ACADEMIC STANDARDS

For B.SC. Programs of

Faculty of Engineering- Mansoura University

According To
National Academic Reference Standards
(NARS 2018)

FOR ENGINEERING

2021

Table of contents

- Renewable and Sustainable Energy Engineering Program
- Materials Engineering for Advanced Technology Program
- Sustainable Water Engineering Program

Introduction

According to the law 82-2006, the National Authority for Quality Assurance and Accreditation of Education "NAQAAE" is responsible for Quality Assurance of education as well as for building the confidence in - and ensuring the recognition of - the output of the Egyptian education system, i.e. graduates / qualifications. The law has granted NAQAAE the authority to set standards and policies and to develop the tools needed to fulfill its defined responsibilities. While recognizing the existence of- and the need for- diverse institutional missions and educational objectives, NAQAAE believes that any Engineering educational program (as any other educational program) must provide assurances that the graduates exhibit general professional competencies that meet the expectations of the community and that serve as the foundation for a process of lifelong learning and professional development of the engineering graduate. To help institutions provide this assurance and to protect the interests of the community and the students themselves, NAQAAE has developed Subject Specific National Academic Reference Standards (NARS) for engineering educational programs as well as for other subject sectors. The NARS-Engineering are meant to express the stakeholders' expectations about the graduate of an engineering school in Egypt, defining (and articulating) the attributes and competencies that holders of the qualification "Bachelor's Degree in Engineering" in the different engineering sectors should exhibit.

The bachelor's degree in Engineering is a level 5 qualification on the Egyptian National Qualification Framework. According to the Egyptian NQF descriptors, the holder of a level 5 qualification should be able to:

- Apply integrated general/ professional knowledge covering a broad spectrum of facts, principles and theories within inter-related domains with specialization in a field of study or work.
- Use analytic critical thinking to solve specialized problems in predictable and non- predictable contexts, while dealing with variation and interfering factors.
- Master a wide spectrum of specialized skills using familiar and less familiar tools.
- Critically evaluate the results of achieved tasks to establish multi-dimensional

Correlations and build technical expertise.

- Identify occupational hazards and design mitigation measures for them
- Apply cost/effectiveness measures.
- Manage processes in familiar and less familiar contexts.
- Use digital tools and media to deal with academic / professional challenges in a critical and creative manner.
- Work or study autonomously under general systems and rules, assuming full responsibility for own learning and self-development. Take informed decisions in familiar contexts.
- Assumes responsibility for own and team performance.
- Evaluate the performance of subordinates and support their development.
- Uses efficiently and develops workplace resources.
- Embrace work ethics.
- Ensures the application of quality assurance standards and procedures, enhancing methodologies and processes.

NAQAAE - being responsible for guaranteeing the quality of qualifications and of education, was keen while developing the NARS-Engineering with different stakeholders to ensure that those standards benchmark with the descriptors of level 5 qualifications on the Egyptian NQF and that they reflect the paradigm shift in Engineering education from time bound to competency-based education as will be evident throughout this document.

About the NARS

The National Academic Reference Standards (NARS)

♦ The National Academic Reference Standards (NARS) are external references for designing and upgrading the undergraduate educational program of faculties of Engineering. They also represent general expectations about the standards for the award of bachelor's degree in engineering and articulate the attributes and competencies that those possessing such qualification should be able to demonstrate.

♦ These standards represent the minimum academic quality requirements, which are regarded as appropriate and reasonable in order to protect the interests of the students, the reputation of individual faculties, and the community.

♦ The first edition of the National Academic Reference Standards was published in 2009 as outcome-based standards. In the last ten years there has been a significant progress -on the international level- in education. NAQAAE, to align with international engineering updated standards, and after consultation with the main stakeholder in Egypt decided to shift the Egyptian NARS from learning outcomes to competency based.

♦ They originate from the NQF and define graduate attributes according to the corresponding level descriptors.

The shift to competency-based engineering education

♦ Historically, engineering education has been a "Structured Process", based on a learning model that is time and teacher centered, where studying standardized courses, learning skills and participating in a projects and years of training were the determinants of completing an engineering educational program.

♦ In the recent past a shift occurred to the Learning Outcomes (LO)-based education, where intended learning outcomes were articulated in the form of Knowledge, Skills and Attitudes that a student must achieve. Despite its being a relatively successful student centered and outcome-oriented model for education; the LO based education model worked with a critical assumption that achieving separate learning outcomes (that were often subject-specific) will enable the engineering graduate to reach an appropriate level of competence to practice with some degree of autonomy. It was also based on the assumption that all learners would achieve the outcomes within the same time-based model.

♦ Through the past decade with higher societal expectations from graduates to demonstrate the development of higher competence standards and with the culminating literature supporting the value of integrated learning, the engineering education worldwide responded by a paradigm shift towards a more holistic and integrated approach to education that is competency-based education (CBE).

♦ CBE thus emerged out of a need to focus engineering education on developing learners' competencies and engaging them in real life experiences, and to emphasize learners' abilities and foster the good practices of integrated learning.

Overview of the structure of NARS- Engineering 2018

♦ The special nature of Engineering Education prepares graduates in quite different disciplines and who can work in varying job markets. Yet, they all share common attributes that are similar and that equip the engineer with critical thinking and problem-solving techniques.

♦ Engineering education varies from one school to another, and the level of specialization is not the same. Engineering programs are not only multidisciplinary, but they are also inter- and intra-disciplinary, a dilemma that faces Engineering education that tries to cope with and meet the demands of a changing technological arena daily.

♦ Thus, the Structure of the NARS-Engineering was developed to reflect the competencies that should be acquired by the engineering graduate, in addition to the competencies of the main sectors.

♦ It is left to the discretion of the different schools to develop their own inter and interdisciplinary approaches and design their programs according to their own missions; if they meet the minimum standards stipulated by the specialization.

♦ It was agreed to develop the competency framework of the NARS-Engineering according to seven specializations: Civil – Mechanical - Architectural – Electrical – Chemical – Textile – Petroleum, Mining and Metallurgy.

NARS-Engineering Competency Framework
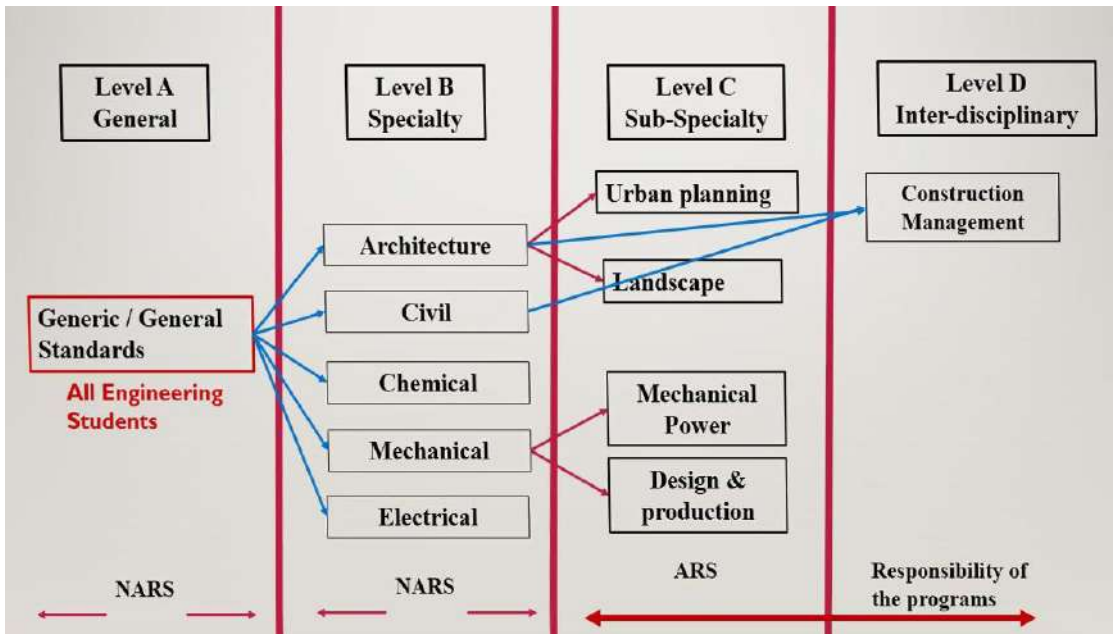
Structure of the NARS- engineering 2018

Due to the special engineering education the NARS will be divided as follows:

♦ Graduate Attributes:

  » The specific qualities that distinguish the graduate engineer

♦ General (Generic) competencies:

  » General description of the Graduate
  » Common Competencies that signify all graduates
  » All graduates of any engineering faculty should be able to master
  » These compromise the basis for the development of the programs

♦ • Specialized (discipline specific) Competencies:

  » Specific description of the graduates of the different specializations
  » Highly specialized competencies that all graduates of the discipline should be able to master.

Schools can design their programs to the level of specialization that comply with their missions. They will need to specify what root discipline they are basing their design and competences on.

Attributes of the Graduates of Engineering

The Engineering Graduate must:

1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations;

2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation;

3. Behave professionally and adhere to engineering ethics and standards;

4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance;

5. Recognize his/her role in promoting the engineering field and contribute in the development of the profession and the community;

6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles;

7. Use techniques, skills and modern engineering tools necessary for engineering practice;

8. 8. Assume full responsibility for own learning and self- development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies;

9. Communicate effectively using different modes, tools and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner;

10. Demonstrate leadership qualities, business administration and entrepreneurial skills.

Competencies for Engineering Graduates

Competencies of engineering graduate (Level A)

The engineering graduates must be able:

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 multi-cultural teams.

A8. Communicate effectively–graphically, verbally and in writing–with a range of audiences using contemporary tools.

A9. Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10. Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.

Competencies for Engineering Specializations

Competencies for engineering specialization (Level B)

1. CIVIL ENGINEERING

In addition to the above Competencies for All Engineering Programs (Level A) the BASIC CIVIL Engineering graduate must be able to:

1.1 Select appropriate and sustainable technologies for construction of buildings, infrastructures and water structures; 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.

1.2 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.

1.3 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.

1.4 Deal with biddings, contracts and financial issues including project insurance and guarantees.

2. MECHNICAL ENGINEERING

In addition to the Competencies for All Engineering Programs (Level A) the BASIC MECHANICAL Engineering graduate and similar programs must be able to:

2.1 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.

2.2 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.

2.3 Select conventional mechanical equipment according to the required performance.

2.4 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.

3. ARCHITECTURAL ENGINEERING

In addition to the Competencies for All Engineering Programs (Level A) the BASIC ARCHITECTURAL Engineering graduate and similar programs must be able to:

3.1 Create architectural, urban and planning designs that satisfy both aesthetic and technical requirements, using adequate knowledge of: history and theory, related fine arts, local culture and heritage, technologies and human sciences.

3.2 Produce designs that meet building users' requirements through understanding the relationship between people and buildings, and between buildings and their environment; and the need to relate buildings and the spaces between them to human needs and scale.

3.3. Generate ecologically responsible, environmental conservation and rehabilitation designs; through understanding of structural design, construction, technology and engineering problems associated with building designs.

3.4 Transform design concepts into buildings and integrate plans into overall planning within the constraints of: project financing, project management, cost control and methods of project delivery; while having adequate knowledge of industries, organizations, regulations and procedures involved.

3.5 Prepare design project briefs and documents and understand the context of the architect in the construction industry, including the architect's role in the processes of bidding, procurement of architectural services and building production.

4. CHEMICAL ENGINEERING

In addition to the Competencies for All Engineering Programs (Level A) the BASIC CHEMICAL Engineering graduate and similar programs must be able to:

4.1 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.

4.2 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.

4.3 Apply numerical modeling methods and/or computational techniques appropriate to chemical engineering.

4.4 Adopt suitable national and international standards and codes to design, operate, inspect and maintain chemical engineering systems.

5. ELECTRICAL ENGINEERIG

In addition to the Competencies for All Engineering Programs (Level A) the BASIC ELECTRICAL Engineering graduate and similar programs must be able to:

5.1 Select, model and analyze electrical power systems applicable to the specific discipline by applying the concepts of: generation, transmission and distribution of electrical power systems.

5.2 Design, model and analyze an electrical/electronic/digital system or component for a specific application; and identify the tools required to optimize this design.

5.3 Design and implement: elements, modules, sub-systems or systems in electrical/electronic/digital engineering using technological and professional tools.

5.4 Estimate and measure the performance of an electrical/electronic/digital system and circuit under specific input excitation and evaluate its suitability for a specific application.

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

6. TEXTILE ENGINEERING

In addition to the Competencies for All Engineering Programs (Level A) the BASIC TEXTILE engineering graduate and similar programs must be able to:

6.1 Design and operate different processing systems in the textile industries and assess the balance of cost, quality and effects on the environment in production operations.

6.2 Analyze, design and evaluate textile products by applying essential theories, principles, methods and different production technologies in textile manufacturing.

6.3 Engage in the recent technological developments and emerging fields relevant to textile engineering to design textile products, processes and systems.

6.4 Manage resources, plan textile mills and implement quality assurance activities in textile engineering.

Academic Reference Standards for B.SC. Programs

NARS-Engineering Competency Framework for Electrical engineering programs

1. **Electrical Power & Machines Engineering Program**
2. **Electronics and Communications Engineering Program**
3. **Computers and Control Systems Engineering Program**
4. **Communications and Computers Engineering Program**
5. **Artificial Intelligence Engineering Program**
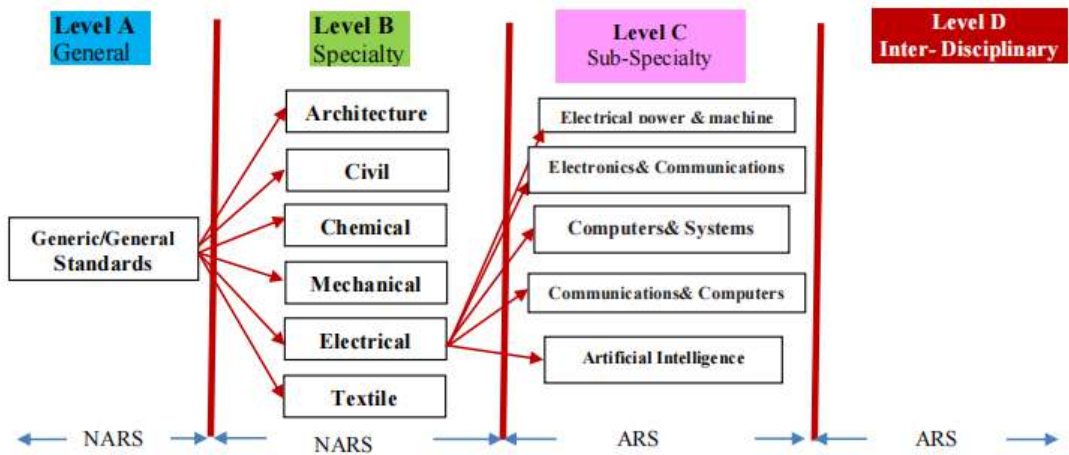
Electrical Power & Machines Engineering Program

Attributes of the Graduates of Electrical Power & Machines Program
In addition to the attributes of the graduates of engineering, the attributes of graduates of electrical power & Machines should be able to:

1. Design, manage, and conduct experiments as well as analyze and interpret data through computer-aided tools and available software to solve problems in industries and power stations.

2. Design and evaluate the performance of different electrical systems, powered by both conventional and renewable energy sources, considering the industrial safety instructions, and minimizing power losses.

3. Perform review of the supplier's documentations to comply the

specifications of the equipment for electric power generation and distribution systems.

Level C: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) and the basic electrical Engineering, the graduates of the electrical power & Machines engineering program should be able to:

C1 Identify and formulate engineering problems to solve problems in the field of electrical power and machines engineering.

C2 Analyze design problems and interpret numerical data and test and examine components, equipment and systems of electrical power and machines.

C3 Integrate electrical, electronic, and mechanical components, and equipment with transducers, actuators and controllers in creatively computer-controlled systems.

C4 Analyze the performance of electric power generation, control and distribution systems.

Electronics and Communications Engineering Program

Attributes of the Graduates of Electronics and Communications Program

In addition to the attributes of the graduates of engineering, the attributes of graduates of Electronics and Communications should be able to:

1. Integrates knowledge based on digital electronics and logic design, fundamentals of communication engineering, electronic circuits, signals and systems, power electronics, applied electromagnetic theory, integrated circuits, VLSI, control systems and computer architecture.

2. Apply control theory and measurement principals for industrial variables, signal conversion, conditioning and processing.

3. Design, operate and maintain digital and analog communication,

mobile communication, coding, and decoding systems.

4. Planning and analyzing communication networks.

5. Adapt to new telecommunication technologies.

6. Manipulate with the electronic circuits, all the way from the discrete components level, circuits' analysis and design, to the troubleshooting with emphasis on electronic power devices.

7. Deal with the computer's hardware, software, operating systems and interfacing.

8. Deal with high frequency techniques.

Level C: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) and the basic electrical Engineering, the graduates of the Electronics and Communications engineering program should be able to:

C1. Develop innovative solutions for the practical industrial problems.

C2. Plan, conduct and write a report on a project or assignment.

C3. Analyze the performance of digital and analog communication, mobile communication, coding, and decoding systems.

C4. Synthesis and integrate electronic systems for certain specific function using the right equipment.

C5. Analyze Communication Networks.

Computers and Control Systems Engineering Program

Attributes of the Graduates of Computer and Control Systems Program are the attributes of the graduates of engineering.

Level C: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) and the basic electrical Engineering, the graduates of the Computer and Systems engineering program should be able to:

C1. Demonstrate a high level of competence in identifying, defining and solving Computers and Systems Engineering problems.

C2. Select and apply appropriate mathematical tools, computing methods, design techniques and tools in Computers and Systems Engineering disciplines, for modeling and analyzing computer and systems;

C3. Evaluate different techniques and strategies for solving Computers and Systems Engineering problems;

C4. Maintain a sound theoretical approach in dealing with new and advancing technology;

C5. Select and apply appropriate IT tools to a variety of Computers and Systems Engineering problems.

C6. Generate an innovative design to solve a problem containing a range of commercial and industrial constraint.

Communications and Computers Engineering Program

Attributes of the Graduates of Communications and Computers Program

In addition to the attributes of the graduates of engineering, the attributes of graduates of Communications and Computers should be able to:

1. Apply knowledge of mathematics, science and engineering in solving open ended problems.

2. Design and conduct experiments and analyze and interpret data in the field of electronics, communications, computers and control systems.

3. Gaining knowledge of contemporary issues as the digital transformation and others related to communications and computers engineering.

4. Use techniques, skills and modern engineering tools in the field of communications and computers.

5. Design, operate and maintain various system as digital and analog communication, mobile communication, coding, and decoding systems, electronic circuits, networks, information security, control, and embedded systems.

6. Design and simulate different applications on computers and cell phones.

Level C: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) and the basic electrical Engineering, the graduates of the Communications and Computers engineering program should be able to:

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

C2. Design and simulate different applications using computers and mobile phones.

C3.Design electromagnetic applications as antennas, microwave resonators, optoelectronics and Fiber optics.

C4. Acquire the concepts of artificial intelligence and bioengineering including signal processing and image processing.

Artificial Intelligence Engineering Program

Attributes of the Graduates of Artificial Intelligence Engineering Program

In addition to the attributes of the graduates of engineering, the attributes of graduates of Artificial Intelligence Engineering should be able to:

1. Apply general and specialized knowledge and theories in the field of AIE.

2. Use critical thinking to solve problems that can or cannot be predicted in the context of AIE specialization; taking into account all variables.

3. Master an expanded set of specialized skills in the field of AIE.

4. Carry out critical evaluation of the results of completed tasks and building technical expertise, optimal exploitation and development of workplace resources.

5. Manage the usual and unusual contexts in the field of AI engineering.

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

7. Apply quality assurance standards in all procedures related to AIE engineering.

Level C: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) and the basic electrical Engineering, the graduates of the Artificial Intelligence Engineering program should be able to:

C1. Prepare and refine data for use in artificial intelligence applications
C2. Measure the performance of artificial intelligence systems for the purpose of their development
C3. Design artificial intelligence systems to solve complex problems in various fields
C4. Build artificial intelligence systems using modern tools
C5. Application of artificial intelligence systems in various applications.

NARS-Engineering Competency Framework for Mechanical engineering programs

1. **Mechanical Power Engineering Program**
2. **Production and Mechanical Design Engineering Program**
3. **Mechatronics Engineering Program**
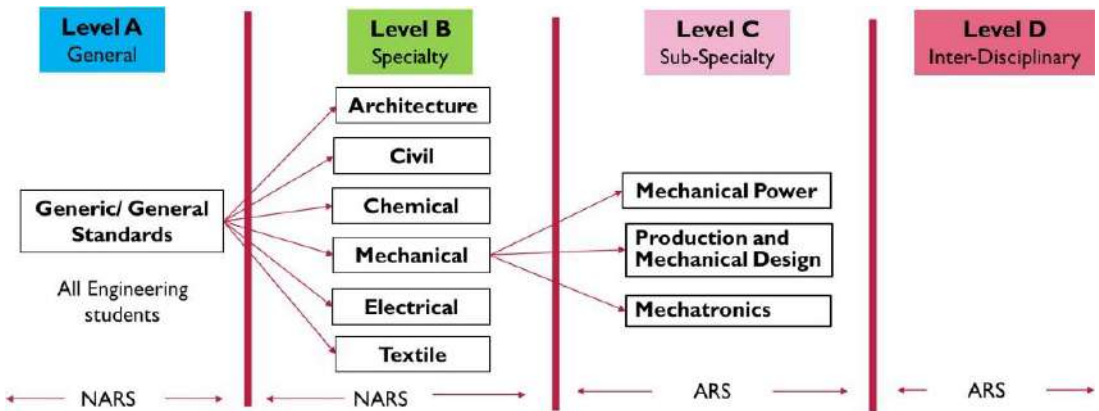
Mechanical Power Engineering Program

Attributes of the Graduates of mechanical power Program

In addition to the attributes of the graduates of engineering, the attributes of graduates of mechanical power engineering should be able to:

1. Design, manage, and conduct experiments as well as analyze and interpret data through computer-aided tools and available software to solve problems in industries and power stations.

2. Design and evaluate the performance of different mechanical systems, powered by both conventional and renewable energy sources, considering the industrial safety instructions, and minimizing power losses.

Level C: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) and the basic mechanical Engineering, the graduates of the mechanical power engineering program should be able to:

C1. Evaluate mechanical power and energy engineering designs, processes and performances and propose improvements.

C2. Analyze and interpret data and design experiments to obtain new data.

C3. Evaluate the performance and energy management of mechanical power engineering systems.

Production and Mechanical Design Engineering Program

Attributes of the Graduates of production and mechanical

program:

In addition to the attributes of the graduates of engineering, the attributes of graduates of production and mechanical design engineering should be able to:

1. Use of mathematics, physics, engineering sciences and systems analysis tools in components, machines and product design and manufacture.

2. Use computer software, necessary for the design, manufacturing and management of industrial systems and projects.

3. Select the suitable engineering materials for design & manufacturing of mechanical component.

4. Use different instruments appropriately and carry-out experimental work, and interpretation, and data presentation.

Level C: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) and the basic mechanical Engineering, the graduates of production and mechanical design engineering program should be able to:

C1. Evaluate and appraise designs, processes and products, and propose improvements;

C2. Interpret numerical data and apply analytical methods for engineering design purposes

C3. Use the principles of engineering science in developing solutions to practical mechanical engineering problems.

C4. Select appropriate manufacturing method and materials considering design requirements.

Mechatronics Engineering Program

The attributes of Mechatronics engineer:

In addition to the attributes of the graduates of engineering, the attributes of graduates of Mechatronics engineering should be able to:

1. Plan, manage and carry out designs of mechanical systems and machine elements using appropriate materials, suitable national and international standards and codes with economic and financial aspects.
2. Analyze and asses performance of mechatronic systems and components using scientific, mathematical, computer-based models, analytical methods and Modeling techniques.
3. Integrate a wide range of analytical tools, techniques, equipment, and software packages to design and develop mechatronic systems to meet a given specification and requirements.

Level C: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) and the basic mechanical Engineering, the graduates of Mechatronics engineering program should be able to:

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 Modeling 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.

NARS-Engineering Competency Framework for Civil engineering programs

1. **Civil Engineering Program**
2. **Infrastructure and Environmental Engineering Program**
3. **Structural Engineering Program**
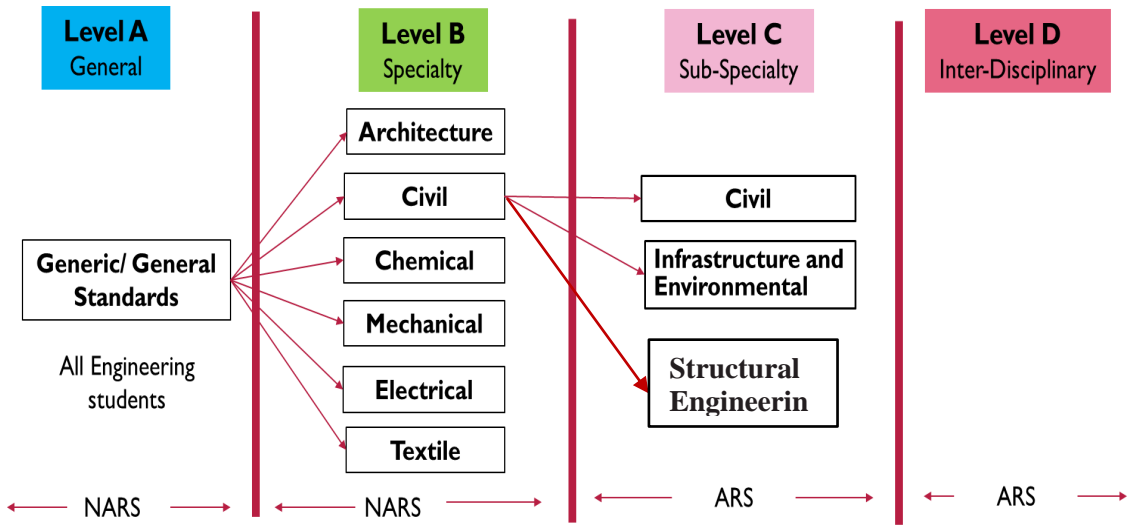
Civil Engineering Program

The attributes of Civil engineer:

In addition to the attributes of the graduates of engineering, the attributes of graduates of Civil engineering program should be able to:

1. Design, construct and protect all types of excavations and tunneling systems for different purposes.

2. Select appropriate building materials from the perspective of strength, durability, suitability of use to location, temperature, weather conditions and impacts of seawater and environment.

3. Select and design adequate water control structures, irrigation and water networks, sewerage systems and pumping stations.

4. Define and preserve properties (lands, real estates) of individuals, communities and institutions, through different surveying and GIS.

5. Design and construct structures for protection against dangers of unexpected natural events such as floods and storms.

6. Use the codes of practice of all civil engineering disciplines effectively and professionally.

Level C: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) and the basic civil Engineering, the graduates of Civil engineering program should be able to:

C1. Select appropriate building materials from the perspective of strength, durability, suitability of use to location, temperature, weather conditions and impacts of seawater and environment.

C2. Select and design adequate water control structures, irrigation and water networks, sewerage systems and pumping stations.

C3. Define and preserve properties (lands, real estates) of individuals, communities, and institutions, through different surveying and GIS tools.

Infrastructure and Environmental Engineering Program

The attributes of Infrastructure and Environmental engineer:

In addition to the attributes of the graduates of engineering, the attributes of graduates of infrastructure and Environmental engineering program should be able to:

1. Demonstrate Leadership qualities, business administration and entrepreneurial skills.

2. Apply general and specialized knowledge and theories in field of infrastructure engineering.

3. Conduct critical thinking to solve problems that can infrastructure engineering and environment specialization taking into account all variables.

4. Make correct decisions in the context of infrastructure engineering and the environment.

Level C: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A)

and the basic civil Engineering, the graduates of infrastructure and Environmental engineering program should be able to:

C1 Choose appropriate and sustainable technologies in infrastructure projects while preserving the environment.

C2 Apply optimal design for infrastructure projects such as transportation, traffic, roads, airports, stations and drinking water and sewage networks

C3 Plane and manage infrastructure projects and assess their environmental impacts.

C4 Deal with tenders, contracts and financial issues related to infrastructure and environmental projects.

Structural Engineering Program

The attributes of Structural engineer:

The attributes of graduates of Structural engineering are the attributes of the graduates of engineering.

**Level C: High specialized competencies**

In addition to the Competencies for All Engineering Programs (Level A) and the basic civil Engineering, the graduates of Structural engineering program should be able to:

C1. Investigate different practical alternatives and select efficient structural systems for engineering projects.

C2. Use information technology and computational abilities in structural engineering projects

NARS-Engineering Competency Framework for Architectural engineering programs

1. Architectural Engineering Program

2. Sustainable Architectural Engineering Program
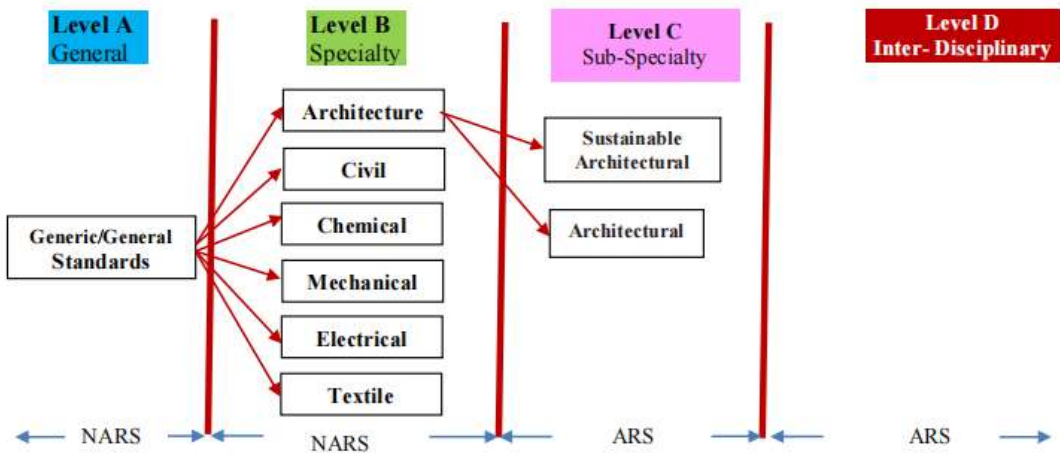
Architectural engineering program

The attributes of Architectural engineer:

In addition to the attributes of the graduates of engineering, the attributes of graduates of Architectural engineering program should be able to:

1. Act professional competence in the relationship between the environment and human needs.

2. Apply advanced lighting, acoustics, and smart systems techniques.

3. Use techniques, skills engineering to select appropriate building and construction materials effectively and professionally

Sustainable Architectural engineering program

The attributes of Sustainable Architectural engineer:

The attributes of graduates of Sustainable Architectural engineering program are the attributes of the graduates of engineering.

Level C: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) and the basic Architectural Engineering, the graduates of Sustainable Architectural engineering program should be able to:

C1 Devise creative and innovative responses to detailed designs using digital technologies including integrating, evaluating and recommending changes and control documentation associated with design by critically reviewing their relative merits to meet the client requirements.

C2 Critically assess sustainable design and technology solutions to meet client requirements and make recommendations to minimize environmental impact of project over building lifecycle to manage stakeholder expectations and identify improvements, deliver value of the building projects using contemporary techniques such as value management, life cycle considerations, choice of construction, materials and environmental approaches, urban settlement in relationship to social, economic, political and cultural factors that influence architectural design to deliver sustainable architectural projects using digital modelling.

C3 Manage resources effectively and developing user needs to meet changing technical and managerial needs to achieve project objectives in the design, construction and operation of buildings to deliver sustainable architectural projects.

C4 Execute complex defined and self- defined projects of research, development or investigation and identify and implement sustainable design requirements in terms of function, scale and context.

NARS-Engineering Competency Framework for programs

1. **Textile Engineering Program**

2. **Chemical and environmental Engineering Program**
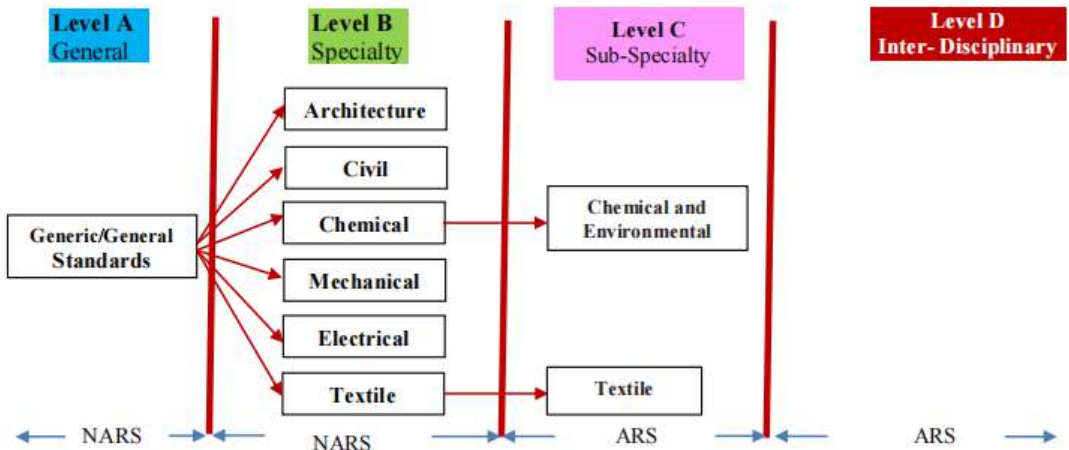
Textile Engineering Program

The attributes of Textile engineer:

In addition to the attributes of the graduates of engineering, the attributes of graduates of Textile engineering program should be able to:

1. Manage textile production processes and identify and solve textile engineering problems.

2. Construct plans for production, maintenance, and replacements of machines and quality assurance activities to achieve specific requirements in terms of production, quality, efficiency, and cost.

3. Follow scientific and technological developments, in the field of textile engineering and related fields.

Level C: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) and the basic Textile Engineering, the graduates of Textile engineering

program should be able to:

C1 Think in a creative manner in textile production system design and operation

C2- Select and apply the special tools and software packages used in textile

engineering for modelling and analyzing design and production problems.

C3 -Identify optimization criteria and assess the delicate balance of cost, quality and effects on the environment in production operations.

C4- Analyze textile products and manufacturing processes, and propose improvement ideas.

Chemical and environmental Engineering Program

The attributes of Chemical and environmental engineer:

In addition to the attributes of the graduates of engineering, the attributes of graduates of Chemical and environmental engineering program should be able to:

1. Apply general, specialized knowledge and theories in the field of Chemical and Environmental engineering.

2. Conduct critical thinking to solve problems that can or cannot be expected in the context of chemical and environmental engineering taking into accounts all variables.

3. Make correct decisions in the context of Chemical and environmental engineering.

Level C: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) and the basic Chemical Engineering, the graduates of Chemical and environmental engineering program should be able to:

C1 Research, design, plane, or perform engineering duties in the prevention, control, and remediation of environmental hazards.

C2 Choose appropriate and sustainable technologies for Chemical and environmental project.

C3 Management of Material Resources – Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work without pollution.

C4 Determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes.

Building and Construction Engineering Program
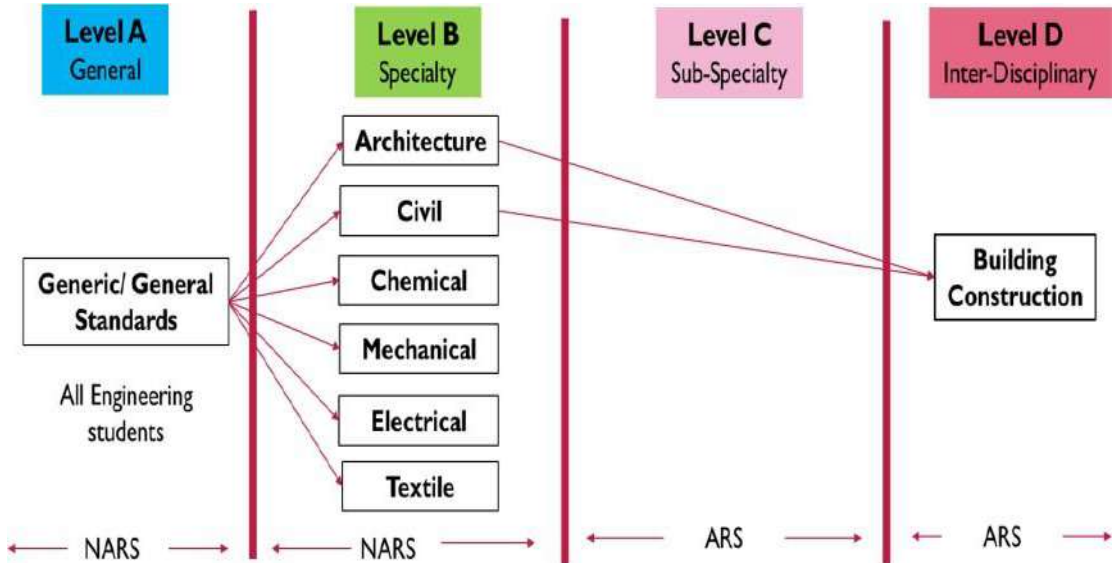
The attributes of Building and Construction engineer:

In addition to the attributes of the graduates of engineering, the attributes of graduates of Building and Construction engineering program should be able to:

1. Apply analytical, experimental, design, construction engineering processes, and management techniques with proficiency aided by modern engineering tools.

2. Act professionally in design and construct of civil, architectural, and building construction engineering disciplines.

3. Use the codes of practice of civil, architectural, and building construction engineering disciplines effectively and professionally.

4. Select appropriate building and construction materials from the perspective of strength, durability, sustainability, suitability, environment conditions, to develop the society scientifically and culturally.

5. Implement quality assurance and quality control systems in building construction engineering projects.

6. Lead, manage, and supervise a group of designers, site engineers, supervisors.

Level D: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) the graduates of Building and Construction engineering program should be able to:

D1. 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.

D2. 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.

D3. 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.

D4. Deal with biddings, contracts and financial issues including project insurance and guarantees

D5. 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.

D6. Generate ecologically responsible, environmental conservation and rehabilitation designs; through understanding of structural design, construction, technology and engineering problems associated with building designs.

Biomedical Engineering Program

| Level A
General | Level B
Specialty | Level C
Sub-Specialty | Level D
Inter-Disciplinary |
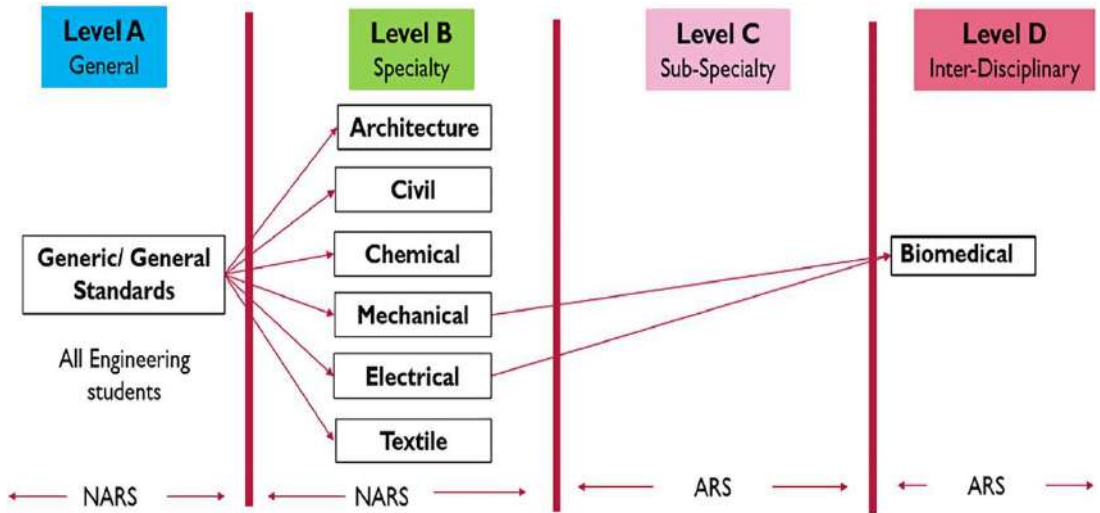
The attributes of Biomedical engineer:

In addition to the attributes of the graduates of engineering, the attributes of graduates of biomedical engineering program should be able to:

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

2. Identify occupational risks and ways to reduce them.

3. Apply cost-effectiveness measures and work ethics.

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

5. Make correct decisions in the context of medical engineering and carry out optimal exploitation and development of workplace resources.

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

Level D: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) the graduates of biomedical engineering program should be able to:

D1. Model, analyze and design physical systems applicable to the specific discipline by applying the concepts of: solid Mechanics, Material

Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis.

D2. Adopt suitable national and international standards and codes; and integrate legal, economic and financial aspects to: design, build, operate, inspect and maintain mechanical systems.

D3. Design, model and analyze an electrical/electronic/digital system or component for a specific application; and identify the tools required to optimize this design. And then; Estimate and measure the performance evaluate its suitability for a specific application.

D4. Adopt suitable national and international standards and codes to: design, build, operate, inspect and maintain electrical / electronic / digital equipment, systems and services.

D5. Design, analyze and measure the performance of medical systems in various fields, and calibrate medical devices to check the results required for the diagnosis.

D6. Use digital technology and computer diagnostics to assist the doctor in early diagnosis of diseases.

Renewable and Sustainable Energy Engineering Program
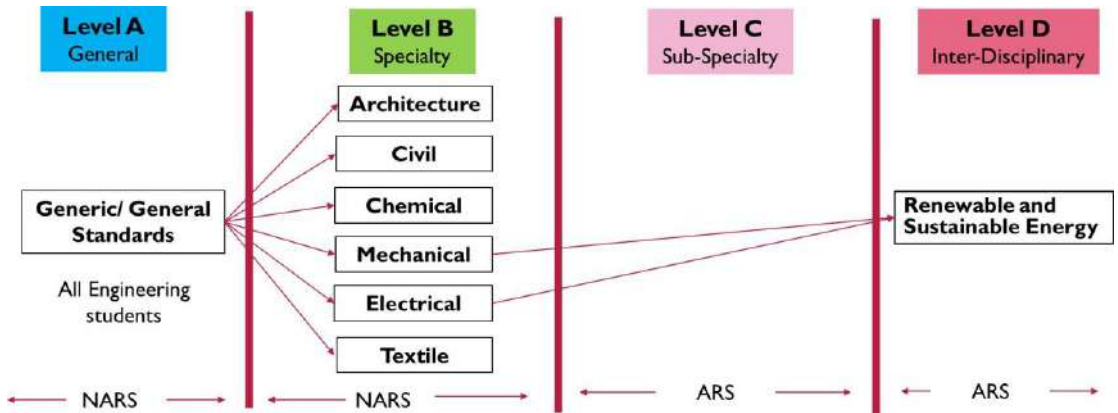
The attributes of Renewable and Sustainable Energy engineer:

In addition to the attributes of the graduates of engineering, the attributes of graduates of Renewable and Sustainable Energy engineering program should be able to:

1. Link renewable energy sciences with other engineering sciences.

2. Deal efficiently with modern technological methods used in generating and converting alternative energies.

3. Employ theories, information, data and ideas that achieve energy and raw materials rationalization and take decisions that guarantee good management and quality performance.

4. Model and design integrated energy systems in which different disciplines overlap.

5. Design, implement, operate and maintain renewable energy stations and conduct specialized research and studies in the energy field

6. Deal with problems during the performance of tasks, communication skills and ensure the performance of equipment efficiently.

Level D: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) the graduates of Renewable and Sustainable Energy engineering program should be able to:

D1 select, model and analyze system applicable to the renewable energy systems by applying the concepts of: Thermodynamics, Heat Transfer, Fluid Mechanics, control Theory and systems, Mechanical Design and Analysis, Dynamics and Vibrations, Generation, Transmission and Distribution of renewable energy systems.

D2 Design, model and analyze an electrical/electronic/ mechanical/digital system or component for renewable energy application; and identify the tools required to optimize this design.

D3 Estimate and measure the performance of an electrical/ electronic/ mechanical/ digital system and circuit under specific input excitation, and evaluate its suitability for a renewable energy application.

D4 Adopt suitable national and international standards and codes to design, build, operate, inspect and maintain electrical/ electronic/ mechanical/ digital equipment, system and services.

D5 Select conventional mechanical and electrical equipment according to the required performance of the renewable energy systems.

Materials Engineering for Advanced Technology Program

The attributes of Materials Engineering for Advanced Technology engineer:

In addition to the attributes of the graduates of engineering, the attributes of graduates of Materials Engineering for Advanced Technology program should be able to:

1. Formulate or design a system, process, procedure or material to meet desired needs.

2. Recognize his/her role in promoting the engineering field, and contribute in the development of the profession and the community.

Level D: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) the graduates of Materials Engineering for Advanced Technology program should be able to:

D1 Design, analyze and measure the performance of materials and evaluating their suitability for a specific application.

D2 Engage in the recent technological changes and emerging fields relevant to materials engineering to respond to the challenging role and responsibilities of a professional materials engineer.

D3 Apply numerical modeling methods and/or computational techniques appropriate to materials engineering.

D4 Adopt suitable national and international standards and codes to: design, operate, inspect and maintain materials engineering systems.

D5 Design and simulate materials behavior for different applications.

Sustainable Water Engineering Program
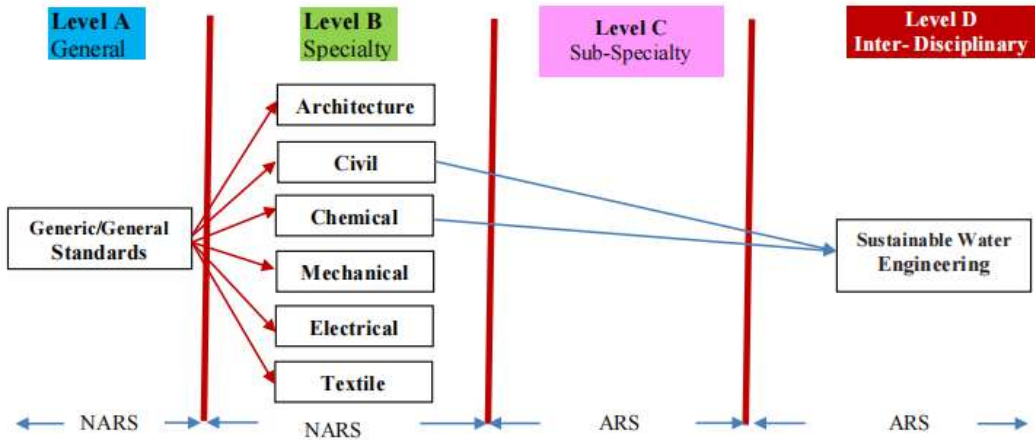
The attributes of Sustainable Water engineer:

The attributes of graduates of Sustainable Water Engineering program are the attributes of the graduates of engineering.

Level D: High specialized competencies

In addition to the Competencies for All Engineering Programs (Level A) the graduates of Sustainable Water Engineering program should be able to:

D1 Select appropriate and sustainable methods and technologies for planning, designs and construction of Civil Structures, especially Water Structures and associated Infrastructures, and Hydropower Plants by applying the full range concepts of civil engineering disciplines and the in-depth knowledge of water engineering and sustainability and considering their codes of practices and standards.

D2 Plan and manage current water resources projects and develop new water resources taking in consideration the constrains of law, politics, environmental, social and sustainability as well safety and risk assessment issues.

D3 Demonstrate the knowledge of principles and applications of computer programs and IT such as CAD, BIM, GIS and Remote Sensing Techniques in the specialized field.

D4 Achieve an optimum water urban planning and designs that satisfy both aesthetic, and technical requirements, using adequate knowledge of related building physics, and environmental technologies and sciences.