Unified Regulations for Bachelor Programs with Credit Hours System

Faculty of Engineering – Mansoura University

2020

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Table of Contents

Chapter One:

Regulations

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

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).
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 student may finish studying the program in nine semesters (when the student has successfully passed 160 credit hours). 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. <u>Semester GPA:</u>

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. <u>Cumulative GPA</u>

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. <u>Total Cumulative Calculation</u>

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. Requirements Condition are met

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+**	Excellent
93% to less than 97%	**4.00**	**A**	
89% to less than 93%	**3.70**	**A-**	
84% to less than 89%	**3.30**	**B+**	Very good
80% to less than 84%	**3.00**	**B**	
76% to less than 80%	**2.70**	**B-**	
73% to less than 76%	**2.30**	**C+**	Good
70% to less than 73%	**2.0**	**C**	

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 Programs 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

Credit Hour System		The Semester System	
Number of points	Estimate	Equivalent Estimate	Equivalent Percentage
4.00	**A +**	**Excellent**	**99%**
4.00	**A**		**95%**
3.70	**A-**		**91%**
3.30	**B+**	**Very Good**	**86%**
3.00	**B**		**82%**
2.70	**B-**	**Good**	**78%**
2.30	**C+**		**75%**
2.0	**C**		**72%**
1.7	**C-**	**Passed**	**69%**
1.3	**D+**		**66%**
1.0	**D**		**62%**
0.0	**F**	**Failed**	**Less than 60%**

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.

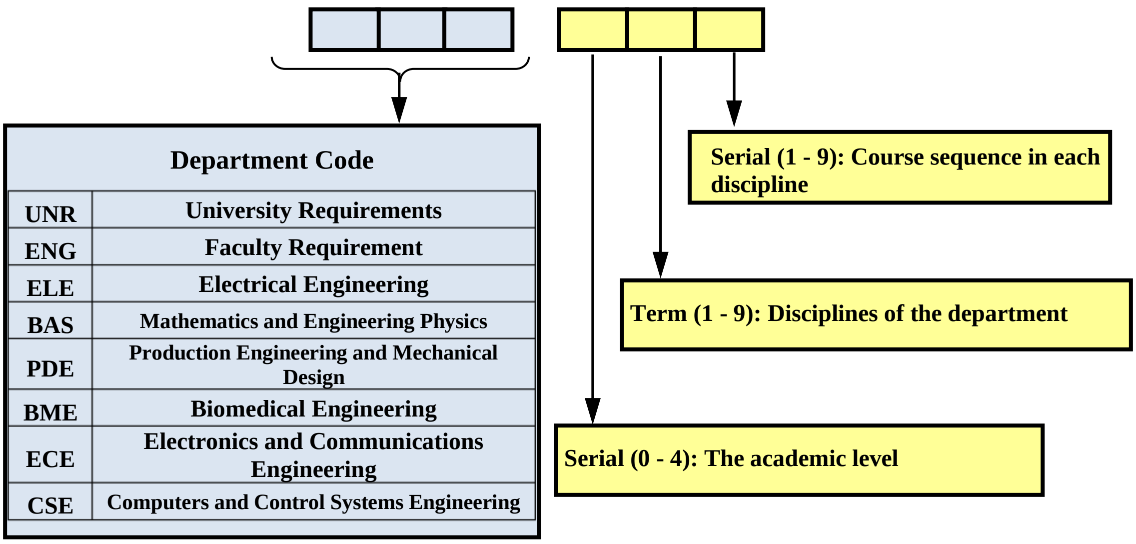


Figure (1): Courses coding system

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	Principles of Engineering Chemistry	3	9	20	20	10	50
PDE051	Principles of Manufacturing 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	Field Training (1) on BME	--	M*	3	--	--	--	--
BME391	Field 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	Fundamentals of 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	Principals of Manufacturing 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	Field 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	Field 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													

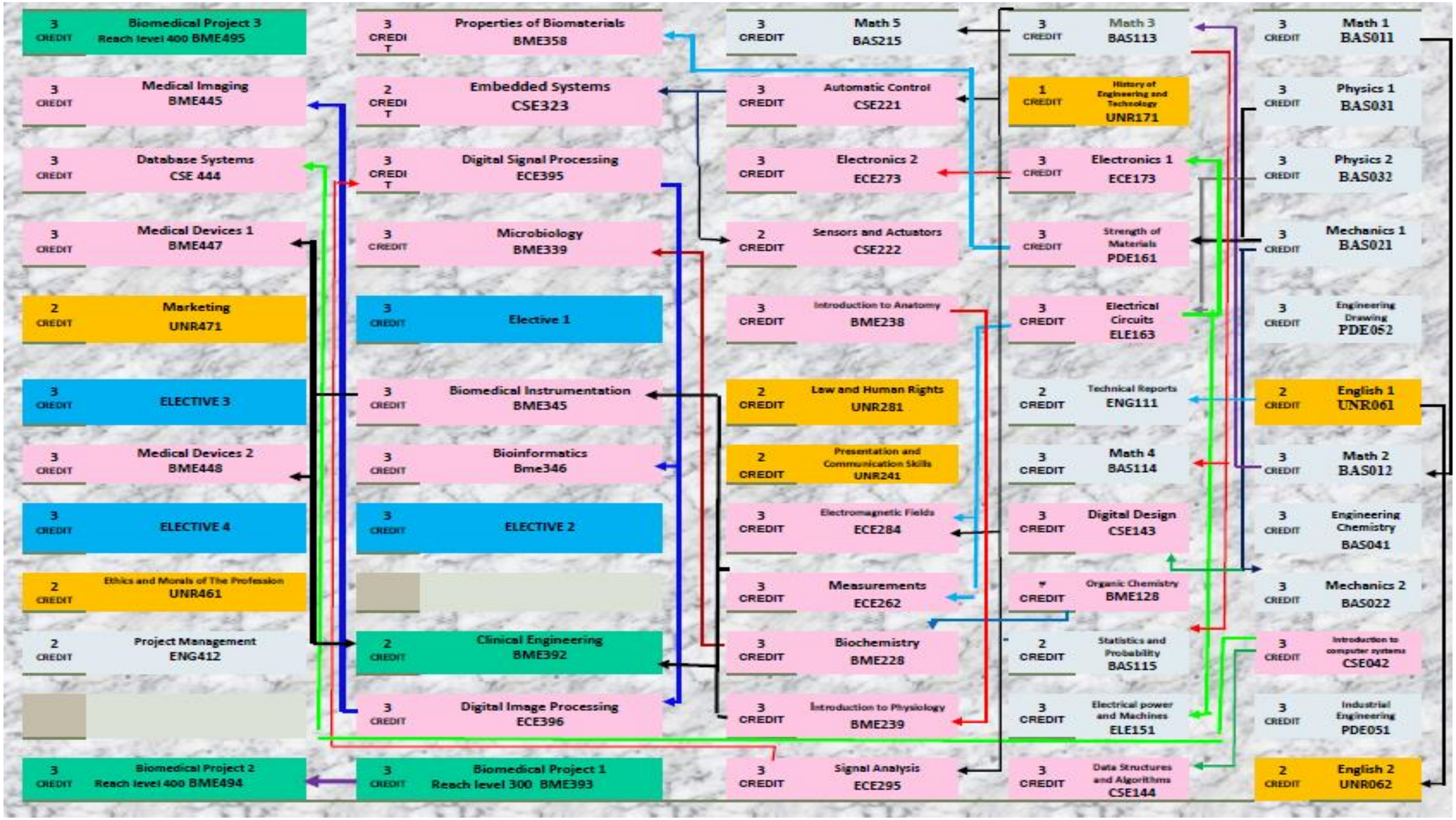
Level 400

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	Basics of Chemical Engineering	√	√														
	PDE052	Engineering Drawing	√		√													
	UNR061	English Language (1)								√								
	BAS012	Mathematics (2)	√															
	BAS022	Mechanics (2)	√															
	BAS032	Physics (2)	√	√														
	CSE042	Introduction to Computer Systems	√				√											
	PDE051	Principles of Manufacturing 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	Field 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	Field 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	2^{ed}	**BAS011**

<u>Integral Calculus:</u> 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.

<u>Analytic Geometry:</u> 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^{ed}	**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	1^{st}	---

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.*

<table>
<tr><th>BAS032</th><th colspan="8">Physics (2)</th><th>Prerequisites</th></tr>
<tr><td>3 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>1</td><td>Lab.</td><td>1.5</td><td>Semester</td><td>2nd</td><td>---</td></tr>
<tr><td colspan="10">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.</td></tr>
<tr><td colspan="10">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.</td></tr>
</table>

<table>
<tr><th>BAS041</th><th colspan="8">Principals of Engineering Chemistry</th><th>Prerequisites</th></tr>
<tr><td>3 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>1</td><td>Lab.</td><td>1.5</td><td>Semester</td><td>1st</td><td>---</td></tr>
<tr><td colspan="10">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.</td></tr>
<tr><td colspan="10">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).</td></tr>
</table>

<table>
<tr><th>PDE051</th><th colspan="8">Principles of Manufacturing Engineering</th><th>Prerequisites</th></tr>
<tr><td>3 Cr</td><td>Lecture</td><td>2</td><td>Tutorial</td><td>--</td><td>Lab.</td><td>3</td><td>Semester</td><td>2ed</td><td>---</td></tr>
<tr><td colspan="10">Introduction to the following processes (Casting- Forging- Metal filing - Machining- Forming- Woodworking)</td></tr>
<tr><td colspan="10">References:
▪ Hitomi, Katsundo. Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics. Routledge, 2017.</td></tr>
</table>

<table>
<tr><th>PDE052</th><th colspan="8">Engineering Drawing</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>1st</td><td>---</td></tr>
<tr><td colspan="10">Two-dimensional drawings - Free-hand sketching - Sectional views - Auxiliary views and conventions - Computer-aided drawing (CAD) of 2D and 3D figures.</td></tr>
<tr><td colspan="10">References:
▪ Mcgraw-hill Mint, "Mechanical Drawing Board & CAD Techniques", Student Edition,2011</td></tr>
</table>

<table>
<tr><th>ENG111</th><th colspan="8">Technical Reports Writing</th><th>Prerequisites</th></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>2nd</td><td>UNR062</td></tr>
<tr><td colspan="10">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.</td></tr>
</table>

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	1^{st}	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	1^{st}	---

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.									
<u>Reference</u>: • *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									
<u>Reference</u>: • *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									
<u>Reference</u>: • *A. Hassanien, "Medical Big Data and Internet of Medical Things: Advances, Challenges and Applications", CRC Press; 1st edition, 2018*									

<table>
<tr><td>3 Cr</td><td colspan="8">Public Health</td><td>BME365</td></tr>
<tr><td>E</td><td>Lectures</td><td>2</td><td>Tutorial</td><td>2</td><td>Lab</td><td>0</td><td>Semester</td><td>--</td><td></td></tr>
<tr><td colspan="10">Pre-requisites: BAS115 & BME228</td></tr>
<tr><td colspan="10">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</td></tr>
<tr><td colspan="10">Reference:
• M. Schneider, "Introduction to Public Health", Jones & Bartlett Learning; 5th edition, 2016</td></tr>
</table>

<table>
<tr><td>3 Cr</td><td colspan="8">Opto-electronics</td><td>ECE366</td></tr>
<tr><td>E</td><td>Lectures</td><td>2</td><td>Tutorial</td><td>2</td><td>Lab</td><td>0</td><td>Semester</td><td>--</td><td></td></tr>
<tr><td colspan="10">Pre-requisites: ECE273</td></tr>
<tr><td colspan="10">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).</td></tr>
<tr><td colspan="10"><u>Reference</u>:
• S. Kasap," Optoelectronics & Photonics: Principles & Practices ", Pearson; 2nd edition, 2012</td></tr>
</table>

<table>
<tr><td>3 Cr</td><td colspan="8">Pattern Recognition</td><td>ECE367</td></tr>
<tr><td>E</td><td>Lectures</td><td>2</td><td>Tutorial</td><td>2</td><td>Lab</td><td>0</td><td>Semester</td><td>--</td><td></td></tr>
<tr><td colspan="10">Pre-requisites :ECE396</td></tr>
<tr><td colspan="10">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</td></tr>
<tr><td colspan="10">Reference:
• G. Dougherty, "Pattern Recognition and Classification", Springer, 2013</td></tr>
</table>

<table>
<tr><td>3 Cr</td><td colspan="8">Introduction to Deep Learning</td><td>ECE421</td></tr>
<tr><td>E</td><td>Lectures</td><td>2</td><td>Tutorial</td><td>2</td><td>Lab</td><td>0</td><td>Semester</td><td>--</td><td></td></tr>
<tr><td colspan="10">Pre-requisites: BME345, ECE395</td></tr>
<tr><td colspan="10">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</td></tr>
<tr><td colspan="10"><u>Reference</u>:
• S. Skansi, "Introduction to Deep Learning", Springer; 1st edition, 2018</td></tr>
</table>

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									
<u>Reference</u>: • *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.									
<u>Reference</u>: • *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.									
<u>Reference</u>: • *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									
<u>CBC/chemistry:</u> Various causes of anemia - Factitious results - Endocrine diseases- Inflammatory disease - Renal disease - Coagulopathies - Hepatic disease Methodologies - Toxic insults - Acid-Base/Electrolyte disturbances, <u>Cytology</u>: Inflammatory/infectious - Benign tumors - Carcinomas - Sarcomas - Round cell tumors									
<u>Reference</u>: • *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	Field 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	Field 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.

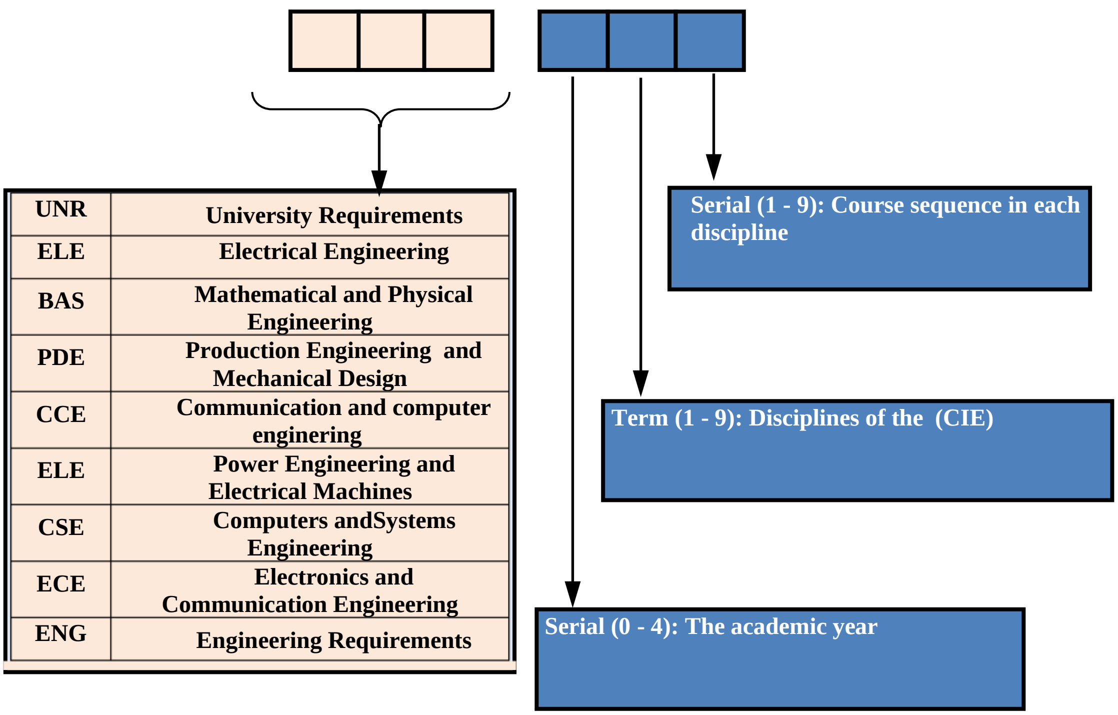


Figure (1): Courses coding system

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	Principals of Engineering Chemistry	3	9	20	20	10	50
PDE051	Principles of Manufacturing 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	Field Training (1)	1	3	--	--	--	--
CCE 371	Field 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	Principals of 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	Principles of Manufacturing 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	Field 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	Basics of Chemical Engineering	√	√													
	PDE052	Engineering Drawing	√		√												
	UNR061	English Language (1)								√							
	BAS012	Mathematics (2)	√														
	BAS022	Mechanics (2)	√														
	BAS032	Physics (2)	√	√													
	CSE042	Introduction to Computer Systems	√				√										
	PDE051	Principles of Manufacturing 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	Field 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**

<u>Integral Calculus:</u> 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.
<u>Analytic Geometry:</u> 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	---

<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	Principals of 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	Principles of Manufacturing 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	6th	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, 9th 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	7th	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	7th	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	**Field 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	Field 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	Basics of Chemical Engineering	3
PDE051	Principles of Manufacturing 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	Field Training (1)	0
MTE395	Field 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	√	√																
	Basics of Chemical Engineering	BAS041	√	√																
	Engineering Drawing	PDE052	√							√										
	English Language (1)	UNR061								√										
	Mathematics (2)	BAS012	√																	
	Mechanics (2)	BAS022	√																	
	Physics (2)	BAS032	√	√																
	Introduction to Computer Systems	CSE042	√				√													
	Principles of Manufacturing 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 Writing	ENG111					√			√										
	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	√				√													
	Field 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		√	√				√	√	√		√	√			√			
	Field Training (2)	MTE395		√	√		√	√	√	√	√	√	√				√	√		
	Data Base Systems	CSE301			√					√										√
	Internet of Things	CSE302			√		√			√	√									√
	Power Electronics	ELE301	√	√	√													√	√	
	Computer-Aided Design	PDE301			√	√	√		√	√	√		√	√					√	√
	Non-Traditional Machining Processes	PDE302			√	√	√		√	√			√							

	Microelectromechanical Systems	MPE301			√	√	√		√									√	√	
	Control in Power Stations and Air conditioning Systems	MPE302			√	√	√		√	√			√	√		√				
	Autotronic Systems	MTE301			√		√		√	√							√	√		
400	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				√	√			√	√					√				
	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	Basics of Chemical Engineering	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	Principles of Manufacturing 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	Field 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	Field 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												

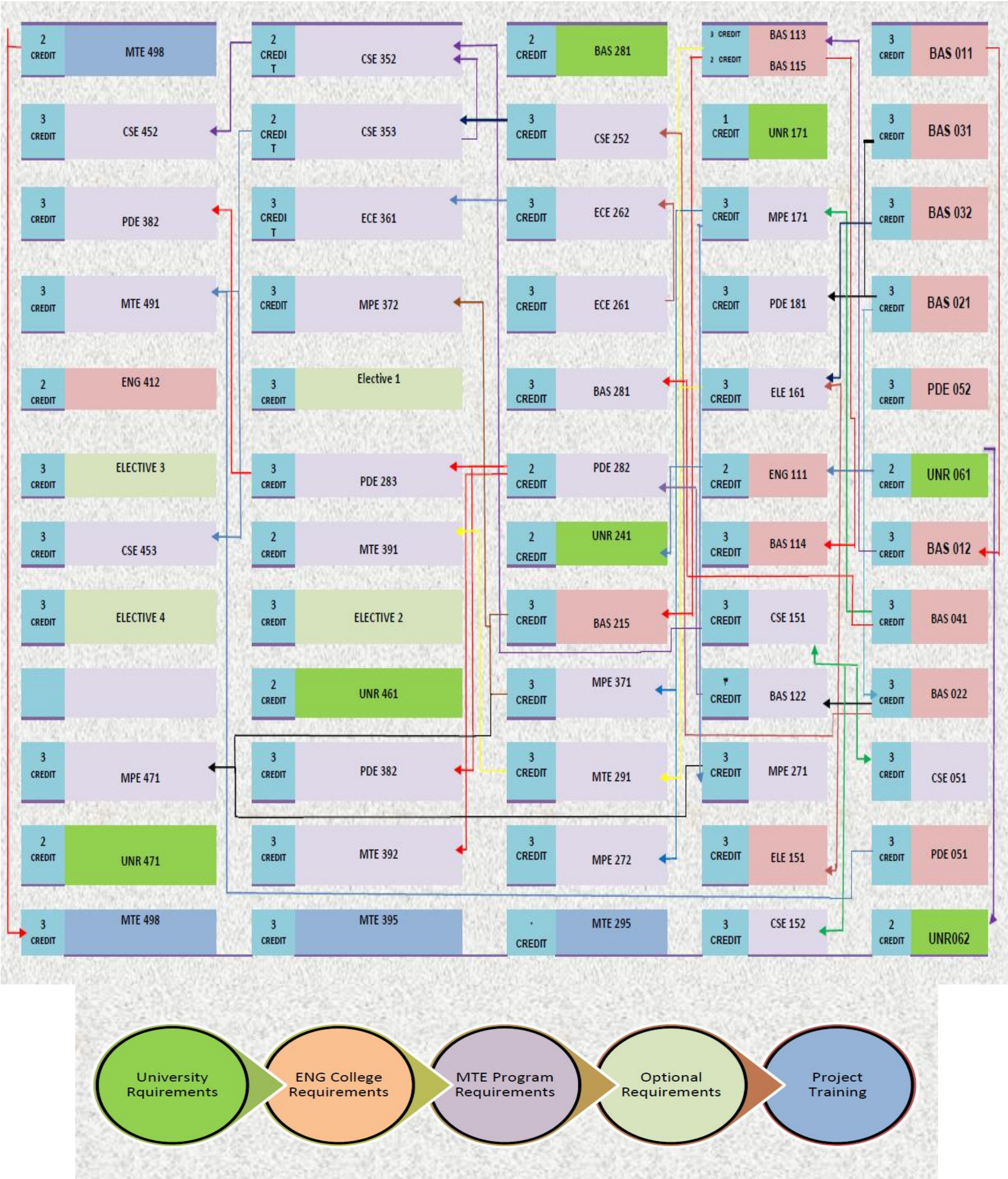
Table for Level 400:

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*									

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.									

UNR461	**Ethics and Morals of the Profession**								**Prerequisites**
2 Cr	Lecture	2	Tutorial	--	Lab.	--	Semester	2ed	------
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	**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	---

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	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	Principals of 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	Principles of Manufacturing 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^{nd}	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	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	2^{ed}	---

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.

Field Training and capstone design courses:

MTE295	Field 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	Field 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	Principles of 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	Principles of Manufacturing 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				

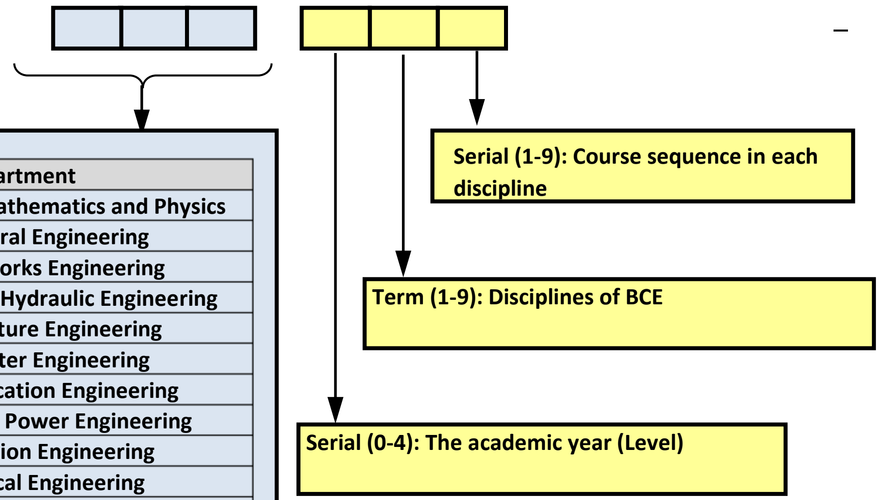
Level	Couse Code	Corse Name	Competencies as Per NARS 2018														
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	D1
	ARC102	Architectural Design (1)															X
	ARC103	Architecture Theory (1)															X
	UNR171	History of Technology Engineering			X												
200	STE205	Concrete Technology											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							
	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	Field Training (1) (Summer Semester)						X	X	X	X	X					
300	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		
	STE316	Contracts and Laws in Construction														X	
	STE301	Field 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		

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
	ARC301	Architectural Design (2)															X
	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)	BAS031	3	9	20	20	10	50
BAS041	Principles of Engineering Chemistry	Not applied	3	9	20	20	10	50
PDE051	Principles of Manufacturing 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	Field Training (1) - Building and Construction Engineering	0	--	--	--	--	--	--
STE301	Field 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.

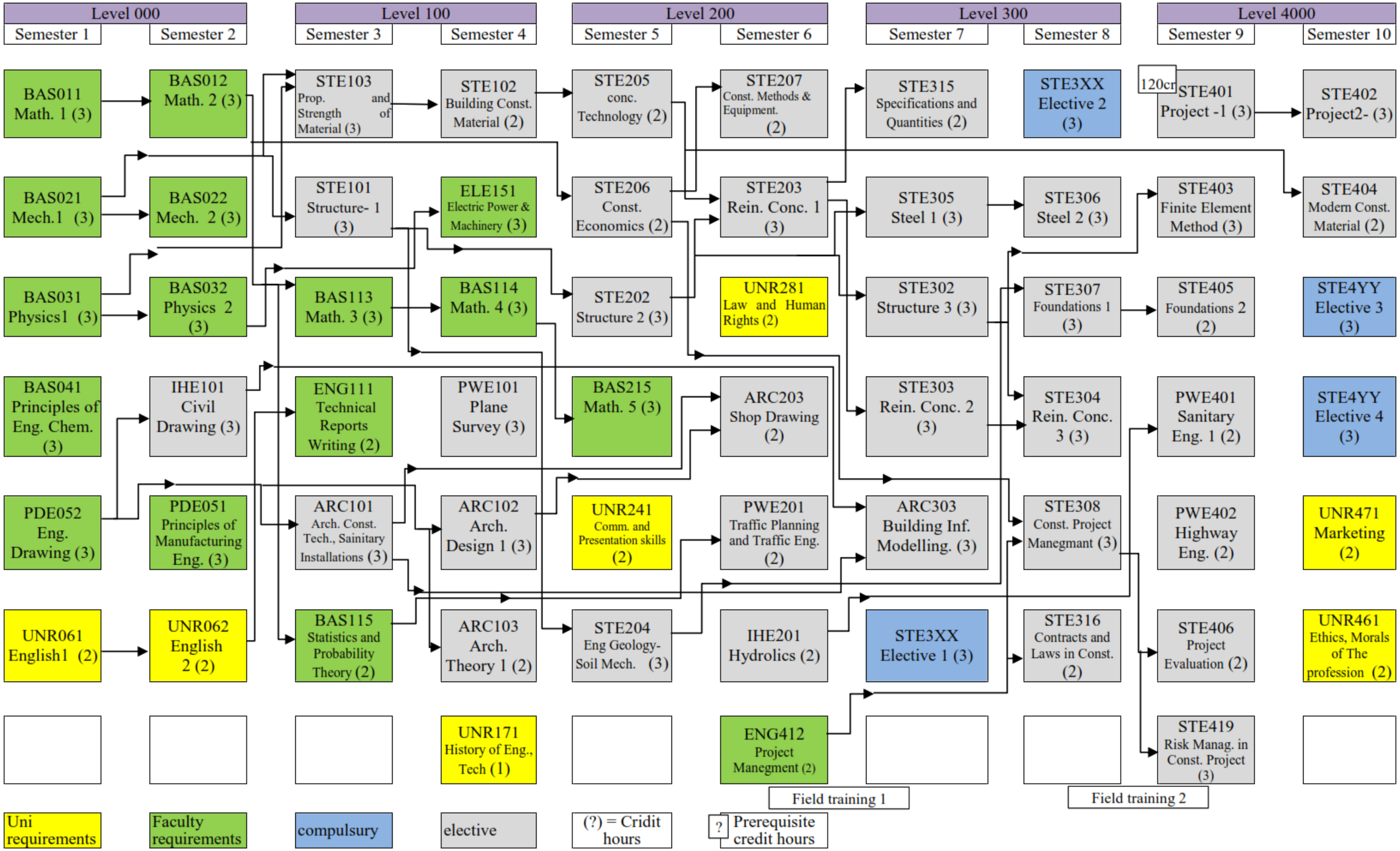

Level 000
Semester 1
Semester 2
Level 100
Semester 3
Semester 4
Level 200
Semester 5
Semester 6
Level 300
Semester 7
Semester 8
Level 4000
Semester 9
Semester 10
BAS011 Math. 1 (3)
BAS012 Math. 2 (3)
STE103 Prop. and Strength of Material (3)
STE102 Building Const. Material (2)
STE205 conc. Technology (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 Manegment (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	Principles of 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	BAS031
IHE101	Civil Drawing	3	2	3	0	4	9	20	30	--	50	100	PDE052
PDE051	Principles of Manufacturing 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	Field 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	Field Training (2) (Summer Semester)	-	-	-	-	-	-	-	-	-	-	-	Field 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	Principals of 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	Principles of Manufacturing 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	2nd	----

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/2nd	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	**Field 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	**Field Training (2)**									**Prerequisite**
0 Cr Compulsory	**Lectures**	**0**	**Tutorials**	**0**	**Lab**	**0**	**Semester**	**Summer**		**Field 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 "التزامات 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	1^{St}	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	1st	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	1st	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.

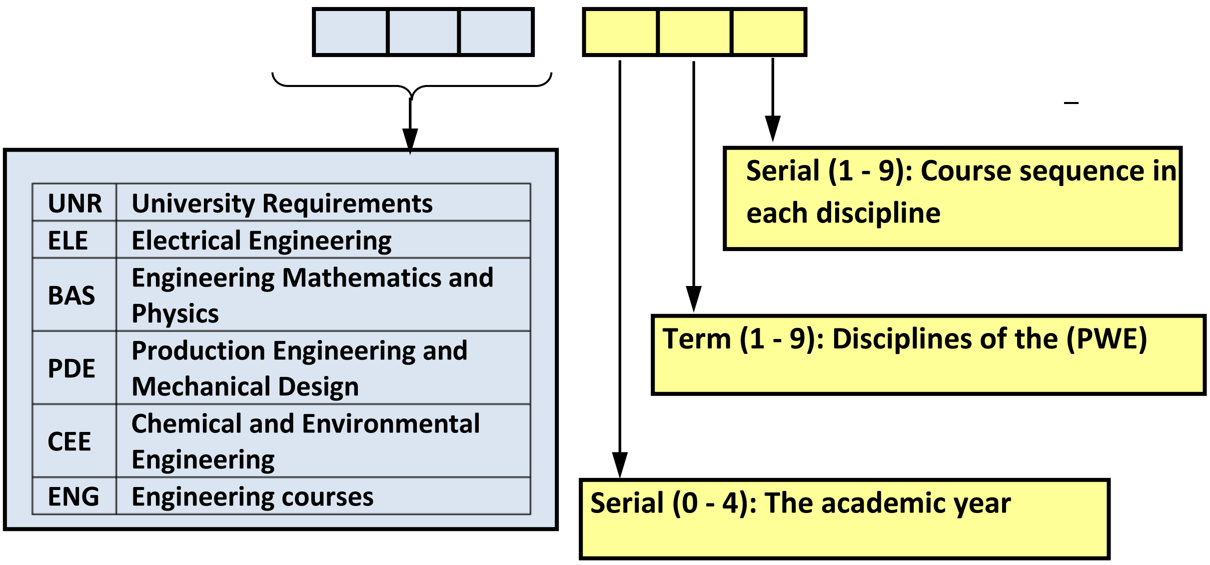


Figure (1): Courses coding system

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	Principles of Engineering Chemistry	3	9	20	20	10	50
PDE051	Principles of Manufacturing 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	Field Training (1)	1
PWE 451	Field 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	Principles of 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	Manufacturing Engineering Principles	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	Field 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	Field 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

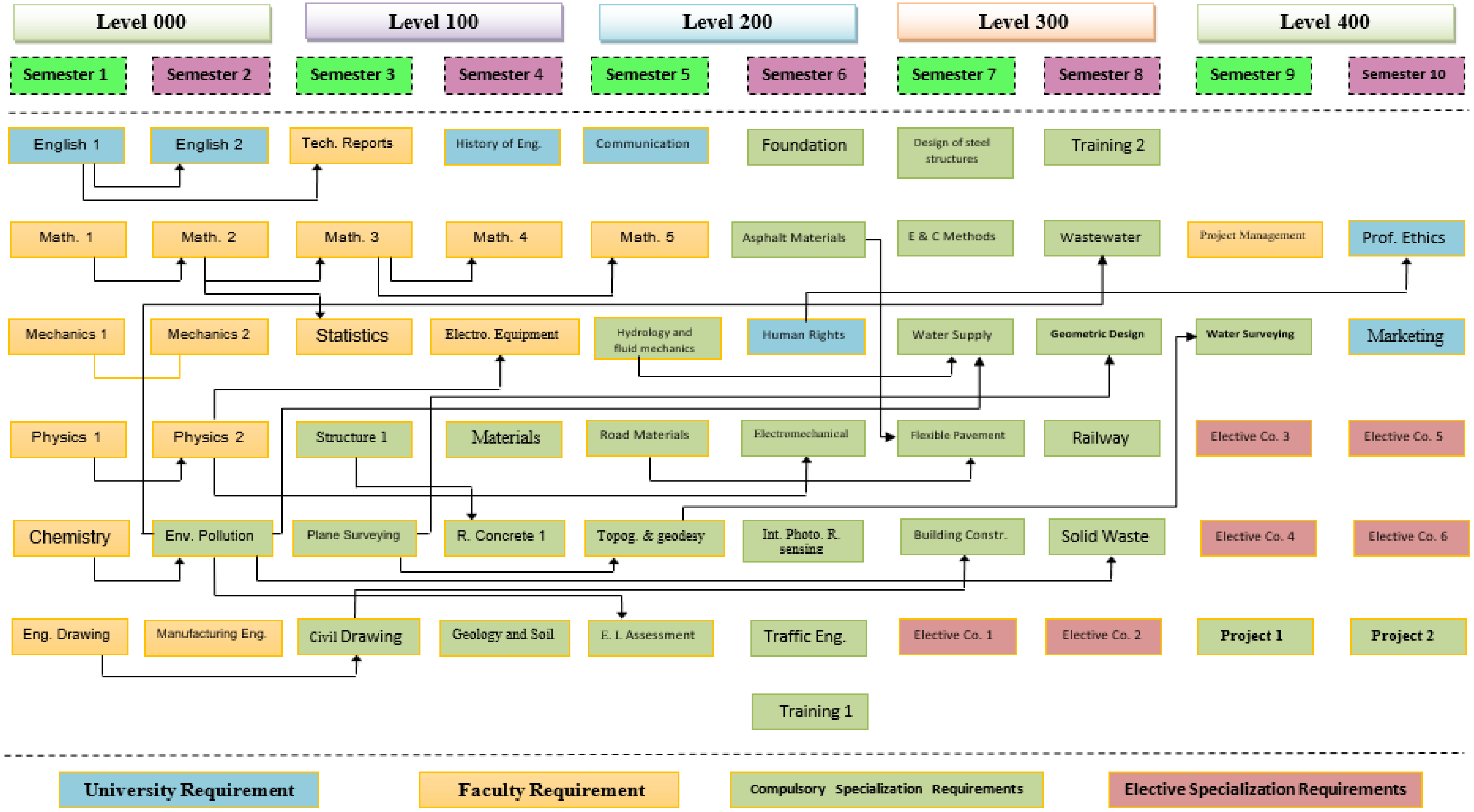
Ninth Semester

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	Principles of 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	Field Training (1)		√	√	√		√	√	√	√	√				
	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	√	√	√	√	√				√	√	√			
300	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	Field Training (2)		√	√	√		√	√	√	√	√				√
	Elective	Elective Course (3)	√	√		√	√					√	√		√	
	Elective	Elective Course (4)	√	√	√		√						√	√	√	
	ENG412	Project Management	√	√	√	√					√	√				
	PWE441	Water Surveying	√	√	√	√	√	√	√	√	√					
400	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	---

<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.

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

<u>Integral Calculus:</u> 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.

<u>Analytic Geometry:</u> 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^{ed}	**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	1^{st}	---

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	1^{st}	---

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	Principals of 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	Principles of Manufacturing 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. Vieděn : 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

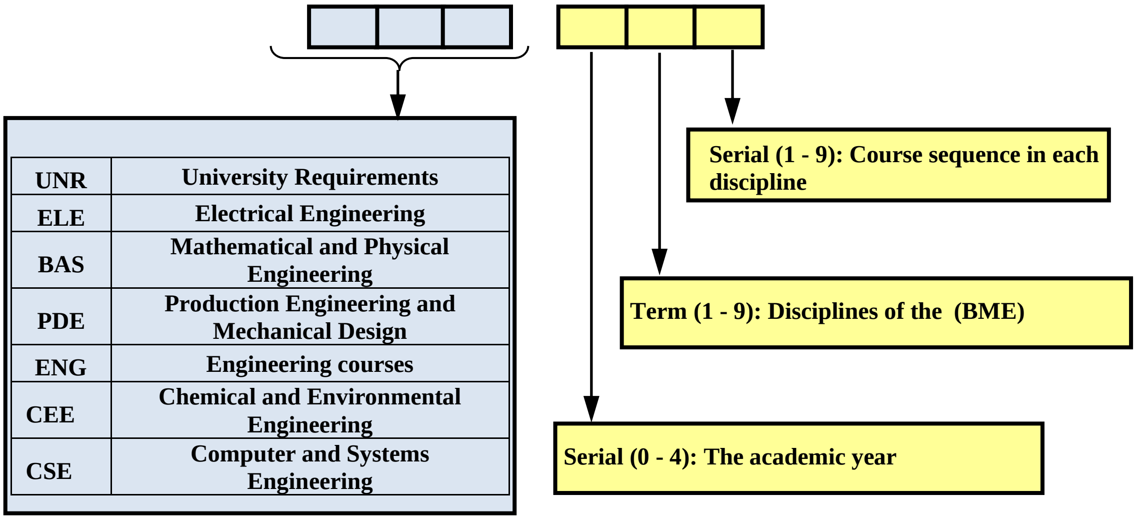


Figure (1): Courses coding system

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	Principles of Engineering Chemistry	3	9	20	20	10	50
PDE051	Principles of Manufacturing 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	Basics of Chemical Engineering	√	√												
	PDE052	Engineering Drawing	√		√											
	UNR062	English Language (2)								√						
	BAS012	Mathematics (2)	√													
	BAS022	Mechanics (2)	√													
	BAS032	Physics (2)	√	√												
	CSE042	Introduction to Computer Systems	√				√									
	PDE051	Principles of Manufacturing 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)**	√	√		√	√	√	√	√	√	√		√		
	UNR461	**Ethics and Morals of the Profession**	√			√	√		√	√	√	√				
	UNR471	**Marketing**	√	√		√	√	√	√	√	√	√				
	CEE435	**Process Control in Chemical Engineering**	√		√						√	√	√			
	CEE463	**Elective (3)**	√		√		√				√	√	√	√		
400	**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	Principles of 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	Principles of Manufacturing Eng.	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.

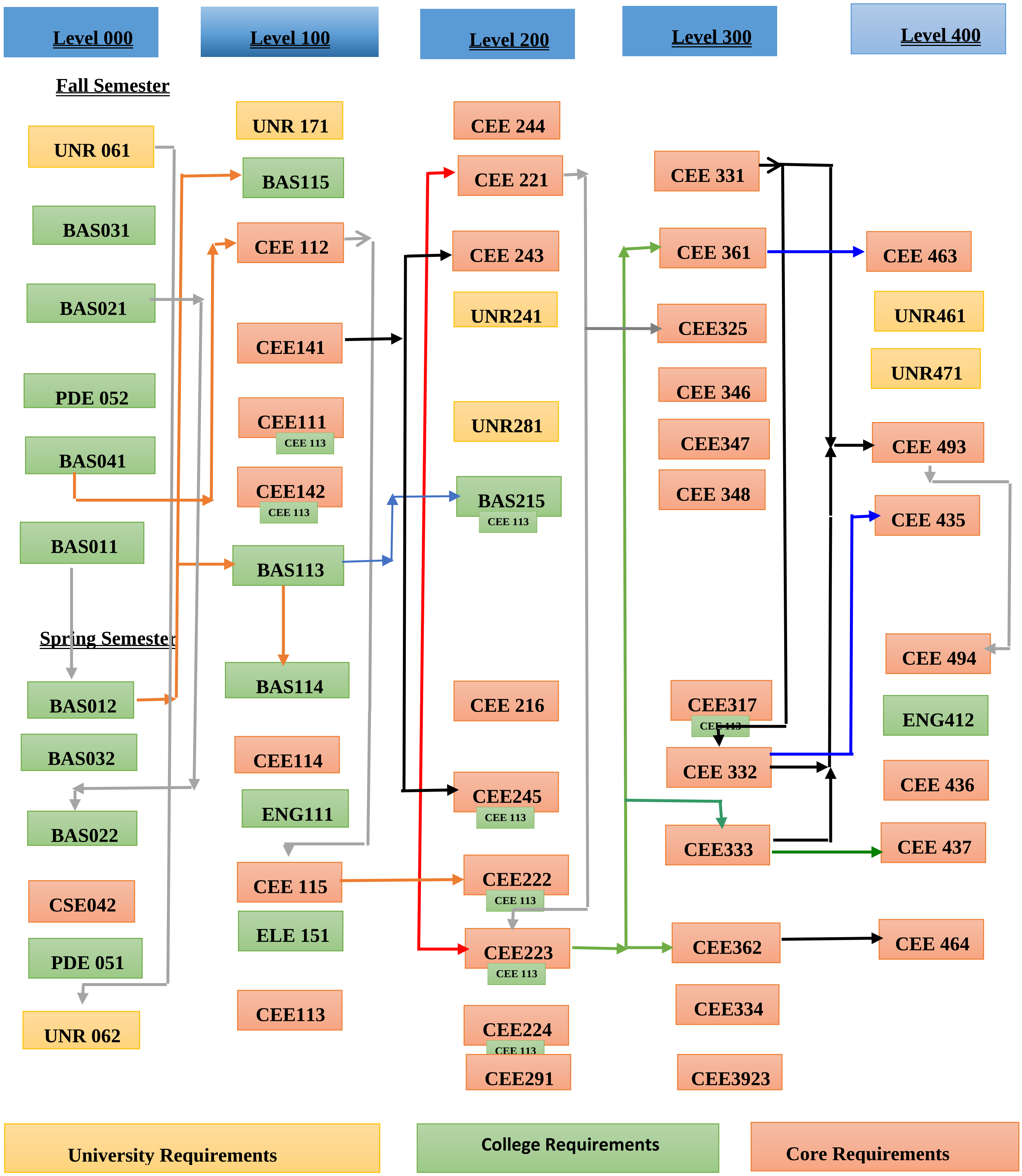


Figure (2) Courses Dependency for CEE Program

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	1^{st}	---

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	2^{ed}	**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	2^{ed}	**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	1^{st}	---

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	Principals ofEngineering 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	Principles of Manufacturing 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	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	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.***

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:

B1. **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.**

B2. **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.**

B3. **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.**

B4. **Adopt suitable national and international standards and codes to: design, build, operate, inspect and maintain electrical/electronic/mechanical/digital equipment, systems and services.**

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.

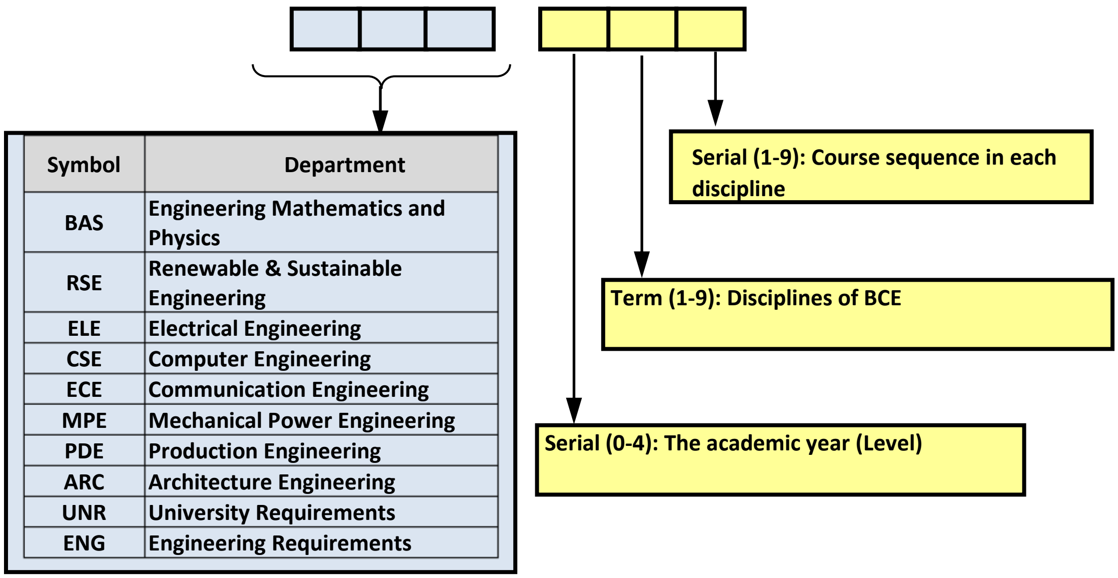


Fig. 1. Course Coding System

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	Basics of Engineering Chemistry	3
PDE05١	Engineering Drawing	3
BAS012	Mathematics (2)	3
BAS022	Mechanics (2)	3
BAS032	Physics (2)	3
PDE052	Principles of Manufacturing 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	Industrial training (1) in energy engineering	--
RSE312	Industrial 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	B1	B2	B3	B4
Mathematics (1)	BAS011	x													
Mechanics (1)	BAS021	x													
Physics (1)	BAS031	x	x												
Basics of 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									
Principles of Manufacturing 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	x												
Thermodynamics	MPE111	x	x					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	x		x		x								
Measurement and Instrumentation	RSE101	x	x				x								
Electronic circuits and integrated systems	ECE211	x	x						x						
Electric Machines (1)	ELE221			x				x			x	x			
Hydraulic Machines	MPE222		x		x		x								
Automatic Control Systems	CSE253	x	x												
Introduction to Energy	RSE204		x				x		x	x					

Conversion															
Communication and Presentation Skills	UNR214								x	x					
Materials Strength & Stresses Analysis	PDE232		x					x	x				x		
Solar energy thermal applications	MPE212			x								x			x
Heat Transfer	MPE213		x		x		x	x		x					
Modeling of dynamic systems	RSE205		x				x	x		x					
Photovoltaic Systems	ELE231		x			x	x		x						
Law and Human Rights	UNR 281		x				x	x							
Industrial training (1) in energy engineering	RSE206							x			x	x			
Mechanical Power Stations	MPE314		x	x							x		x		
Electric Machines (2)	ELE322		x			x		x	x	x					
Automatic control equipment	MPE323			x	x			x							
Refrigeration and Air Conditioning Systems	MPE313		x			x			x		x				
Elective course (1)	Elective				x		x			x		x	x	x	
Environmental impact Assessment	UNR364		x			x			x	x					x
Introduction to wind energy	RSE308		x	x							x				
Energy storage systems	RSE309			x	x		x						x	x	
Power electronics and applications	ELE333				x						x	x			
Elective course (2)	Elective		x				x		x		x	x	x	x	
Energy Policies and Economics	RSE311			x	x			x				x	x	x	
Smart buildings	ARC311			x	x						x		x		
Industrial training (2) in energy engineering	RSE312			x				x	x		x	x	x	x	x
Elective course (3)	Elective						x				x	x	x	x	x
Design of energy systems	RSE413						x				x	x	x	x	x
Power system analysis	ELE413						x			x	x	x	x	x	x
Project management	ENG412				x	x			x	x					
Introduction to Biomass Energy	RSE415					x	x					x	x		
Project (1) in Energy Engineering	RSE416				x	x		x	x	x			x	x	x
Power System control	ELE414										x	x	x	x	x
Power system protection	ELE415		x	x	x						x	x	x	x	
Ethics and Morals of the Profession	UNR461					x	x			x	x				
Elective course (4)	Elective		x	x		x			x		x	x	x	x	x
Project (2) in Energy Engineering	RSE417		x	x	x	x	x	x	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	Basics of 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	Principles of Manufacturing 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	-------
ELE111	Electric Circuits	3	2	2	--	4	8	20	30		50	100	BAS032
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	BAS041
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	BAS114
RSE204	Introduction to Energy Conversion	2	2	-	--	4	6	20	30	-	50	100	ELE112
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	RSE102
ELE231	Photovoltaic Systems	3	2	1	1.5	4.5	9	20	20	10	50	100	ELE141
UNR 281	Law and Human Rights	2	2	٠	٠	2	4	20	30	-	50	100	----------
RSE206	Industrial 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	RSE204
ARC311	Smart buildings	2	2		--	3	5	20	30	--	50	100	RSE204
RSE312	Industrial 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

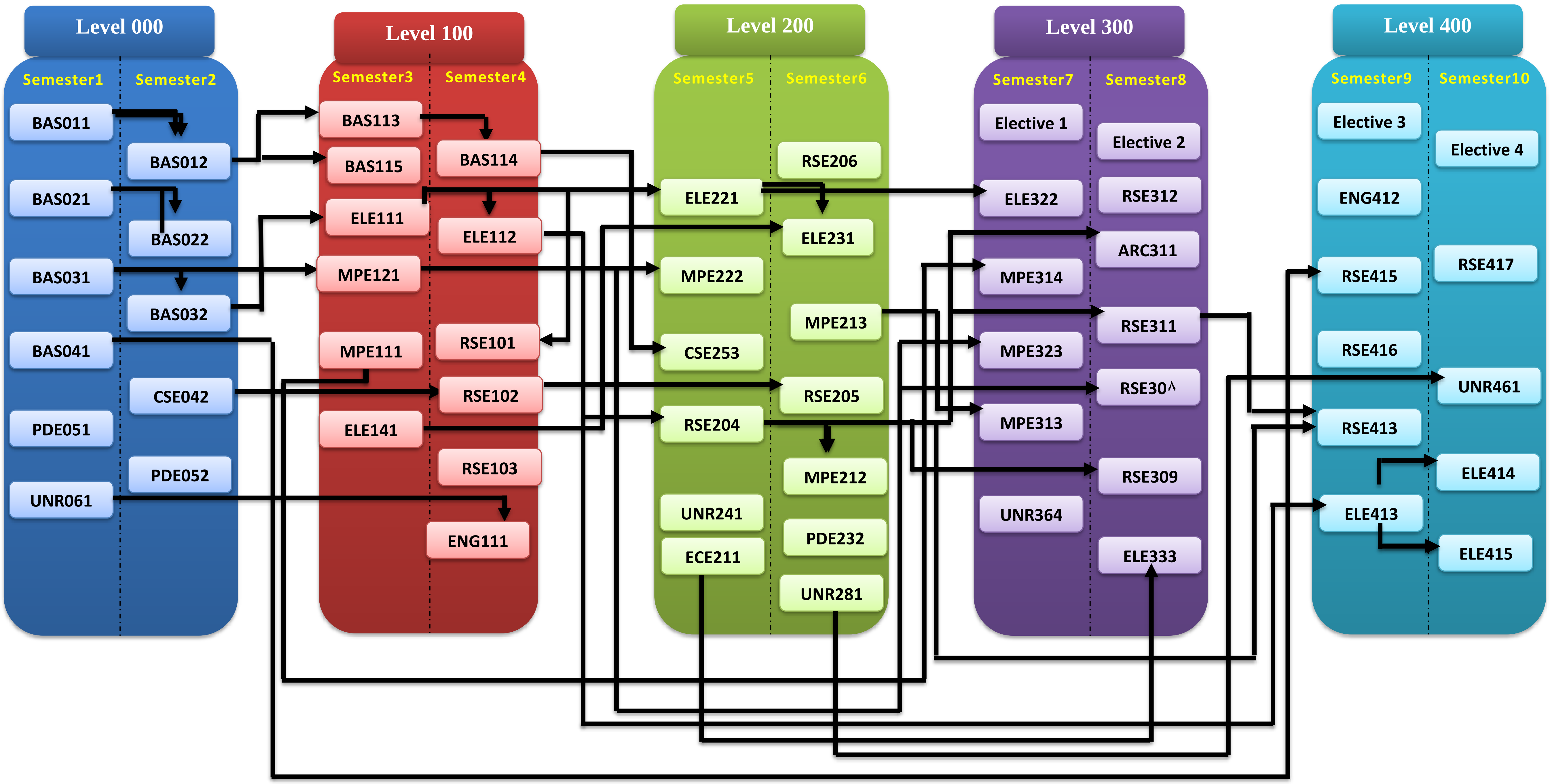
Course Coding		No. of Hrs/week						Course grades					Prerequisites
Course Code	Course Title	Credits	lect.	Tut.	Lab.	Free work	SWL	midterm	Sem. work	lab	written	total	
Elective	Elective course (3)	3	2	1	1.5	4.5	9	20	20	10	50	100	Depends on course
RSE413	Design of energy systems	3	2	1	1.5	4.5	9	20	20	10	50	100	RSE204-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	BAS041
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**	

<u>Calculus</u>: 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.

<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>

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.

<u>References:</u>

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	Basics of 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	**Principles of Manufacturing 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**	BAS032

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	BAS041
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.									

ECE211	**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**	BAS114

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**	ELE112

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

PDE2323	**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	RSE102

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	ELE141

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	**Industrial 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**	RSE204
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**	RSE204
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	**Industrial 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**	MPE111

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.