									

BAS 031	**Physics (1)**								**3 Cr**
B	**Lectures**	**2**	**sections**	**1**	**Lab**	**1.5**	**semester**	**1**	**mandatory**
Prerequisites: ----									
Material properties: Physical quantities - Standard units and dimensions - Mechanical properties for materials - Fluid properties - Periodic motion - Mechanical waves - Sound waves - Waves in elastic media. **Heat and thermodynamics**: Temperature measurements and thermometers - Thermal expansion - Specific and latent heat - Heat transfer - Gas motion theory - First law of thermodynamics - Entropy and second law of thermodynamics.									
References: ● Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 6th Edition, Thomson Brooks/Cole 2014. ● Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.									

BAS 032	**Physics (2)**								**4 Cr**
B	**Lectures**	**2**	**sections**	**1**	**Lab**	**1.5**	**semester**	**2**	**mandatory**
Prerequisites: Physics (1) BAS 031									
ال Electricity and Magnetism: Electric charge - Electric force - Electric field- Column's law- Electric flux- Gauss law- Electric potential- Electric capacitance and Dielectrics - Ohm's law and simple circuits- Magnetic field - Baiot and Savart laws. Optics and Modern physics: Nature of light and laws of geometric optics - Interference - Diffraction - polarization - optical fiber - laser - photoelectric effects - principle of quantum theory - special theory of relativity.									
References: ● Physics for Scientists and Engineers, R.A. Serway and J.W. Jewett, 9th Edition, Thomson Brooks/Cole 2014., ● Paul A. Tipler, " Physics for scientists and engineers" sixth edition, 2008.									

BAS 041	**Engineering Chemistry**								**3 Cr**
B	**Lectures**	**2**	**sections**	**1**	**Lab**	**1.5**	**semester**	**1**	**mandatory**
Prerequisites: ----									
Equations of state-chemical thermodynamics - Material and energy balance in chemical processes- properties of solutions - Basic principles in electrochemistry and it's applications- selected topics in chemical industry.									
References: ● Brown, L. T, LeMay H. E. Jr; Bursten, B. E.; Murphy, C.J., and Woodward, P.; " Chemistry The Central Science", Pearson International Edition (11th edn), Pearson Printice Hall,)2009)									

PDE 051	**Production Engineering**								**3 Cr**
B	**Lectures**	**2**	**sections**	**0**	**Lab**	**3**	**semester**	**2**	**mandatory**
Prerequisites: ----									
Introduction to the following processes (Casting- Forging- Metal filing - Machining- Forming- Woodworking)									
References: ● *Hitomi, Katsundo. Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics. Routledge, 2017.*									

PDE 052	**Engineering Drawing**								**3 Cr**
B	**Lectures**	**2**	**sections**	**2**	**Lab**	**0**	**semester**	**1**	**mandatory**
Prerequisites: ----									
Two-dimensional drawings - Free-hand sketching - Sectional views - Auxiliary views and conventions - Computer-aided drawing (CAD) of 2D and 3D figures.									
References: ● Mcgraw-hill Mint, "Mechanical Drawing Board & CAD Techniques", Student Edition,2011									

NG 111	**Technical Reports Writing**								**2 Cr**
B	**Lectures**	**1**	**sections**	**2**	**Lab**	**0**	**semester**	**1**	**mandatory**
Prerequisites: English (1) **UNR 061**									
Technical writing definition - audience analysis - technical writing styles - technical document characteristics - automated document organization - official and unofficial document types - structure of different types of technical documents.									
References: ● *G. J. Alred, W. E. Oliu, The Handbook of Technical Writing, 12th Edition, Bedford/St. Martin's; 2018* ● *K. Hyland, Teaching and researching writing. 3rd edition Routledge academic publisher, 2016* ● *M. Markel, Technical Communication, 11th edition, MacMillan, 2015*.									

BAS 115	**Linear Algebra**								**3 Cr**
B	**Lectures**	**2**	**sections**	**2**	**Lab**	**0**	**semester**	**1**	**mandatory**
Prerequisite**: Mathematics (2) BAS 012**									
Content: Introduction to linear Algebra – linear equations – linear transformations – vector algebra – orthogonality – values and vectors – linear programming systems – matric computation – vector spaces – advanced linear algebra									
References: ● *Lay, David C., Steven R. Lay, and Judi J. McDonald. "Linear algebra and its applications 2016*									

BAS 116	**Mathematical Methods for Engineering**								**3 Cr**
B	**Lectures**	**2**	**sections**	**2**	**Lab**	**0**	**semester**	**2**	**mandatory**
Prerequisites: Mathematics (2) **BAS 012**									
Applications of partial differentiation - Maximum values of functions in more than one variable and applications - First order differential equations - Second order differential equations - Laplace transform and its applications - Analytical geometry in space.									
References: ● D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007. ● S. A. Wirkus, and R. J. Swifi, "A Course of Ordinary Differential Equations", Taylor & Francis Group, LLC, 2015.									

BAS 216	Statistical Data Analysis								2 Cr
B	**Lectures**	**1**	**sections**	**2**	**Lab**	**0**	**semester**	**2**	**mandatory**

Prerequisites: Linear Algebra **BAS 115**

Measures of tendency and dispersion - Probability distributions - Sampling theorem - tests of hypothesis - non-parametric tests - regression and correlation - time series.

References:

- D. Backman, "Advanced Calculus Demystified", McGraw-Hill, 2007.
- S. A. Wirkus, and R. J. Swifi, "A Course of Ordinary Differential Equations", Taylor & Francis Group, LLC, 2015.

ELE 151	Electrical Power and Machines								3 Cr
B	**Lectures**	**2**	**sections**	**2**	**Lab**	**0**	**semester**	**2**	**mandatory**

Prerequisites Electric Circuits ECE 121

Power: Electrical power systems - three phase systems - Theory and models of transformers - Transmission line models - Voltage and frequency control - effective and ineffective power - Optimal work of power systems.

Machines: The theory of operation - The construction of the Direct Current motors. The speed ،torque ،and current characteristics - applications of the DC motors. The theory of operation and construction of stepper motors - Permanent-magnet DC motor and Low-inertia DC Motors. The theory of operation ،construction of three phase induction motors.

References:

- Nilsson, J.W. and S.A. Riedel, Electric circuits. 2015: Pearson Upper Saddle River, NJ.
- Slade, P.G., Electrical contacts: principles and applications. 2017: CRC press.

<table>
<tr><td>BAS 217</td><td colspan="8">Discrete Mathematics</td><td>3 Cr</td></tr>
<tr><td>B</td><td>Lectures</td><td>2</td><td>sections</td><td>2</td><td>Lab</td><td>0</td><td>semester</td><td>2</td><td>mandatory</td></tr>
<tr><td colspan="10">Prerequisites : Statistical Data Analysis BAS 216</td></tr>
<tr><td colspan="10">Content: Introduction – set theory – logic – logical operations on sets – counting – proofs – algorithms – algorithm complexity analysis – mathematical induction – sequences – graphs and trees – directed graphs – undirected graphs- adjacency matrix – graph algorithms and their applications</td></tr>
<tr><td colspan="10"><u>References:</u>
● Mazumder, Numerical Methods for Partial Differential Equations, Finite Difference and Finite Volume Methods, science direct ,2016.
● Hamming, Richard. Numerical methods for scientists and engineers. Courier Corporation, 2012.</td></tr>
</table>

<table>
<tr><td>ENG 312</td><td colspan="8">Project Management</td><td>2 Cr</td></tr>
<tr><td>B</td><td>Lectures</td><td>1</td><td>sections</td><td>2</td><td>Lab</td><td>0</td><td>semester</td><td>2</td><td>mandatory</td></tr>
<tr><td colspan="10">Prerequisites --</td></tr>
<tr><td colspan="10">Basics of project management - basic administrative functions - planning, preparatory for different engineering applications. Elements of human resources management: recruitment, mentoring, and control. Total quality management, continuous improvement. - Integration management - Domain management - Time management - Cost management - Communication management - Risk management - Procurement management</td></tr>
<tr><td colspan="10"><u>References:</u>
● Kerzner, H. and H.R. Kerzner, Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons, 2017.
● Kalpakjian, S., K. Vijai Sekar, and S.R. Schmid, Manufacturing Engineering and technology. Pearson, 2014.
● Nigel J. Smith, "Engineering Project Management", 3rd Edition, Wiley-Blackwell, 2008</td></tr>
</table>

Requirements for the specialization:

CSE 151	Introduction to Artificial Intelligence								3 cr
C	2	Lectures	2	section	0	Lab	1	semester	Mandatory
Prerequisites: ---									
Content: Properties of intelligence – research in artificial intelligence – level of intelligence – problems with artificial intelligence – smart agent – knowledge classification – search methodologies – different types of search algorithms – blind search – finding optimal solutions – optimization functions – correlation – probabilistic modeling									
<u>Reference</u>: ● *Russell, Stuart J., and Peter Norvig. Artificial intelligence: a modern approach. Malaysia; Pearson Education Limited,, 2016.*									

CSE 141	Digital Design								3 cr
C	2	Lectures	1	section	1.5	Lab	1	semester	Mandatory
Prerequisites: CSE 042									
Content: simplifying circuits – logic gates – Boolean algebra – converting between binary, decimal, octal and hexadecimal systems – digital systems – Karnaugh maps – logic converters – circuits – coders – comparisons – some functionalities using logic gates – AND – OR – NOR gates – TTL – FPGA applications									
<u>**References:**</u> • *Mano, M. Morris, and Charles R. Kime. Logic and computer design fundamentals. Pearson Higher Education, 2015.,* • *Thomas L. Floyed, Digital fundamentals, Pearson international edition, 11th edition, 2019.*									

ECE 121	Electric Circuits								3 cr
C	2	Lectures	2	section	0	Lab	1	semester	Mandatory
Prerequisites: Physics (2) BAS 032									
Content: Elements of electric circuits – simple resistance networks – analysis of direct current circuits – electric networks theorems – first order circuits – alternating current electric circuits – power and power factor – resonance circuits – triple phase circuits									
References: • *William Hayt, Jack Kemmerly, Steven Durbin, Engineering Circuit Analysis, 8th ed. 2011.*									

ECE 122	Electronics								3 cr
C	2	Lectures	1	section	1.5	Lab	2	semester	Mandatory
Prerequisites: Electric circuits ECE 121									
Content: Analysis and applications of diodes – rectifying networks – Peak Inverse Voltage (PIV) – generating energy using solar cells – bipolar junction transistors properties and applications in case of direct current- direct current circuits. Field Effect Transistor (FET) and its applications - Metal Oxide Semiconductor Field Effect Transistor (MOSFET) and their applications – amplifiers - feedback amplifiers – oscillators									
References: • *Ulrich Tietze, Christoph Schenk, Eberhard Gamm "Electronic Circuits: Handbook for Design and Application", Springer; 2nd edition (March 11, 2008)* • *Neamen, Donald A. Microelectronics: circuit analysis and design. 4th edition. New York: McGraw-Hill, 2021*									

BAS 218	Advanced Engineering Mathematics								3 cr
C	2	Lectures	2	section	0	Lab	2	semester	Mandatory

Prerequisites: Statistics and Data Analysis BAS 216

Content: statistical dispersion – probability distributions – sampling from normal distribution – hypothesis testing – nonparametric tests – correlation – regression – time sequences – random variables – optimization theory – linear optimization – nonlinear optimization.

References:

- *Mary C. Meyer, Probability and Mathematical Statistics: Theory, Applications, and Practice in RSBN-10: 1611975778, SIAM (June 24, 2019)*
- *Rao, Singiresu S. Engineering optimization: theory and practice. John Wiley & Sons, 2019*

CSE 111	Programming (1)								3 cr
C	2	Lectures	0	section	3	Lab	2	semester	Mandatory

Prerequisites: Introduction to computer systems - CSE 042

Content: Introduction to programming – programming functions – logical operations – sequences – loops – characters and strings – data structures – dictionaries – error handling and exceptions – versions and version control

References:

- *Mark Lutz, "Learning Python", O' Reilly 5th edition, 2013*
- *Sommerville, software engineering, 10 ed., Pearson India 2018*

<table>
<tr><td>CSE 112</td><td colspan="8">Algorithms and Data Structures</td><td>3 cr</td></tr>
<tr><td>C</td><td>2</td><td>Lectures</td><td>1</td><td>section</td><td>1.5</td><td>Lab</td><td>2</td><td>semester</td><td>Mandatory</td></tr>
<tr><td colspan="10">Prerequisites: Introduction to computer systems - CSE 042</td></tr>
<tr><td colspan="10">Content: Introduction to data structures – data structures – data representation - Trees – queues – matrices and sequences – complexity analysis – search and sorting algorithms – recurrence – algorithms using advanced programming languages.</td></tr>
<tr><td colspan="10"><u>References:</u>
● Narasimha Karumanchi, Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles, Fifth Edition 5th Edition, 2017</td></tr>
</table>

<table>
<tr><td>ECE 234</td><td colspan="8">Signals and Systems</td><td>3 cr</td></tr>
<tr><td>C</td><td>semester</td><td>1</td><td>Lab</td><td>0</td><td>section</td><td>2</td><td>Lectures</td><td>2</td><td>Mandatory</td></tr>
<tr><td colspan="10">Prerequisites: BAS 116 – Mathematical methods in Engineering</td></tr>
<tr><td colspan="10">Content: Continuous and discrete signals and systems – basic properties of systems – properties of continuous and discrete systems – Fourier series representation = periodic signals- Parseval theorem- Fourier transform – properties for Fourier transform – Fourier transform for periodic signals – amplitude modulation – Frequency modulation – sampling theorem – continuous time signals and their representation using Z transform</td></tr>
<tr><td colspan="10"><u>References:</u>
• Lizhe Tan Jean Jiang, “Digital Signal Processing Fundamentals and Applications”, Academic Press, 9th November 2018.</td></tr>
</table>

ECE 223	Instrumentation and Measurements								3 cr
C	2	Lectures	1	section	1.5	Lab	1	semester	Mandatory

Prerequisites: BAS 116 – Mathematical Methods in Engineering

Content: Signal classification – components of a measuring device – static and dynamic properties of a measuring device – classification of measuring devices – digital measurement systems – signal conversion - sensors

References:

- *Webster, John G., and Halit Eren, eds. Measurement, Instrumentation, and Sensors Handbook: Two-Volume Set. CRC press, 2018.*
- *Morris, Alan S., and Reza Langari. Measurement and instrumentation: theory and application. Academic Press, 2012..*

ECE 221	Automatic Control								3 cr
C	2	Lectures	2	section	0	Lab	1	semester	Mandatory

Prerequisites: BAS 116 – Mathematical Methods in Engineering

Introduction to control systems - Open and closed loop control systems – Laplace transformation and transfer function - Block diagram reduction – Signal flow graph - Modeling of systems: (Electrical circuits, Mechanical systems, DC motors, AC servo motors, Synchro, Potentiometers, stepper motors – Hydraulic Servo motor – Thermal systems – liquid level systems) – Linearization of nonlinear mathematical model – Time response analysis: (First order systems – second order systems – steady state error) – Stability of control systems: (Routh stability analysis – Determining relative stability using Routh and root locus method) – Applications of the previous topics using MATLAB/Simulink toolboxes

References:

- *Farid Golnaraghi, Benjamin Kuo, "Automatic Control Systems", McGraw-Hill Education, 10 edition, 2017*
- *Ogata, Katsuhiko. Modern control engineering. Upper Saddle River, NJ: Prentice Hall, 2015*

ECE 224	Sensors, actuators and Sensor Networks								**3 Cr**
B	**Lectures**	**2**	**sections**	**2**	**Lab**	**0**	**semester**	**2**	**mandatory**
Prerequisites **ECE 223**									
Contents: Sensors and actuators in instrumentations - sensor signal preprocessing - types of sensors and actuators - specifications of sensors and actuators - sensors errors - mechanical sensors- digital sensors- stepper motors- dc motor - sensor networks - wireless sensor networks - wearable devices									
References: • *De Silva, Clarence W. Sensors and actuators: Engineering system instrumentation. CRC Press, 2015.* • *Yang, Kun. Wireless sensor networks. 2014*									

CSE 251	Machine Learning								3 cr
C	2	Lectures	2	section	0	Lab	1	semester	Mandatory
Prerequisites: CSE 151									
Content: Introduction to machine learning – simulation and modeling – supervised learning – unsupervised learning – reinforcement learning – applications to supervised learning – linear regression – logistic regression – parametric and nonparametric algorithms – newton's method – fuzzy models and their applications in control systems using Matlab.									
Reference: ● *Mohri, Mehryar, Afshin Rostamizadeh, and Ameet Talwalkar. Foundations of machine learning. MIT press, 2018*									

CSE 212	Database Systems								3 cr
C	2	Lectures	0	section	3	Lab	2	semester	Mandatory
Prerequisites: CSE 112									
Content: Basic concepts in databases – data structures and operations – data models – architecture of a database – defining data – Database design NO SQL DB – Database programming languages including SQL and Algebra									

Reference:

- *Jukic, Nenad, Susan Vrbsky, and Svetlozar Nestorov. Database systems: Introduction to databases and data warehouses. Prospect Press, 2016*
- *Coronel, Carlos, and Steven Morris. Database systems: design, implementation, & management. Cengage Learning, 2016*

ECE 235	Digital Signal Processing								3 cr
C	2	Lectures	1	section	1.5	Lab	2	semester	Mandatory
Prerequisites: ECE 234 Signals									
Content: Introduction – filter design – voice recognition – text recognition – predictive models – text encoding – video encoding – applications of artificial intelligence in signal processing.									

Reference:

- *Lizhe Tan Jean Jiang, "Digital Signal Processing Fundamentals and Applications", Academic Press, 9th November 2018*
- *Steiglitz, Kenneth. A digital signal processing primer: with applications to digital audio and computer music. Dover Publications, 2020*

CSE 313	Data Management								3 cr
C	2	Lectures	0	section	3	Lab	2	semester	Mandatory
Prerequisites: CSE 112 Algorithms and Data Structures									

Content: Introduction to data management – different representations of databases – data visualization – optimal methods for data storage and data retrieval – optimal methods for data transfer – managing big data – data protection and privacy – legal and ethical aspects of dealing with sensitive data.

References:

- *Michael N. Mitchell, "Data Management Using Stata: A Practical Handbook", Stata Press; 2nd edition 202*

CSE 311	Programming (2)								3 cr
C	2	Lectures	0	section	3	Lab	2	semester	Mandatory
Prerequisites: CSE 212, CSE 111									

Content: Introduction to advanced programming – algorithm programming – object oriented programming – creating programming environments – libraries specialized in learning and visualization (matplotlib, scikit-learn)-efficient file access – efficient data storage and retrieval

References:

- *Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", O'Reilly Media; 2nd edition (October 15, 2019)*
- *Mark Lutz , "Programming Python: Powerful Object-Oriented Programming ", O'Reilly O'Reilly Media; Fourth edition (January 18, 20112*

CSE 317	Computer Architecture								3 cr
C	2	Lectures	2	section	0	Lab	1	semester	Mandatory
Prerequisites: Digital Design CSE 141									
Content: Computer arithmetic - design of ALU - pipelined ALU and processor – multiprocessors - multicomputers control unit - instruction repertoires (RISC, CISC) - interrupt circuits - bus synchronization - I/O devices - channels - memory architectures - connection of computer peripherals - Distributed Systems- parallel processors architecture - scalable computer platforms - vector processors - vectorizing compilers - systolic arrays - loosely and tightly coupled processors - symmetric and CC-NUMA multiprocessors- data flow machines - interconnecting networks - clustering - parallel programming - performance evaluation - case studies									
References: • *Andrew S. Tanenbaum, Structured Computer Organization (5th Edition) 5th Edition, Pearson; 5 ed. 2005* • *Harris, Sarah, and David Harris. Digital design and computer architecture: arm edition. Morgan Kaufmann, 2015*									

ECE 332	Neural Networks								3 cr
C	2	Lectures	1	section	1.5	Lab	1	semester	Mandatory
Prerequisites: Advanced Mathematics BAS218									
Content: Introduction to neural networks – artificial neuron – applications to neural networks – activation functions – multilayer feed forward neural networks – backpropagation algorithms – introduction to genetic algorithms – applications to genetic algorithms – examples of neural network trainings.									
References: • *Metin Akay, Handbook of Neural Engineering, 2006.* • *Demuth, Howard B., et al. Neural network design. Martin Hagan, 2014* • *James Loy, "Neural Network Projects with Python: The ultimate guide to using Python to explore the true power of neural networks through six projects", Springer 2019*									

ECE 333	Digital Image Processing								3 cr
C	2	Lectures	1	section	1.5	Lab	1	semester	Mandatory

Prerequisites: Signal Analysis and Processing ECE 235

Content: Introduction to image processing – digital image representation – image reconstruction – image enhancement – image compression – image analysis – feature extraction from image – pattern recognition – computer vision – video processing.

Reference:

- *Bhabatosh, Chanda. Digital image processing and analysis. PHI Learning Pvt. Ltd., 2011*
- *Understanding digital image processing, Vipin Tyagi, CRC press, 2018*

CSE 351	Deep Learning								3 cr
C	2	Lectures	1	section	1.5	Lab	2	semester	Mandatory

Prerequisites: Neural Networks ECE 332

Content: Introduction to deep learning – Probability and information theory – conditional probability – numerical methods – feedforward neural networks – deep learning architecture – optimization methods for deep learning – applications to deep learning.

Reference:

- *Ian Goodfellow ,Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press 2016*

<table>
<tr><td>CSE 315</td><td colspan="8">Embedded Systems</td><td>3 cr</td></tr>
<tr><td>C</td><td>2</td><td>Lectures</td><td>1</td><td>section</td><td>1.5</td><td>Lab</td><td>2</td><td>semester</td><td>Mandatory</td></tr>
<tr><td colspan="10">Prerequisites: Computer Architecture CSE 317</td></tr>
<tr><td colspan="10">Content: Introduction to embedded systems – embedded system design – embedded computing – design and analysis for programs for embedded system design – design examples – efficient embedded system design-programming project</td></tr>
<tr><td colspan="10"><u>References:</u>
• Andrew S. Tanenbaum, Structured Computer Organization (5th Edition) 5th Edition, Pearson; 5 ed. 2005
• Harris, Sarah, and David Harris. Digital design and computer architecture: arm edition. Morgan Kaufmann, 2015</td></tr>
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<table>
<tr><td>ECE 321</td><td colspan="8">Communications Networks</td><td>3 cr</td></tr>
<tr><td>C</td><td>2</td><td>Lectures</td><td>2</td><td>section</td><td>0</td><td>Lab</td><td>2</td><td>semester</td><td>Mandatory</td></tr>
<tr><td colspan="10">Prerequisites: Sensors, actuators and sensor networks ECE 224</td></tr>
<tr><td colspan="10">Content: Types of Networks- OSI system and its seven layer communications model - networks engineering – design of TCP/IP algorithms- planning and design of communications networks – network layers- network protocols-network administration – network sensors – network traffic.</td></tr>
<tr><td colspan="10"><u>References:</u>
• Yang, Kun. Wireless sensor networks. 2014
• Dargie, Waltenegus, and Christian Poellabauer. Fundamentals of wireless sensor networks: theory and practice. John Wiley & Sons, 2010
• Mosharraf, Firouz. Computer Networks: A Top-down Approach. McGraw-Hill, 2016</td></tr>
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CSE 423	Robotics								3 cr
C	2	Lectures	1	section	1.5	Lab	2	semester	Mandatory
Prerequisites: Automatic Control CSE 221									

Content: Robotic systems – definition of robotic space and the degrees of freedom – types of robotic arms- definition of states - representation of rotations – rotational transformations – rigid transformations – homogeneous transformations – forward motion – kinematics of robotic arms : Euler's equation – Lagrange Equations – newton's recurrence formulation – linear control in robotic manipulators.

Reference:

- *Craig, John J. Introduction to robotics: mechanics and control, 3/E. Pearson Education India, 2009*
- *Saha, Subir Kumar. Introduction to robotics. Tata McGraw-Hill Education, 2014..*

3 cr	Big Data								SE 451
Elective	semester		Lab	3	section	0	Lectures	2	C
Prerequisites: Data Management – CSE 313									

Content: Introduction to big data – data loading and streaming – visualization methods for big data – managing big data – parallel and distributed systems for big data – graphical methods for representing big data- clustering methods for big data – similarity measures- designs of recommendation systems – efficiency when dealing with big data – data privacy from the legal and ethical perspectives.

Reference:

- *Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, Wiley 2015*

3 cr	AI Applications								CSE 452
Elective	semester		Lab	3	section	0	Lectures	2	C
Prerequisites: Deep Learning CSE 351									
Content: Applications of artificial intelligence in biomedical systems – natural language processing – AI applications to speech recognition – AI applications to object recognition – AI applications to robotics – AI applications to search engines - Project									
Reference: • *Joshi, Prateek. Artificial intelligence with python. Packt Publishing Ltd, 2017* • *Sterne, Jim. Artificial intelligence for marketing: practical applications. John Wiley & Sons, 2017*									

Elective Classes for Level 300

CSE 316	Decision Making systems								3 cr
C	2	Lectures	2	section	0	Lab		semester	Elective
Prerequisites: Advanced Mathematics (BAS 218)									
Content: Introduction to decision support systems – uncertainty in decision support systems – linear programming – knowledge representation , recommendation systems, interfaces for decision support – search and recommendation sorting – simplex methods – evaluation of recommendations.									
Reference: • *Bonczek, Robert H., Clyde W. Holsapple, and Andrew B. Whinston. Foundations of decision support systems. Academic Press, 2014* • *E. Berner, "Clinical Decision Support Systems: Theory and Practice", Springer; 3rd edition, 2016*									

CSE 334	Pattern Recognition								3 cr
C	2	Lectures	2	section	0	Lab		semester	Elective
Prerequisites: Advanced Mathematics (BAS 218)									
Content: Introduction to pattern recognition – problem formulation – structuring the solution – data collection – data preprocessing – classification and recognition – supervised learning – unsupervised learning – parametric methods- nonparametric methods.									
Reference: ● *G. Dougherty, "Pattern Recognition and Classification", Springer, 2013* ● *R. Duda , P.Hart and D. Strock, "Pattern Classification", Wiley, Nov 2000*									

BAS 315	Optimization Methods								3 cr
C	2	Lectures	2	section	0	Lab		semester	Elective
Prerequisites: Advanced Mathematics (BAS 218)									
Content: Linear optimization – numerical optimization – dynamic optimization – nonlinear optimization – inferential methods in optimization									
Reference: • *Rao, Singiresu S. Engineering optimization: theory and practice. John Wiley & Sons, 2019*									

CSE 319	Bioinformatics								3 cr
C	2	Lectures	2	section	0	Lab	-	semester	Elective
Prerequisite BAS 216									

Review of DNA replication ‹transcription ‹and translation ‹Genome organization - Review of molecular biology methods - DNA and protein databases ‹data storage ‹file formats ‹information retrieval - Database queries ‹sequence retrieval ‹Creation of restriction endonuclease maps - Dot plots ‹Sequence alignment ‹Local alignment ‹Global alignment ‹Multiple alignments - Alignment scores ‹Statistical significance of database searches - Genetic distances ‹Distance based phylogenies ‹Phylogenetic tree construction - Consensus sequences ‹Finding genes and open reading frames in DNA sequences - Microarrays and the transcriptome - Microarray analysis and applications of microarrays - Introduction to proteomics - Prediction of protein structure and function - Comparative genomics - Future directions of bioinformatics

Reference:

- J. *Momand, "Concepts in Bioinformatics and Genomics" , Oxford University Press; 1st edition, 2016*

CSE 318	Human Computer Interaction								3 cr
C	2	Lectures	2	section	0	Lab	-	semester	Elective
Prerequisites: Machine Learning CSE 251									

Content: Introduction to Human Computer Interaction – introduction to cognitive psychology – design methods – simulation of human perception – design sensitivity analysis – design of evaluation metrics - error prevention, detection and recovery in HCI systems

Reference:

- *Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004*

BAS 311	Statistical Learning								3 cr
C	2	Lectures	2	section	0	Lab		semester	Elective

Prerequisites: Statistics and Data Analysis (BAS 216)

Content: Linear regression – multivariate linear regression – logistic regression – linear models – nonlinear models – linear discrimination – decision trees – random forests – principal component analysis (PCA) - clustering

References:

- *Gareth James, "An Introduction to Statistical Learning: with Applications in R", springer 2017*

ECE 335	Data Analysis and Visualization								3 cr
C	2	Lectures	1	section	1.5	Lab		semester	Elective

Prerequisites: Programming 2 (CSE 311) and BAS 218

Content: Introduction to data analysis and visualization – Introduction to Python and R and their application to data representation, analysis and visualization – data exploration and pattern recognition – managing high dimensional data – statistical analysis of data – hypothesis testing- decision making – dashboard design

Reference:

- *Phuong Vo.T.H, Martin Czygan, Ashish Kumar, Kirthi Raman, "Python: Data Analytics and Visualization", O'Reilly 2017*

CSE 352	Cognitive Science								3 cr
C	2	Lectures	2	section	0	Lab		semester	Elective
Prerequisites:									
Content: Human information processing and artificial intelligence – Perception – Human memory – Visual cognition – Language and thought									
References: ● *Gurumoorthy, Sasikumar, Bangole Narendra Kumar Rao, and Xiao-Zhi Gao. Cognitive Science and Artificial Intelligence: Advances and Applications. Springer Singapore, 2018.*									

Electives – Level 400

3 cr	Internet of Things								CSE 432
Elective	semester		Lab	0	section	2	Lectures	2	C
Prerequisites: Communications Networks (CSE 321)									
Content: Introduction to Internet of things (IoT) - Device platforms and operating systems in the internet of things – wireless communication in IoT- **smart devices and networks connections - IoT embedded web servers – standardaization for communications protocols**									
Reference: • *Samuel Greengard , "The Internet of things", Springer, 2015*									

3 cr	Advanced Deep Learning								CSE 454
Elective	semester		Lab	0	section	2	Lectures	2	C
Prerequisites: Deep Learning CSE 351									
Content: Review of the basics of deep learning – advanced models in deep learning and their applications – Image to Image architectures and their applications – Generative Adversarial Networks (GANs) and their applications to different signals – transfer learning – learning form limited data – reinforcement learning – recurrent neural network models.									
Reference: ● *Ian Goodfellow ,Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press 2016* ● *S. Skansi, "Introduction to Deep Learning", Springer; 1st edition, 2018*									

3 Cr	**Natural Language Processing**								**CSE 455**
Elective	-	semester	0	Lab	2	Sections	2	Lectures	C
Prerequisites: Deep Learning CSE 351									
Content: Introduction to natural language processing – information extraction from text – translation – sentiment analysis – vector representation of words – probabilistic modeling of computational linguistics -reccuent neural networks – sequence models – long short term memory models – language translation – recommendation models									
Reference: • *Daniel Jurafsky and James Martin, " Speech and language processing", 2rd edition, 2008* • *Jacob Eisenstein, "Introduction to natural language processing", MIT Press, 2019*									

3 cr	Computer Vision								ECE 435
Elective	semester		Lab	1.5	section	1	Lectures	2	C
Prerequisites: Digital Image Processing (ECE 333)									
Content: Introduction to computer vision – basics of image formation – basics of photography – image histogram – edges – texture – image motion and tracking – optical flow– stereo – image classification – scene analysis – depth estimation- deep learning and neural networks- eigen values and eigen vectors – classification and clustering – pattern recognition.									
Reference: • *Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011*									

CSE 412	**Soft Computing**								**3 Cr**
C	Lectures	2	Sections	1	Lab	1.5	semester		Elective
Prerequisites: Neural Networks ECE 332									
Content: Introduction to soft computing – various methods in soft computing – neural networks-fuzzy logic – clustering using fuzzing logic – hybrid models – fuzzy neural networks – genetic algorithms and their applications									
Reference: • *Khalid, Saifullah, ed. Applied Computational Intelligence and Soft Computing in Engineering. IGI Global, 2017*									

3 Cr	**High Performance Computing**								**CSE 413**
Elective		semester	0	Lab	2	Sections	2	Lectures	C
Prerequisites: Programming (2) CSE 313									

Content: Computer architecture - multi-core architecture - vector representation - multiplexing - distributed processing - distributed memory - shared memory - parallel computing - data storage methods - task scheduling - GPU - communication between the computing client side and the computing server - data transmission between the client and the computing server Highly efficient programs used in computer technologies

Reference:

- *Greorg Hager and Gerhard Wellein , "Introduction to High Performance Computing for Scientists and Engineers ", CRC Press, 2010*

3 cr	Biomedical applications of Artificial Intelligence								CSE 456
Elective	semester		Lab	0	section	2	Lectures	2	C
Prerequisites: Deep Learning (CSE351)									

Content: Introduction to artificial intelligence in biomedical applications – biomedical signals and systems – introduction to mining of biomedical data – convolutional neural networks and its applications to malignancy detection – generative adversarial networks applications in medical images – image-to -image architectures and their applications to medical image segmentation – clinical outcome analysis from biomedical signals

Reference:

- *Ian Goodfellow ,Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press 2016*
- *Kevin Zhou, Hayit Greenspan and Dinggang Shen, "Deep Learning for Medical Image Analysis", Academic Press, 2016*

3 Cr	**Reinforcement Learning**								**CSE 457**
Elective	-	semester	0	Lab	2	Sections	2	Lectures	C
Prerequisites: Deep Learning CSE 351									
Content: Introduction to deep reinforcement learning – definition of the environment and states – definition of set of actions – definition of rewards- problem formulation in a deep reinforcement learning environment – application of deep reinforcement learning in artificial intelligence									
Reference: • *Maxim Lapan, "Deep Reinforcement Learning Hands-On: Apply modern RL methods to practical problems of chatbots, robotics, discrete optimization, web automation, and more, 2nd Edition", 2020* • *Laura Greasser and Wah loon Keng, "Foundations of Deep Reinforcement Learning: Theory and Practice in Python ", Addidon-Wesley, 2020*									

3 Cr	**Data Mining**								**CSE 414**
Elective	-	semester	0	Lab	2	Sections	2	Lectures	C
Prerequisites: Deep Learning BAS 218, Deep Learning CSE 351									
Content: General concepts in data mining and its different applications – parsing and storing different data types – data clustering methods – feature extraction – statistical analysis for the data – pattern recognition – manipulating different data types such as audio and text – data visualization techniques – application of machine learning algorithms on different data types									
Reference: • *P. Tang, M.Steinbash, A. Karpatne and V.Kumar, "Introduction to Data Mining", Pearson; 2nd edition (January 4, 2018)*									

3 Cr	AI applications in Signal and Image Processing								CSE 458
اختياري	-	semester	0	Lab	2	sections	2	Lectures	C
Prerequisites: Artificial Intelligence CSE 151 – Deep Learning CSE 351									
Content: Introduction to artificial intelligence applications and deep learning in signal processing – advanced deep network architectures – recuurent neural networks – long short term memory models – generative adversarial networks and their applications to generate audio signals									
References: ● *Ian Goodfellow ,Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press 2016* ● *David Foster, "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play", O'Reilly, 2019*									

3 Cr	Applications of AI in Art								CSE 459
Elective	-	semester	0	Lab	2	Sections	2	Lectures	C
Prerequisites: Deep Learning CSE 351									
Content: Introduction to applications of artificial intelligence and deep learning in art – Generative Adversarial Networks (GANs) and their applications in art generation – style transfer networks – GANs applications in music generation - - applications of GANs in interior design									
Reference: ● *David Foster, "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play", O'Reilly, 2019*									

CSE 411	**Cloud computing**								**3 Cr**
C	Lectures	2	Sections	1	Lab	1.5	semster	-	Elective
Prerequisites: Programming 2 – CSE313									

Define cloud computing, and describe the different service delivery models of the cloud computing architecture, and the ways in which the clouds can be deployed in the form of public, private, hybrid, and community clouds. Topics include history and enabling techniques, paradigm processing programming paradigm, distributed systems and system, DFS and virtualization, grid computing, cluster computing, map reduction algorithms and functional programming, and Hadoop, HDF using Hadoop / Map reduction with extremely large data sets. Students learn about the security challenges facing cloud deployments and how to adopt, operate, and judge the cloud using popular media systems. Project is required

Reference:

- *Buyya, Rajkumar, James Broberg, and Andrzej M. Goscinski, eds. Cloud computing: Principles and paradigms. Vol. 87. John Wiley & Sons, 2010*
- *Rittinghouse, John W., and James F. Ransome. Cloud computing: implementation, management, and security. CRC press, 2016*

Projects and Practical Training

0 Cr	**Practical Training in Artificial Intelligence**								**ARI 171**
Mandatory	-	semester	0	Lab	0	Sections	0	Lectures	D
Prerequisites: Passing Level 100									
Content: A practical training in a relevant institute for at least two weeks and at least 75 hours. The student is expected to provide a report as a documentation of the training and present the key learnings									

0 Cr	**Training (1) in Artificial Intelligence**								**ARI 271**
Mandatory	-	semester	0	Lab	0	Sections	0	Lectures	D
Prerequisites: Passing Level 300 and ARI 171									
Content: A practical training in a relevant institute for at least two weeks and at least 75 hours. The student is expected to provide a report as a documentation of the training and present the key learnings									

0 Cr	**Training (2) Artificial Intelligence**								**ARI 371**
mandatory	-	semester	0	Lab	0	sections	0	Lectures	D
Prerequisites: Passing Level 300 and ARI 271									
Content: A practical training in a relevant institute for at least two weeks and at least 75 hours. The student is expected to provide a report as a documentation of the training and present the key learnings									

3 Cr	**Project (1) in Artificial Intelligence**								**ARI 381**
mandatory	2	Semester	1.5	Lab	1	Sections	2	Lectures	D
Prerequisites: Passing Level 200									
Content: Completing a project that applies all the learnt concepts from different disciplines to solve a real-life problem. Student is expected to finish the project in a team and document the findings in a report and present the methodology and results									

3 Cr	**Project (2) in Artificial Intelligence**								**ARI 481**
mandatory	1	semester	3	Lab	2	Sections	1	Lectures	D
Prerequisites: Passing Level 300									
Content: Completing a project that applies all the learnt concepts from different discplines to solve a real-life problem. Student is expected to finish the project in a team and document the findings in a report and present the methodology and results									

3 Cr	**Project (3) in Artificial Intelligence**								**ARI 482**
Mandatory	2	semester	3	Lab	2	Sections	1	Lectures	D
Prerequisites: Passing Level 300 and Project 2									
Content: Completing a project that applies all the learnt concepts from different disciplines to solve a real-life problem. Student is expected to finish the project in a team and document the findings in a report and present the methodology and results.									