NATIONAL ACADEMIC REFERENCE STANDARDS (NARS)

FOR ENGINEERING

2nd Edition

August 2009

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SECTION 1 NATIONAL ACADEMIC REFERENCE STANDARDS (NARS) FOR ENGINEERING

1.1 INTRODUCTION

Engineers solve real-life problems. They find the best solutions through the application of their knowledge, experience and skills. Engineers help to define and refine the way of life by providing innovative, higher-performance, safer, cleaner or more comfortable daily-used facilities for human beings. They seek improvements through the processes of invention, design, manufacturing and construction.

The products of engineering activities are intended to be sustainable. However, drawbacks are associated with such activities; for example, the water, air, environment and acoustic pollutions have been aggravated by many engineering marvels created throughout the past decades.

The engineer's problem-solving complexity grows as the world's social and technological problems become more closely related. For example, the problem of air pollution cannot be solved physically without considering the social, legal, political, and ethical conflicts. Moreover, the impact of the available engineering solutions on the interests of the individuals and groups should be considered.

Engineering studies provide students with the advanced, effective, technology-based education that should meet the expected needs of future science and technology. They should also promote the technical understanding and problem-solving skills required to face the engineering challenges of tomorrow.
The NARS for Engineering set out generic statements which represent general expectations about standards for the Bachelor of Science (B.Sc.) degree in Engineering. These statements clarify the attributes associated with the award of engineering degrees:

- The awards are in accord with the frameworks for contemporary engineering education.
- The Engineering degrees address the national expectations of the graduate engineers.
- The degrees satisfy the actual and expected market needs.

According to the Accreditation Board for Engineering and Technology (ABET), Engineering is the knowledge of the mathematical and natural sciences, gained by study, experience, and practice, applied with judgment to develop ways to economically utilize the materials and forces of nature for the benefit of mankind. It is the ability to initiate and conduct activities associated with engineering processes, systems, problems, opportunities, history, future impacts and ethics with minimal negative consequences. It involves knowledge, ways of thinking, action coordination and capability development. It helps preparing individuals to make well-informed choices whether they act as consumers, workers, citizens or members of the global community.
The engineering education should achieve excellence in undergraduate and graduate education, research, public service and advancement of the state-of-the-art within the discipline. It aims to produce able, broadly educated, highly qualified

engineers through academic excellence. Moreover, it motivates students, faculty and staff to learn, grow, achieve and serve the needs of society nationally, regionally and internationally. It also prepares students for a productive and rewarding career in engineering based on strong moral and ethical foundation.

1.2 THE ATTRIBUTES OF THE ENGINEER

The graduates of the engineering programs should be able to:

a) Apply knowledge of mathematics, science and engineering concepts to the solution of engineering problems.
b) Design a system; component and process to meet the required needs within realistic constraints.
c) Design and conduct experiments as well as analyze and interpret data.
d) Identify, formulate and solve fundamental engineering problems.
e) Use the techniques, skills, and appropriate engineering tools, necessary for engineering practice and project management.
f) Work effectively within multi-disciplinary teams.
g) Communicate effectively.
h) Consider the impacts of engineering solutions on society & environment.
i) Demonstrate knowledge of contemporary engineering issues.
j) Display professional and ethical responsibilities; and contextual understanding
k) Engage in self- and life- long learning.

1.3 NATIONAL ACADEMIC REFERENCE STANDARDS (NARS) FOR ENGINEERING

The academic reference standards represent the general expectations about the qualifications, attributes and capabilities that graduates of the engineering programs should be able to demonstrate.

1.3.1 Knowledge and Understanding:

The graduates of the engineering programs should be able to demonstrate the knowledge and understanding of:

a) Concepts and theories of mathematics and sciences, appropriate to the discipline.
b) Basics of information and communication technology (ICT)
c) Characteristics of engineering materials related to the discipline.
d) Principles of design including elements design, process and/or a system related to specific disciplines.
e) Methodologies of solving engineering problems, data collection and interpretation
f) Quality assurance systems, codes of practice and standards, health and safety requirements and environmental issues.
g) Business and management principles relevant to engineering.
h) Current engineering technologies as related to disciplines.
i) Topics related to humanitarian interests and moral issues.
j) Technical language and report writing
k) Professional ethics and impacts of engineering solutions on society and environment

l) Contemporary engineering topics.

1.3.2 Intellectual Skills

The graduates of the engineering programs should be able to:

a) Select appropriate mathematical and computer-based methods for modeling and analyzing problems.
b) Select appropriate solutions for engineering problems based on analytical thinking.
c) Think in a creative and innovative way in problem solving and design.
d) Combine, exchange, and assess different ideas, views, and knowledge from a range of sources.
e) Assess and evaluate the characteristics and performance of components, systems and processes.
f) Investigate the failure of components, systems, and processes.
g) Solve engineering problems, often on the basis of limited and possibly contradicting information.
h) Select and appraise appropriate ICT tools to a variety of engineering problems.
i) Judge engineering decisions considering balanced costs, benefits, safety, quality, reliability, and environmental impact.
j) Incorporate economic, societal, environmental dimensions and risk management in design.
k) Analyze results of numerical models and assess their limitations.
l) Create systematic and methodic approaches when dealing with new and advancing technology.

1.3.3 Practical and Professional Skills

The graduates of the engineering programs should be able to:

a) Apply knowledge of mathematics, science, information technology, design, business context and engineering practice integrally to solve engineering problems.
b) Professionally merge the engineering knowledge, understanding, and feedback to improve design, products and/or services.
c) Create and/or re-design a process, component or system, and carry out specialized engineering designs.
d) Practice the neatness and aesthetics in design and approach.
e) Use computational facilities and techniques, measuring instruments, workshops and laboratory equipment to design experiments, collect, analyze and interpret results.
f) Use a wide range of analytical tools, techniques, equipment, and software packages pertaining to the discipline and develop required computer programs.
g) Apply numerical modeling methods to engineering problems.
h) Apply safe systems at work and observe the appropriate steps to manage risks.
i) Demonstrate basic organizational and project management skills.
j) Apply quality assurance procedures and follow codes and standards.
k) Exchange knowledge and skills with engineering community and industry.
l) Prepare and present technical reports.

1.3.4 General and Transferable Skills

The graduates of the engineering programs should be able to:

a) Collaborate effectively within multidisciplinary team.
b) Work in stressful environment and within constraints.
c) Communicate effectively.
d) Demonstrate efficient IT capabilities.
e) Lead and motivate individuals.
f) Effectively manage tasks, time, and resources.
g) Search for information and engage in life-long self learning discipline.
h) Acquire entrepreneurial skills.
i) Refer to relevant literatures.

1.4 NARS CHARACTERIZATION FOR ENGINEERING DISCIPLINES

1.4.1 Indicative Curricula Content by Subject Area

Table 1: Indicative curricula content by subject area

	Subject Area	%	Tolerance
A	Humanities and Social Sciences (Univ. Req.)	11	9-12 %
B	Mathematics and Basic Sciences	21	20-26 %
C	Basic Engineering Sciences (Faculty/Spec. Req.)	21	20-23 %
D	Applied Engineering and Design	21	20-22 %
E	Computer Applications and ICT*	10	9-11 %
F	Projects* and Practice	9	8-10 %
	Subtotal	93	92-94 %
G	Discretionary (Institution character-identifying) subjects	7	6-8 %
	Total	100	100%

* This part of the curriculum may be served in separate course(s) and/or included in several courses and its hours should be indicated in the course specification

1.4.2 Definition of Subject Areas

A- Humanities and Social Sciences

a) Acquiring knowledge of non-engineering fields that strengthen the consciousness of the engineer of the society and its culture, including business, marketing, welfare, ethics, law, arts, etc.
b) The ability to consider and evaluate the impact of the technology on the society, public health and safety.
c) The ability to appreciate and engage in social and entrepreneurial activities essential to the engineering practice and reflect on the management of the economics and social science
d) The ability to engage in life-long learning and respond effectively to the needs of the society.

B- Mathematics and Basic Sciences

Mathematics

a) Acquiring knowledge in mathematical and analytical methods.
b) The ability to reason about and conceptualize engineering components, systems or processes using analytical methods related to the discipline.
c) The ability to analyze and model engineering components, systems and processes specific to the discipline.
d) The skill of using probability and statistical methods.

Basic Sciences

a) Acquiring knowledge of physics, chemistry, mechanics, earth sciences, biological sciences and other specific subjects which focus on understanding the physical world.
b) The ability to select and apply scientific principles in practical problem solving.
c) The ability to analyze, model and reason about engineering components, systems or processes using principles and knowledge of the basic sciences as applicable in each engineering disciplinary context.
d) The ability to adopt scientific evidence-based techniques in problem solving.

C- Basic Engineering Sciences

a) Integrating knowledge and understanding of mathematics and physical sciences to develop basic engineering laws and concepts related to the discipline.
b) The ability to extend knowledge and develop models and methods and use techniques, principles and laws of engineering sciences that lead to engineering applications across disciplinary boundaries.
c) The ability to deal effectively with numbers and concepts to identify/solve complex and open ended engineering problems.

D- Applied Engineering and Design

a) Attaining knowledge of current practice, engineering codes and design techniques relevant to the discipline.
b) The ability to apply engineering knowledge and creative, iterative and open-ended procedures when conceiving and developing components, systems and processes.
c) The ability to integrate engineering knowledge, engineering codes, basic and mathematical sciences in designing a component, a system or a process.
d) The ability to work under stress, taking into account time, economy, health and safety, social and environmental factors and binding laws.

E- Computing and ICT

a) Attaining knowledge of ICT principles.
b) The ability to use computers, networks and software to support engineering activity, and to enhance personal/team productivity.

c) The ability to assess, use and validate results produced by packages and create software as required in discipline.
d) The ability to use general ICT tools effectively.

F- Project

a) Gaining the knowledge and experience of applying the different principles and techniques introduced in the program of study.
b) The ability to work within defined constraints, tackle work which lacks a well-defined outcome or which has a wide range of possible solutions and exhibit creativity in dealing with unfamiliar real-life problems.
c) The ability to investigate, plan and execute technical research specific to the discipline over an extended period of time; meeting deadlines and putting technical work in a social and commercial context.
d) The ability to work in a team, search published sources of information, interprets technical data and analyzes and presents findings in various ways.

G- Discretionary Subjects

a) Attaining knowledge and understanding of subjects selected by the institution to identify its character and/or satisfy the needs of the society.
b) The ability to recognize, appreciate and respond effectively to the needs of the society via utilizing the technical knowledge specific to the discipline.
c) The ability to lead and motivate people as well as organize and control tasks, people and resources.

SECTION 2 NARS CHARACTERIZATION FOR AEROSPACE ENGINEERING PROGRAMS

2.1 Introduction

Aerospace engineering programs deals with the effective and efficient introduction and applications of the basic laws of physical, engineering, space, atmospheric, earth, life, social, and humanitarian sciences into the aerospace industries.

Aerospace engineers should be curious about how flying crafts in atmosphere and in space are made to work. They have a desire to solve problems and a talent for understanding the operation of mechanical, electrical and electronic devices in flying vehicles. Aerospace engineers conceive, plan, analyze, design and direct the production and manage the operation of a wide variety of installations such as control, aviation, propulsion, power generation, materials, structures and the aerodynamic systems of flying crafts whether in atmosphere or in space. Besides, an aerospace engineer needs to have sufficient knowledge of the atmospheric environment and space physics. Such engineer should effectively use the basic principles of motion, energy, momentum applied to fluid mechanics, material and structure mechanics, combustion and power generation, control theory, thermal science in addition to measurement theories and experimentation. The objective is to insure that the flying crafts or the onboard systems functions safely, efficiently, reliably, and are manufactured at a competitive cost with minimized environmental hazards.

Aerospace Engineering is a broad discipline which covers the fields of solid and fluid mechanics, aerospace structural and material mechanics, aerodynamics, thermodynamics, propulsion and power generation systems, control systems, navigation systems, engineering design, production technology, economics and management. Basic studies are devoted to acquiring sufficient knowledge on mechanical properties of materials and design of aerospace structures, aircraft aerodynamics, propulsion engine, control and aviation systems and power generation systems. These studies also provide knowledge on structural, aerodynamic control and measurement techniques that can be used in a variety of facet of modern society. Undergraduate educational programs in Aerospace engineering are, therefore, specifically designed to provide a wide variety of topics.

A B.Sc. degree in aerospace engineering is designed for students who seek careers as engineers in aviation companies, aerospace industry, aerospace and aviation activities, army, consulting firms and private and governmental agencies. This degree is also appropriate for students who plan to be researchers or who intend to pursue an advanced degree in engineering. A typical program curriculum incorporates analytical tools, creative thought and diversity of skills as well as the state of art of the profession.

Job opportunities of Aerospace engineer

Besides working directly in private and governmental aviation, aerospace companies and activities, the aerospace engineer is fit to inter-disciplinary private or governmental agencies requiring the capacities to design, manufacture, manage, develop and maintain light structural, aerodynamic, control, power generation, environmental, wind and solar energy, flight operations and information systems.

2.2 The Attributes of Aerospace Engineer

In addition to the general attributes of engineer, the aerospace engineer should be able to:

a) Design, operate, test and maintain aerospace propulsion systems
b) Calculate, design, test and repair aerospace structures and consider the engine-airframe integration.
c) Design, maintain, repair and test control systems
d) Analyze the controllability and stability of aerospace vehicles
e) Analyze multi-disciplinary mechanical, electrical hydraulic and aerodynamic systems.
f) Work as a chief engineer in the aerospace operational, maintenance and overhaul firms.

2.3 NARS for Aerospace Engineering

The following academic reference standards represent the general expectation about the qualifications attributes and capabilities that the graduates of Aerospace engineering programs should be able to demonstrate.

2.3.1 Knowledge and Understanding:

In addition to the knowledge and understanding of engineers, the graduates of aerospace engineering program should demonstrate knowledge and understanding of:

a) Propulsion systems: classification, performance, applications, design concepts and operations
b) Aerospace structures: theory, design and analysis techniques.
c) Advanced alloys and composite materials: classification, specifications and manufacturing processes.
d) Low and high speed aerodynamic and flight mechanics
e) Classical and advanced control topics
f) Contractions, special features, of different of specialized aerospace systems; Hydraulic, pneumatic, flight control, feeding and environmental control systems.

2.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of aerospace engineering program should be able to:

a) Analyze and judge propulsion systems performance

b) Investigate the effects of flight conditions on the propulsion system performance;
c) Assess control system performance and give suggestions to improve controllability and stability.
d) Investigate and analyze the impact of the aerodynamic features of aerospace structure on the stability and controllability.
e) Consider the working constraints of aerospace structures and evaluate the geometrical limitations.
f) Propose solutions to practical aerospace engineering problems.
g) Analyze different aerodynamic configurations and their impact on the flight conditions.
h) Analyze the orbital elements of orbiting satellites

2.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of aerospace engineering program should be able to:

a) Design and calculate propulsion systems and their subsystems.
b) Calculate the different operating modes of propulsion systems and their subsystems and components
c) Calculate, design, manufacture and test basic aerospace structures
d) Design and maintain different aerospace and control systems.
e) Design space missions and launching element.
f) Calculate different flight configurations and their impact on the flight stability

SECTION 3 NARS CHARACTERIZATION OF ARCHITECTURAL ENGINEERING

3.1 INTRODUCTION

The discipline of architecture draws on knowledge and skills from the human and physical sciences, the humanities, and the fine and applied arts. It addresses the accommodation of all human activity in all places under all conditions, understanding our place within differing physical, historical, cultural, social, political and virtual environments. Architecture proposes, forms, and transforms our built environment, and does so through an engagement with the spaces, buildings, cities and landscapes in which we live. Architectural education is therefore rich, varied and by definition interdisciplinary.

While architectural education must be concerned with the constraints of the physical world and historical and cultural dimensions, it must also constantly adapt to a changing social, economic and environmental context nationally, regionally and internationally.

3.2 THE ATTRIBUTES OF AN ARCHITECTURAL ENGINEER

In addition to the general attributes of engineer, the architect must be able to:

a) Design robust architectural projects with creativity and technical mastery.
b) Demonstrate investigative skills, attention to details, and visualize/ conceptualize skills.
c) Adopt a holistic problem solving approach for complex, ambiguous, and open-ended challenges and scenarios.
d) Demonstrate knowledge of cultural diversity, differences and the impact of a building on community character and identity.
e) Address urban issues, planning, and community needs through design work.
f) Recognize the new role of architectural engineer as the leader of design projects— who has the ability to understand, assemble, and coordinate all of the disciplines— to create a sustainable environment.

3.3 NARS FOR ARCHITECTURAL ENGINEERING

The following academic reference standards represent the general expectation about the qualifications attributes and capabilities that the graduates of Architectural Engineering programs should be able to demonstrate.

3.3.1 Knowledge and Understanding:

In addition to the knowledge and understanding of engineers, the graduates of architectural engineering program should demonstrate knowledge and understanding of:

a) Principles of architectural design, and the preparation and presentations of design projects in a variety of contexts, scales, types and degree of complexity.
b) Principles of building technologies, structure & construction methods, technical installations, properties of materials, and the way they may influence design decisions.

c) Fundamentals of building acquisition, operational costs, and of preparing construction documents and specifications of materials, components, and systems appropriate to the building.
d) Theories and legislations of urban and regional planning.
e) The processes of spatial change in the built and natural environments; patterns and problems of cities; and positive & negative impacts of urbanization.
f) The significance of urban spaces and the interaction between human behavior, built environment and natural environment.
g) Theories and histories of architecture, planning, urban design, and other related disciplines.
h) Physical modeling, multi-dimensional visualization, multimedia applications, and computer-aided design.
i) The role of the architecture profession relative to the construction industry and the overlapping interests of organizations representing the built environment.
j) Various dimensions of housing problem and the range of approaches, policies, and practices that could be carried out to solve this problem.
k) Principles of sustainable design, climatic considerations, and energy consumption and efficiency in buildings and their impacts on the environment.

3.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of architectural engineering program should be able to:

a) Integrate different forms of knowledge, ideas from other disciplines, and manage information retrieval to create new solutions.
b) Think three-dimensionally and engage images of places & times with innovation and creativity in the exploration of design.
c) Predict possible consequences, by- products and assess expected performance of design alternatives.
d) Reconcile conflicting objectives and manage the broad constituency of interests to reach optimum solutions.
e) Integrate relationship of structure, building materials, and construction elements into design process.
f) Integrate community design parameters into design projects.
g) Appraise the spatial, aesthetic, technical and social qualities of a design within the scope and scale of a wider environment
h) Discuss, search and formulate informed opinions appropriate to specific context and circumstances affecting architecture profession & practice.
i) Analyze the range of patterns and traditions that have shaped and sustained cultures and the way that they can inform design process.

3.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of architectural engineering program should be able to:

a) Produce and present architectural, urban design, and planning projects using an appropriate range of media and design-based software.

b) Produce professional workshop and technical drawings using traditional drawing and computer-aided drawings' techniques.
c) Use appropriate construction techniques and materials to specify and implement different designs;
d) Participate professionally in managing construction processes.
e) Demonstrate professional competence in developing innovative and appropriate solutions of architectural and urban problems.
f) Display imagination and creativity.
g) Respect all alternative solutions; changes in original plan of the project, differences in style, culture, experience and treat others with respect.
h) Provide leadership and education to the client particularly with reference to sustainable design principles.
i) Respond effectively to the broad constituency of interests with consideration of social and ethical concerns.
j) Contribute positively to the aesthetic, architecture and urban identity, and cultural life of the community.

SECTION 4 NARS CHARACTERIZATION OF AUTOMOTIVE ENGINEERING

4.1 INTRODUCTION

Automotive Engineering deals with the engineering problems, opportunities and needs of the automotive sector and related industries. The discipline focuses on the design and manufacture of automobiles and their component parts, as well as on the integration of components into an automotive system. The automotive sector includes automobiles as well as related transportation devices like trucks and motorcycles. This sector is continually advancing and giving rise to new opportunities and challenges especially as oil reserves are drying and energy alternative sources are being continually fetched.
Many engineering companies are involved in the automotive industry and the automotive sector plays a particularly vital role in the industrial economy.

The Automotive program is aimed at students wishing to pursue a career in the automotive industry. The program enables students to develop a thorough understanding of mechanical engineering principles, while at the same time developing expertise that is uniquely automotive in nature. The program will challenge students and faculty to improve the learning process.

Based on the Mechanical Engineering program, Automotive Engineering will provide students with a broad education designed to give them the skills necessary to become professional engineers. The first two years of the program are typically the same as those of Mechanical Engineering, concentrating on basic engineering principles and including studies in mathematics and the physical sciences. Later years build upon acquired knowledge and include specialized topics such as Automotive Safety, Alternative Fuels, Advanced Manufacturing, Automotive Power Train and Vehicle Dynamics, Automotive Combustion Technology, Automotive Suspension and Undercarriage, Automotive NVH and Aerodynamics, Automotive Electrical and Electronic Systems, Advanced Materials and Joining and Vehicle Emission Control. Engineering students are also required to undertake studies in courses designed to assist them develop the communication skills necessary to work effectively.

The field of automotive engineering is dependent on the application of computers in analysis, design, manufacturing, and operation of facilities. The program should demonstrate that graduates are competent in the application of computer technologies commonly used in industry, governmental service, and private practice associated with mobility and material requirements. Graduates should also demonstrate proficiency in the application of probability and statistics to the solution of mobility problems.
Graduates should have a working knowledge of the design, manufacture, and maintenance of major subsystems and technologies associated with mobility. However, in the field of automotive engineering, management and technology are often inextricably intertwined. The program should demonstrate that graduates have developed the ability to apply modern and effective management skills in

identification and investigation of problems, analysis of data, synthesis and implementation of solutions, and operations of facilities.

Career Opportunities

The Automotive Engineering program introduces principles covering a wide range of relevant areas, which allows graduates to be well prepared for careers in the automotive and other high-tech industries. However, being based on a Mechanical Engineering degree, graduates in Automotive Engineering will retain flexibility in the choice of engineering industry for their careers. In most cases graduates will also be able to work wherever mechanical engineers are employed.

4.2 THE ATTRIBUTES OF AUTOMOTIVE ENGINEER

The objectives of the undergraduate programs in Automotive Engineering are to provide an inclusive curriculum that allows all students to learn and progress unhindered through the program. Therefore, In addition to the general attributes of engineer, the automotive engineer should be able to:

a) Have advanced and internationally recognized skills and in-depth technical competence necessary for a successful career in Automotive Engineering.
b) Are familiar with current best practice in the automotive engineering.
c) Are capable to work as a mechanical engineer in general, and as a manufacturing or design engineer in the areas of automotive engineering.
d) Possess the necessary skills to analyze and investigate the mechanical and electrical systems applied in automotive engineering.
e) Have the skills to work as a production line or service engineer in the automotive industry.

4.3 NATIONAL ACADEMIC REFERENCE STANDARDS FOR AUTOMOTIVE ENGINEERS

The following academic reference standards represent the general expectations about the qualifications attributes capabilities that the graduates of automotive programs should be able to demonstrate.

4.3.1 Knowledge and Understanding:

In addition to the knowledge and understanding of engineers, the graduates of automotive engineering program should demonstrate knowledge and understanding of:

a) Detailed knowledge and understanding of the themes and specialist subjects of the automotive context program.
b) The requirements, limitation and design processes for power train, undercarriage, braking, chassis, vehicle body, electrical systems and vehicle interior.
c) The current practices in manufacturing relevant to the core modules of the program;
d) The current practices in maintenance and repair shops of different vehicle aggregates.

e) The hardware, software and networks of computer systems used in automotive industry logistics and performance evaluation.
f) The drivability, safety limitations and compulsory tests especially applied in automotive engineering.

4.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of automotive engineering program should be able to:

a) The capacity at an appropriate level to identify project management knowledge and skills used in an automotive engineering context
b) The ability to assess and analyze information in support of problem solving, design and development, critical evaluation of alternatives and performance data.
c) Create solutions to automotive engineering especially to manufacturing and maintenance problems in a creative way, taking account of industrial and commercial constraints.

4.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of automotive engineering program should be able to:

a) Using special automotive test & measurement equipment and conducting experimental laboratory and practical development work.
b) Experience at an appropriate level to use computer-aided design, analysis, logistics and maintenance packages relevant to automotive engineering.
c) Application of fault diagnosis procedures using the automotive industry special instrumentation to identify production and operation problems.

SECTION 5 NARS CHARACTERIZATION OF CONSTRUCTION ENGINEERING

5.1 INTRODUCTION

Construction and building engineering is a broad discipline concerned with the design, engineering and management process of construction and building projects. It includes: proficiency in engineering design; understanding of legal and professional practice issues related to the construction industry; understanding of construction processes, communications, methods, materials, systems, equipment, planning, scheduling, safety, cost analysis, and cost control; understanding of management topics such as economics, business, accounting, law, statistics, ethics, leadership, decision and optimization methods, process analysis and design, engineering economics, engineering management, safety and cost engineering.

Graduates of the Construction Engineering degree program design and manage construction processes that create living and working environments such as office buildings, industrial buildings, airports, housing, roads, bridges, utilities, water resources and coastal engineering projects. They can work in projects for: construction management; construction engineering; structures of all types; geo-techniques & foundations; transportation systems; surveying works; environmental engineering works; water resources and hydraulic structures projects; water supply systems; and coastal protection projects. Following are some of the job opportunities that can be pursued by the program graduates:
Field engineer: implements and coordinates engineered construction processes.
Design engineer: develop conceptual and detailed designs for many construction projects such as office buildings, industrial buildings, airports, housing, roads, bridges, hydraulic structures, coastal structures, utilities, and dams.
Survey engineer: perform surveying activities for all types of construction projects.
Cost estimator: develops itemized costs and budgets for design and construction based upon knowledge and pre-design of operations, materials, and resources requirements.
Planning /scheduling engineer: designs and monitors the plan for timing and sequence of construction operations.
Quality control / assurance engineer: ensures that the items of the construction project and the construction process conform to specifications and standards.
Projects controls engineer: reviews the cost and time performance of the project during construction.
Contract administrator: reviews the project's contracts and prepares / reviews change orders and claims.
Health and safety engineer: reviews and implements the project's health and safety system to ensure health and safety standards are adopted throughout the project.
Project engineer: designs all or part of the project construction process, coordinates construction engineering to accomplish the overall objectives of the facility design team.

Project manager: oversees all aspects of a project, coordinates subcontractors, and provides primary contact to the client as well as to the company's leaders.
Chief engineer, designer, estimator, planner, project controls, contract administration, health and safety, and project manager: oversees operations in designated areas related to multiple projects.
Division head or vice president, president, chief executive officer: manages overall company operations.

5.2 THE ATTRIBUTES OF A CONSTRUCTION ENGINEER

The main aim of the construction and building engineering program is to prepare individuals for a professional career in construction and building engineering by providing graduates with the necessary technical skills, personal skills and knowledge in construction and building engineering. The main objective of the program is to produce and qualify graduates of the construction and building engineering department. Therefore, in addition to the general attributes of engineer, the construction engineer should be able to:

a) Apply analytical, experimental, design, construction engineering and management techniques with proficiency aided by modern tools
b) Understand global, ethical, and social implications of the profession in regards to public safety and sustainability issues
c) Acquire and utilize personal, communication, and leadership skills and be able to work collaboratively in a multidisciplinary team
d) Pursue distinguished employment as well as lifelong learning

5.3 NATIONAL ACADEMIC REFERENCE STANDARDS FOR CONSTRUCTION ENGINEERING

5.3.1 Knowledge & Understanding

In addition to the knowledge and understanding of engineers, the graduates of construction engineering program should demonstrate knowledge and understanding of:

a) The essential construction processes and the technologies and techniques used in the construction and building engineering field.
b) Principles of construction and building engineering sciences as applied to civil engineering principles;
c) Properties, behavior & fabrication of construction materials.
d) Principles of design specific to construction and building.
e) Projects management, including planning, finance, bidding, contract procedures, cost estimators and quality systems.
f) The different analytical and computer methods that can be applied to the various areas of construction and building engineering.

5.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of construction engineering program should be able to:

a) Identify and solve construction engineering problems.
b) Solve environmental and socioeconomic problems.

c) Determine levels, types and systems of building foundations. Determine levels, types and systems of building foundations based on geotechnical techniques and codes of practice.
d) Evaluate and integrate information and processes through individual and group project work.
e) Solve a wide range of problems related to the analysis, design, and the construction of buildings and civil engineering projects.
f) Analyze and interpret financial information.
g) Suggest solutions and designs on a conceptual level and in detail that consider sustainability and other issues of importance

5.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of construction engineering program should be able to:

a) Prepare and undertake individual construction engineering projects.
b) Use laboratory and field equipment competently and safely.
c) Observe record and analyze data in laboratory as well as in the field.
d) Use appropriate computer-based support tools and software packages for problem-solving and analysis of results.
e) Prepare technical drafts and finished drawings both manually and using CAD.
f) Prepare quantity surveying reports, cost estimates, and construction schedules.
g) Administer contracts and control time, cost and quality of projects.
h) Schedule work to meet multiple deadlines in complex activities.

SECTION 6 NARS CHARACTERIZATION OF CHEMICAL ENGINEERING

6.1 INTRODUCTION

Chemical Engineering is a broad and versatile profession concerned with the development and application of processes in which chemical or physical changes of materials are involved. This branch of engineering is based on the sciences of chemistry, physics, mathematics, and the biosciences and is guided by the principles of economics.

Chemistry occupies a central position in modern science. The behavior of atoms and molecules underpins our understanding of almost all phenomena in the world. However, the manufacture of products applying this fundamental understanding of chemistry is quite different from the laboratory scale, and this is where chemical engineers apply their skills. Chemical Engineers are involved in developing new processes, synthesizing new products and optimizing the performance of existing process systems. Qualified chemical engineers can choose from a wide variety of career opportunities including plant management, research, commissioning, process safety, environmental protection, process control, consultancy or marketing and sales.

The headline of the brochure for the American Institute of Chemical Engineers states that chemical engineers are responsible for the production of items, “from microchips to potato chips.” Chemical engineers work in the chemical, fuel, aerospace, environmental, food, and pulp and paper industries, among many others. Chemical engineering is a problem-solving profession with a practical bias; expect to answer the question “how” more than any other. Chemical engineers translate the discoveries chemists make into real-world products. If a chemist invents a better fertilizer, for example, a chemical engineer might design the method to make mass production of that fertilizer possible.

Chemical engineers may work in:

Chemical engineers apply the principles of chemistry to solve problems involving the production or use of chemicals and bio-chemicals. They design equipment and processes for large-scale chemical manufacturing, plan and test methods of manufacturing products and treating byproducts, and supervise production. Chemical engineers also work in a variety of manufacturing industries other than chemical manufacturing, such as those producing energy, electronics, food, clothing, petrochemicals, pharmaceuticals and paper, as well as petroleum refining. Chemical engineers apply principles of physics, mathematics, and mechanical and electrical engineering, as well as chemistry. Some may specialize in a particular chemical process, such as oxidation or polymerization. Others specialize in a particular field, such as Niño-materials, or in the development of specific products. They should be aware of all aspects of chemicals manufacturing and how the manufacturing process affects the environment and the safety of workers and consumers.

Within these industries, chemical engineers rely on their knowledge of mathematics and science, particularly chemistry, to overcome technical problems safely and economically. And, of course, they draw upon and apply their engineering knowledge to solve any technical challenges they encounter.

Specifically, chemical engineers improve food processing techniques, and methods producing fertilizers, to increase the quantity and quality of available food. They also construct the synthetic fibers that make our clothes more comfortable and water resistant; they develop methods to mass-produce drugs, making them more affordable; and they create safer, more efficient methods of refining petroleum products, making energy and chemical sources more productive and cost effective.

NARS Characterization for chemical engineering is framed so as to:
Promote diversity of provision and encourage institutions to explore new ways to enhance the knowledge and awareness of their students about the broad features of chemical engineering and inspire a sense of excitement of this rapidly developing discipline.

6.2 THE ATTRIBUTES OF CHEMICAL ENGINEERS

In addition to the general attributes of an engineer, the chemical engineer should be able to:

a) Build upon sound foundation in mathematics and other request science
b) Utilize and manage resources creatively through effective analysis and interpretation.
c) Recognize the potential and applicability of computer based methods in chemical engineering design.
d) Draw upon a basic knowledge of chemical process industries.
e) Address the issues of process dynamics and control in plant operation.
f) Plan and execute research work, evaluate outcomes and draw conclusions.
g) Relate chemical reactions and their characteristics to process industries.
h) Engage in safe laboratory practice.
i) Apply knowledge and skills to respond to the recent technological changes.
j) Identify and control the impact that chemical engineering has on society from an environmental, economic, social and cultural point of view.
k) Recognize the challenging role and responsibilities of the professional engineer, while abiding by the ethics of the profession.

6.3 NATIONAL ACADEMIC REFERENCE STANDARDS FOR CHEMICAL ENGINEERS

6.3.1 Knowledge and Understanding:

In addition to the knowledge and understanding of engineers, the graduates of chemical engineering program should demonstrate knowledge and understanding of:

a) The fundamentals, basic characteristics and features of organic and inorganic reactions, and their application in chemical process industries including petroleum refining, natural gas processing, petrochemicals industry, electrochemistry, fertilizers and ceramics, etc.

b) The characteristics of the different states of matter and interfaces between them.
c) The conventional procedures of chemical analysis and characterization of common engineering materials and components.
d) The principles of chemical engineering including chemical reaction equilibrium and thermodynamics; mass and energy balance; transport processes; separation processes, mechanical unit operations and process control.
e) General principles of design techniques specific to particular products and processes including reactor and vessel design.
f) Environmental impact of various industries, waste minimization and treatment of industrial facilities.

6.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of chemical engineering program should be able to:

a) Integrate processing steps into a sequence and apply analysis technique such as energy and mass balance.
b) Summarize and select the appropriate techniques relevant to different industries.
c) Collect data, draw simplified equipment flow sheets, charts and curves and interpret data derived from laboratory observation.
d) Synthesize new processes or products through utilization and effective management of available resources.

6.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of chemical engineering program should be able to:

a) Perform complete mass and energy balances for chemical engineering plants.
b) Apply the principles of chemical equilibrium and process thermodynamics to systems with chemical reactions.
c) Conduct troubleshooting in chemical engineering plants.
d) Use chemical engineering IT tools and programming in design.
e) Determine the characteristics and performance of measurement and control systems.
f) Employ principles and concepts of transport phenomena in problem solving.

SECTION 7 NARS CHARACTERIZATION OF CIVIL ENGINEERING

7.1 INTRODUCTION

Civil Engineering is the profession that provides the community with a wide range of civil works and structures for better and easier living conditions. Civil engineering programs use mathematics, natural sciences, engineering and human sciences to provide easier life for mankind.

Civil engineer is responsible among his community, industry or society for establishing the safe, economic, healthy and convenient accommodation for every individual in the society.

Civil engineer selects, plans, and designs roadways that provide –from an engineering perspective- suitable, safe, secure and economic traffic means for all user groups. He is capable too of providing the suitable water resource for communities and making the adequate design of water and sewerage networks and public works' installations. In addition to managing construction sites, the civil engineer can supervise construction of all sorts of buildings such tower buildings, bridges, harbors and airports that are required for the development, welfare and independence of the society.

Civil engineer takes the responsibility of planning and designing the adequate structures for protection against the dangers of unexpected floods, storms and wave actions. He can also select and design the adequate repair procedures for structures of all types.

Civil engineer is capable of permanently providing the community with every new and up-to-date development in all civil engineering disciplines through long life learning.

Civil engineer may work as planner, designer, construction supervisor, construction manager and consultant for private and governmental firms in disciplines involving structures of all types, building materials, geo-techniques and foundations, roadways and traffic engineering, surveying works, environmental engineering, water and sewerage networks, treatment plants, water resources, hydrology, irrigation and water control structures.

7.2 THE ATTRIBUTES OF A CIVIL ENGINEER

In addition to the general attributes of engineer, the civil engineer should be able to:

a) Act professionally in design and supervision of civil engineering disciplines
b) Use the codes of practice of all civil engineering disciplines effectively and professionally
c) Design, construct and protect all types of excavations and tunneling systems for different purposes
d) Manage construction sites
e) Select appropriate building materials from the perspective of strength, durability, suitability of use to location, temperature, weather conditions and impacts of seawater and environment

f) Select and design adequate water control structures, irrigation and water networks, sewerage systems and pumping stations
g) Define and preserve properties (lands, real estates) of individuals, communities and institutions, through different surveying and GIS tools
h) Design and construct structures for protection against dangers of unexpected natural events such as floods and storms
i) Lead and supervise a group of designers and site or lab technicians

7.3 NATIONAL ACADEMIC REFERENCE STANDARDS FOR CIVIL ENGINEER

7.3.1 Knowledge & Understanding

In addition to the knowledge and understanding of engineers, the graduates of civil engineering program should demonstrate knowledge and understanding of:

a) Engineering principles in the fields of reinforced concrete and metallic structures' analysis and design, geo-techniques and foundations, hydraulics and hydrology, water resources, environmental and sanitary engineering, roadways and traffic systems, surveying and photogrametry
b) Properties, behavior and fabrication of building materials
c) Projects and construction management including planning, finance, bidding and contracts

7.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of civil engineering program should be able to:

a) Select appropriate building materials from the perspective of strength, durability, suitability of use to location, temperature, weather conditions and impacts of seawater and environment
b) Select and design adequate water control structures, irrigation and water networks, sewerage systems and pumping stations
c) Analyze and select codes of practices in designing reinforced engineering concrete and metallic structures of all types. Determine the levels, types and design systems of building foundations, tunnels and excavations
d) Define, plan, conduct and report management techniques
e) Assess and evaluate different techniques and strategies for solving engineering problems

7.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of civil engineering program should be able to:

a) Use laboratory and field equipment competently and safely
b) Observe, record and analyze data in laboratory and in the field
c) Practice professionally construction management skills. Prepare technical drafts and detailed drawings both manually and using CAD
a) carry out maintenance of all types of roadways and traffic systems
b) Prepare quantity surveying reports
c) Plan, design, construct, operate, control and carry out maintenance of all types of roadways and traffic systems

SECTION 8 NARS CHARACTERIZATION OF COMPUTER ENGINEERING

8.1 INTRODUCTION

Computer engineering (CE) is a discipline that embodies the science and technology of design, construction, implementation, and maintenance of software and hardware components of modern computing systems and computer-controlled equipment. Computer engineering has traditionally been viewed as a combination of both computer science (CS) and electrical engineering (EE). Computer engineering is a field that experiences effects from rapid technological development in different real life applications. Computer engineering programs use basic sciences, mathematics, engineering and electronics, physical and human sciences to provide new computer technologies and systems that make human applications easier, more productive, faster and also enjoyable to use.

A computer engineer is a person trained to be proficient in the design and implementation of computer systems, both hardware and software. He should essentially be able to design digital control circuitry and program it to function correctly. To perform these tasks, the computer engineer must be knowledgeable in related mathematics, physics sciences, electronics, communications, computer hardware and software, networking and other engineering concepts and systems. A proper level of expertise must be possessed through practicing the discipline concepts in solving problems of real applications. This level of expertise should be permanently upraised by engaging in life-long learning processes.

Computer Engineer may work in:
Private and governmental firms and agencies, where it is required to design, manufacture, operate, develop or maintain computer systems or computer-controlled systems. He/ She may also work as a computer network engineer.

8.2 THE ATTRIBUTES OF A COMPUTER ENGINEER

Computer engineering is a field that requires many skills. In addition to the general attributes of an engineer, the computer engineer should be able to:

a) Demonstrate inductive reasoning abilities, figuring general rules and conclusions about seemingly unrelated events
b) Use current advanced techniques, skills, and tools necessary for computing practices to specify, design, and implement computer-based systems.
c) Recognize the information requirements of various business activities on both operational and decision making levels.
d) Tackling business problems using system analysis tools and techniques.
e) Managing projects related to computer systems in diverse fields of applications.
f) Implementing phases of the computer system development life cycle, procurement and installation of hardware, software design, data manipulation and system operations.

8.3 NATIONAL ACADEMIC REFERENCE STANDARDS (NARS) FOR COMPUTER ENGINEERING PROGRAMS

8.3.1 KNOWLEDGE & UNDERSTANDING

In addition to the knowledge and understanding of engineers, the graduates of computer engineering program should demonstrate knowledge and understanding of:

a) Engineering principles in the fields of logic design, circuit analysis, machine and assembly languages, computer organization and architectures, memory hierarchy, advanced computer architectures, embedded systems, signal processing, operating systems, real-time systems and reliability analysis.
b) Quality assessment of computer systems;
c) Related research and current advances in the field of computer software and hardware
d) Technologies of data, image and graphics representation and organization on computer storage media
e) Modern trends in information technology and its fundamental role in business enterprises

8.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of computer engineering program should be able to:

a) Select the appropriate mathematical tools, computing methods, design techniques for modeling and analyzing computer systems;
b) Select, synthesize, and apply suitable IT tools to computer engineering problems.
c) Proposing various computer-based solutions to business system problems. Cost-benefit analysis should be performed especially in sensitive domains where direct and indirect costs are involved.
d) Identifying symptoms in problematic situations.
e) Innovating solutions based on non-traditional thinking and the use of latest technologies
f) Capability of integrating computer objects running on different system configurations.

8.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of computer engineering program should be able to:

a) Design and operate computer-based systems specifically designed for business applications.
b) Use appropriate specialized computer software, computational tools and design packages throughout the phases of the life cycle of system development;
c) Write computer programs on professional levels achieving acceptable quality measures in software development.
d) Conducting user support activities competently.

Section 9 NARS Charactrization of Electrical Power Engineering

9.1 Introduction

Electrical power and machines engineering discipline is that main branch of electrical engineering which concerns with generation, transmission, distribution, utilization, and control of electric energy. The vast electrical power systems which expand over each nation in the world and interconnection networks among neighboring countries are considered the largest and most complex man-made systems. Proper planning, design, implementation, operation and control of these large-scale electrical power systems require advanced engineering knowledge and techniques. Electrical generators are used in power stations to convert thermal or hydraulic energy into electrical energy. Electric motors are the essential parts for driving all kinds of machines in industrial plants and are also used for diving electric transport systems. Electrical transformers can change voltage levels, thus facilitate electrical power transmission over long distances. Modern power electronics and automatic control techniques are extensively employed in electrical power and machines systems for improving performance, operation and control.

The electrical power and machines engineering program consists of two main fields, namely electrical power engineering subjects and electrical machines engineering subjects. These are essentially supported by two main topics: automatic control engineering and power electronics subjects. Other essential subjects in the program include electrical circuits, electronic circuits and devices, electromagnetism, energy conversion, measurements and computer programming. Basic subjects in the program include mathematics, physics, materials engineering, workshop technology, laboratories, management and environmental issues. The electrical power and machines engineering program should be characterized by the following properties:

- To provide students with a wide and comprehensive introduction to basic sciences and mathematics with a through understanding of the fundamental knowledge necessary for engineering studies.
- To provide students with basic engineering skills of drawings, workshop technologies, laboratories and practical field training.
- To provide students with the required depth in electrical power and machines engineering subjects necessary for performing engineering jobs.
- To provide students with essential knowledge of highly interest for future postgraduate studies and research in the field of electrical engineering.
- To provide students with principals of engineering design skills including creative ideas, project innovation, practical synthesis and management.
- To provide students with a necessary environment to work both individually and within groups, thus developing their communications skills.

The educational objectives of electrical power and machines engineering program should be designed to produce engineers who are ready to contribute effectively to the advancement of electrical engineering profession and to accommodate the needs of local and global industries. Specific educational objectives may be summarized as follows:

- To prepare undergraduate students who will be able to create new ways to meet society's needs through the applications of fundamentals of engineering sciences to practical problems using design, analyses and syntheses of electrical components, circuits, and systems. Thus, becoming successful engineering problems solvers, life long learners, innovators, and professionals in the field of electrical power and machines.
- To prepare engineers who will become leaders in the electrical power and machines engineering profession, and be able to shape the social, intellectual, business and technical activities.
- To prepare engineers who will be able to work on electrical power and machines systems including the design and realization of such systems.
- To insure that students are exposed to elements of social sciences, humanities and environmental studies so that they understand the necessities for professionalism, ethical responsibilities and the needs to function in multidisciplinary teams.
- To prepare students to express themselves effectively in both oral and written communication.
- To prepare students for engineering analyses and problem solving using appropriate mathematical and computational methodologies.
- To teach students to use experimental and data analysis techniques for electrical power and machines engineering applications.
- To provide students with awareness of tools and skills necessary for participating effectively in building a strong national economy and to meet current and future modern industry needs.
- To provide various industries by highly qualified electrical power and machines engineers who have a broad knowledge of electrical engineering and related principles, theories and applications.

COMMUNITY DEVELOPMENT

Electrical energy is the most essential part for all phases in modern societies. Electrification has made large-scale manufacturing possible, encouraged the growth of cities, modern farming, and magnified our ability to communicate. One measure of the nation’s development is the yearly electrical energy consumption per capita. Modern life in every where in the world depends mainly on electrical energy. Electricity is required to drive machines in all industries, agriculture equipment, electrical transportation, and home appliances. Electrical lilting is used in streets, and residential, public, commercial and industrial buildings. Electrical power and machines engineers serve the society by providing electrical energy with high quality, safety and reliability at any time and any place throughout the country.

JOB OPPORTUNITIES FOR GRADUATES

As electricity is needed in all places in the society, electrical engineers are required in every place of our life. Typical job opportunities for electrical power and machines engineers are as follows:

- Electrical distribution companies
- Electrical generation companies
- Electrical power stations
- Electrical transmission company and energy control centers

- Ministry of electricity and energy and associated organizations
- New and renewable energy authority
- Oil and Petrochemicals sectors
- Electrical equipment and components factories
- Electronics industries
- Under ground and other transportation organizations

9.2 THE ATTRIBUTES OF ELECTRICAL ENGINEERS

In addition to the general attributes of engineer, the electrical engineer should be able to:

a) Design and supervise the construction of systems to generate, transmit, control and use electrical energy.
b) Design and develop heavy equipment, such as generators, motors, transmission lines and distributing systems.
c) Plan and manage engineering activity during the diverse phases of electric power generation, transmission and control
d) Prepare and reviews simple sketches, specifications and data sheets for electric power generation, control and distribution systems
e) Perform design reviews and checks for electric power generation and distribution systems
f) Perform review of supplier documentation for compliance with specifications
g) Develops load lists
h) Develops low voltage power systems

9.3 NATIONAL ACADEMIC STANDARDS FOR ELECTRICAL POWER ENGINEERS

9.3.1 KNOWLEDGE AND UNDERSTANDING

In addition to the knowledge and understanding of engineers, the graduates of electrical power and machines engineering program should demonstrate knowledge and understanding of:

a) Analytical and computer methods appropriate for electrical power and machines engineering.
b) Design methods and tools for electrical power and machines equipment and systems.
c) Principles of operation and performance specifications of electrical and electromechanical engineering systems.
d) Fundamentals of engineering management
e) Basic electrical power system theory
f) Theories and techniques for calculating short circuit, motor starting, and voltage drop
g) Diverse applications of electrical equipment
h) Logic circuits
i) Basic power system design concepts for underground, cable tray, grounding, and lighting systems
j) Basics of low voltage power systems
k) Principles of performing electrical system calculations, including load flow, earthling and equipment sizing

9.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of electrical power and machines engineering program should be able to: engineering graduates should be able to:

a) Identify and formulate engineering problems to solve problems in the field of electrical power and machines engineering.
b) Analyze design problems and interpret numerical data and test and examine components, equipment and systems of electrical power and machines.
c) Integrate electrical, electronic and mechanical components and equipment with transducers, actuators and controllers in creatively computer controlled systems.
d) Analyze the performance of electric power generation, control and distribution systems

9.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of electrical power engineering program should be able to:

a) Design and perform experiments, as well as analyze and interpret experimental results related to electrical power and machines systems.
b) Test and examine components, equipment and systems of electrical power and machines.
c) Integrate electrical, electronic and mechanical components and equipment with transducers, actuators and controllers in creatively computer controlled systems.
d) Specify and evaluate manufacturing of components and equipment related to electrical power and machines.
e) Apply modern techniques, skills and engineering tools to electrical power and machines engineering systems.

Section 10 NARS Characterization of Electronic Engineering

10.1 INTRODUCTION

Electronics becomes more and more influential on the human society. The reason for this is that almost all electronic products are produced in huge quantities so interfering with every one's life. In addition, electronic subsystems become part of almost any industrial product nowadays. Beside the basic laws of physical sciences, mathematics, and basic engineering sciences, electronics engineering programs combine electronic engineering principles and traditional computer science with good practice in design and project management applied to technically demanding problems. Graduates will be well qualified to play a disciplined and innovative part in research and development across the IT and Electronics sector.

An electronics engineer should have strong background in basic science and basic mathematics and be able to use these tools in their own engineering field. He should employ necessary techniques, hardware, and communication tools for modern engineering applications. He also should be able to work in a multi-disciplinary environment, and follow and contribute to the developments in their own field recognizing the significance of lifelong learning.

Electronics engineering is a broad discipline that covers the fields of integrated electronic circuits, electronic data storage, high-speed computing, communications, signal processing, microwave, wave propagation and antenna, optoelectronics, automation, automatic control and monitoring systems, circuit analysis, network analysis, digital signal processing, and microprocessors.

Programs of electronics engineering are designed to strike a balance between theoretical and laboratory experience and to impart fundamental and practical understanding of the principles required for a successful career in electronics engineering. This requires a solid core of foundation courses in physics, mathematics, computer science, and general engineering, which is also essential for lifelong learning. Concentration courses in Electronics Engineering (that integrate theory and laboratory wherever possible) cover electromagnetic, wave propagation and antenna, circuits, electronics, power electronic devices, digital logic design, computers, programming, computer networks, signal processing ,optoelectronics and communications. Courses of interest are electric machinery, power system, classical control, modern control, industrial electronics circuits, digital control techniques, robotics, mechatronics, biomedical systems and modern automation systems. The capstone senior thesis and industrial internship are also required. State-of the-art electronics engineering elective courses provide seniors and advanced undergraduates.

G**raduates who followed one of electronics engineering programs are careered into jobs** including manufacturers of mobile phones, telephone centrals, computers, antenna and radar systems, industrial control, home appliances, biomedical engineering, networking companies, communication systems, and integrated circuits. Others have joined research groups in university and industry, the public service, and the teaching professions.

10.2 THE ATTRIBUTES OF AN ELECTRONICS ENGINEER

In addition to the general attributes of engineer, the electronics engineer should be able to:

a) Participate in and lead quality improvement projects.
b) 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.
c) Apply control theory and measurement principals for industrial variables, signal conversion, conditioning and processing.
d) Deal with the computers hardware, software, operating systems and interfacing.
e) Design, operate and maintain digital and analog communication, mobile communication, coding, and decoding systems.

10.3 NATIONAL ACADEMIC REFERENCE STANDARDS (NARS) FOR ELECTRONIC ENGINEERING

10.3.1 Knowledge and Understanding:

In addition to the knowledge and understanding of engineers, the graduates of electronic engineering program should demonstrate knowledge and understanding of:

a) Elementary science underlying electronic engineering systems and information technology;
b) Basics of design and analyzing electronic engineering systems, while considering the constraints of applying inappropriate technology and the needs of commercial risk evaluation;
c) Principles of Analyzing and design of electronic circuits and components;
d) Principles of Analyzing and design of control systems with performance evaluation;
e) Biomedical instrumentation;
f) Communication systems
g) Coding and decoding techniques
h) Microwave applications
i) Antenna and wave propagation
j) Nanotechnology application
k) Usage of optical fiber
l) Methods of fabrication of Integrated circuits
m) Analysis of signal processing
n) Optical communication systems

10.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of electronic engineering program should be able to:

a) Develop innovative solutions for the practical industrial problems.

b) Plan, conduct and write a report on a project or assignment.
f) Analyze the performance of digital and analog communication, mobile communication, coding, and decoding systems.
c) .
d) Synthesis and integrate electronic systems for certain specific function using the right equipment.

10.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of electronic engineering program should be able to:

a) Use appropriate mathematical methods or IT tools.
b) Practice computer programming for the design and diagnostics of digital and analog communication, mobile communication, coding, and decoding systems.
c) Use relevant laboratory equipment and analyze the results correctly.
d) Troubleshoot, maintain and repair almost all types of electronic systems using the standard tools.
e) Identify appropriate specifications for required devices.
f) Use appropriate tools to measure system performance.

SECTION 11 NARS CHARACTERIZATION OF INDUSTRIAL AND MANAGEMENT ENGINEERING

11.1 INTRODUCTION

Industrial and Management Engineering is a broad professional discipline concerned with the, design, control and management of integrated systems and procedures for organizing the resources of production – people, materials, equipment, and information – to achieve specific objectives.

The complexity of modern industrial and service organizations with their emphasis on competitiveness and quality increased their need for effectiveness and higher productivity. The extensive use of automation and computerization has led to an increased demand for a new breed of Industrial Engineering graduates. Although the discipline is relatively a new professional area developed during the past three decades, it is already one of the largest rapidly growing engineering professions.

Career Opportunities for Industrial Engineers

Industrial Engineering programs of study prepare graduates for careers in all phases of industrial, manufacturing and service firms. It qualifies them to perform different managerial and technical functions that require scientific and engineering background. This is achieved by combining the study of science, mathematics, engineering fundamentals, design, management and quality principles, the programs provide a unique background and a sound basis for life-long career development in engineering practice, research, or management.

Recent developments such as wide spread industrial interest in systems approach, information systems, advanced materials, manufacturing processes, global firms, Supply chain, and quality systems have made the Industrial Engineer’s entrance into management even more likely. They are trained to have familiarity with qualitative and quantitative methods interaction and control. At present, the demand for Industrial Engineers exceeds supply assuring job opportunities expected to expand rapidly in the future.

Career opportunities for Industrial Engineers cover a whole spectrum of industrial systems and service systems. Industrial systems include, but are not limited to: automotive, aerospace, apparel, basic metals, beverages, building materials, chemicals, computers, appliances, electronics, equipment, fabricated metals, food processing, glass, ceramics, heavy machinery, paper, petroleum refining, pharmaceuticals, plastics, power utilities, publishing, textiles, tire and rubber, and wood and furniture.

Service systems include, but are not limited to: banking, education, communications, financial services, government, health and medical, hotel, information, insurance, repair and maintenance, restaurant, retail trade, transportation, wholesale trade, transportation, and warehousing.

11.2 THE ATTRIBUTES OF AN INDUSTRIAL ENGINEER

In addition to the general attributes of engineer, the industrial and management engineer should be able to:

a) Demonstrate the ability to design, develop, implement, and improve integrated systems that include people, materials, information, equipment and energy.
b) Understand the engineering relationships between the management tasks of planning, organization, leadership, control, and the human elements in production, research and service organizations.
c) Comprehend and handle the integration of management systems into a series of different technological environments.
d) Provide strong ties and linkages between the local economic sectors and industrial communities with the department graduates in areas related to research, hands-on training, and field investigations.
e) Emphasizing risk assessment and the impact of uncertainties associated with economic and process decisions in industrial and service sectors.
f) Underlining the key roles of safety dimensions, sustainable technology, environmental friendliness, and cleaner production measures in manufacturing, materials, managerial and economic alternatives as reflected in the program course structure.

11.3 NARS FOR INDUSTRIAL AND MANAGEMENT ENGINEERING

The following academic reference standards represent the general expectation about the qualifications attributes and capabilities that the graduates of Industrial and Management Engineering programs should be able to demonstrate.

11.3.1 Knowledge and Understanding

In addition to the knowledge and understanding of engineers, the graduates of industrial and management engineering program should demonstrate knowledge and understanding of:

a) The fundamental manufacturing processes and the most recent technologies that are used in that field. In addition to, the most important materials used in industry, their structure, and their modes of failure.
b) Basics of industrial engineering such as production planning and control, production scheduling, and inventory management.
c) Organisations, their internal structures and their management, including the management of human resources, financial resources and operations.
d) Globalization and its effect on the different operations of an organization and the importance of industrial data systems in that regard.
e) The key concepts of quality engineering and reliability and their importance in the production of goods and services.

11.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of industrial and management engineering program should be able to:

a) Solve a wide range of problems related to the analysis, design, and construction of production systems.
b) Identify a range of solutions and critically evaluate and justify proposed design solutions.
c) Analyze and solve the problems presented by industrial entities.

11.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of industrial and management engineering program should be able to:

a) Use the scientific literature effectively and make discriminating use of Web resources.
b) Use appropriate computer-based support tools for problem-solving and analysis of results.
c) Apply the acquired skills in a commercial or industrial environment.

Section 12 NARS Characterization of Marine Engineering and Naval Architecture

12.1 INTRODUCTION

Marine engineering and naval architecture program concerns with the design, repair and operation for all floating units at sea, lakes and rivers. It depends mainly on the basic sciences, physical, engineering and human sciences connected with the transportation of human and cargo by sea, lakes or rivers in the most easy and safe way.

The sailing or floating vehicles with crew onboard are units with all facilities to sustain life, such as food, electrical and mechanical power, fresh water, sewage plant and recreation areas.

The marine engineer and naval architect should be capable of understanding the nature of floating units and their building and design methods. He/she should also be familiar with the working principals of all machineries and equipment on board these units. This requires the sufficient knowledge about mechanical, structural and electrical engineering.

A B.Sc. degree in marine engineering and naval architecture is designed for students who seek careers in shipbuilding and repair industry (such as shipyards) ,naval yards, classification societies, surveyors as well as marine engineers on board ships, offshore drilling rigs, navy force, ports and maritime transport companies. This degree is also appropriate for students who plan to be researchers or who intended to pursue an advanced or specialized degree in engineering.

A typical program curriculum incorporates analytical tools, creative thoughts and diversity of skills as well as the state of the art of the profession.
Marine and naval architecture engineers may work in ship building and repair yards, ports, navy, classification societies, and onboard ships (sea going and inland units) and floating units such as offshore drilling rigs.

12.2 THE ATTRIBUTES OF MARINE AND NAVAL ARCHITECTURE ENGINEER

In addition to the general attributes of engineer, the marine and naval architecture engineer should be able to:

a) Work professionally in the marine and naval systems design and manufacturing
b) Use of mathematics and physical sciences and system analysis tools in ship's hull design in addition to propulsion and auxiliary machineries and equipment
c) Understand and apply of all the International Conventions and national maritime laws in ship design and operation
d) Choose the adequate building materials from the prospect of strength, durability, suitability and environmental conditions
e) Use of computer graphics for design, communication and visualization

f) Use of the industry standard software packages (hull, nesting, piping, etc) CAD/CAM and develop what is necessary to design and build marine systems.
g) Managing the shipbuilding projects taking into consideration the economic , environmental, and social constrains
h) Preserve clean and healthy environment during building and operating the floating units

12.3 NARS FOR MARINE ENGINEERING AND NAVAL ARCHITECTURE

The following academic reference standards represent the general expectation about the qualifications attributes and capabilities that the graduates of Marine engineering and naval architecture programs should be able to demonstrate.

12.3.1 Knowledge and Understanding:

In addition to the knowledge and understanding of engineers, the graduates of marine engineering and naval architecture program should demonstrate knowledge and understanding of:

a) The constraints within which his/her engineering judgment will have to be exercised
b) A number of engineering science disciplines such as Mechanical, Electrical and structural Engineering;
c) Engineering design principles and techniques;

12.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of marine engineering and naval architecture program should be able to:

a) Solve engineering ship design and shipbuilding problems, often on the basis of limited and possibly contradicting information;
b) Analyze and interpret data, and design experiments to obtain new data;
c) Design a marine system, component or process to meet a need;
d) Evaluate designs, shipbuilding processes and propose improvements;
e) Maintain a sound theoretical approach in dealing with new and advancing technology,
f) Use the principles of engineering science in developing solutions to practical Marine engineering and naval architecture problems.
g) Solve ship design and shipbuilding problems.

12.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of marine engineering and naval architecture program should be able to:

a) Use basic workshop equipment safely;
b) Understand and apply safe systems of work;
c) Research for information
d) Prepare engineering drawings, computer graphics and specialized technical reports.
e) Use and manage the exploitation of modern CAD and CAD/CAM facilities
f) Work as a chief engineer in the shipbuilding, maintenance and ship operation;

SECTION 13 NARS CHARACTERIZATION OF MECHANICAL ENGINEERING APPLICATIONS IN AGRICULTURE

13.1 INTRODUCTION

Mankind needs agricultural products for survival. With the exponential growth of world population, the development of land cultivation and agricultural productivity are gaining progressive importance. This, in turn, necessitates the continuous development of agricultural mechanization and technology. Moreover, the exchange of agricultural products between nations, and the need to store products for all-year round usage, acquires the development of agricultural products processing and preservation. The "Applications of Mechanical Engineering in Agriculture" program aims to prepare engineers capable to design, operate and maintain agricultural mechanization devices and equipment as well as agricultural products processing devices, equipment and plants. The former include cultivation, seeding, irrigating, weeds and insects controlling and traction equipment. The latter include products sorting, storage, processing, quality preservation, packaging and canning as well as plants planning and management.

The program of "Mechanical Engineering Applications in Agriculture" may be considered as a broad and multi-disciplinary one as it covers sciences and technologies of agriculture, machine design, thermo-fluids, energy and power, production, automatic and environmental control, economy and management. The graduates of the program can handle many mechanical engineering problems as well as its applications in agriculture. The field of application is open for innovative ideas in both areas of agricultural machinery and agricultural products processing; and the graduates of the program are to be qualified to advance the technology in such applications.

The graduates of the "Mechanical Engineering Applications in Agriculture" program help to:

- Design and develop agricultural machinery.
- Develop agricultural processing systems and equipment.
- Develop, operate and maintain tractors and other agricultural machinery.
- Improve the maintenance and performance of environmental control systems and equipment.
- Plan a food processing plant (lay out, material transfer systems and equipment, heat exchangers, products packaging, etc.).

The graduates of the program may work in:

- Food processing industries.
- Heavy and agricultural machinery establishment.
- Managements of plants, power stations and workshops.
- Ventilation and air conditioning of spaces including those of farms.
- Grinding and silage firms and large grain storage silos.
- Research and development.

13.2 THE ATTRIBUTES OF MECHANICAL ENGINEERING APPLICATIONS IN AGRICULTURE ENGINEER

In addition to the general attributes of engineer, the mechanical applications in agriculture engineer should be able to:

a) Apply theories and concepts of chemistry, physics, mathematics, thermodynamics and engineering principles to analyze the agricultural mechanization and processing systems and components.
b) Apply and integrate knowledge, understanding and skills of different subjects to solve real problems related to agriculture mechanization equipment and applications in food industries.
c) Design and implement projects in the fields of agriculture mechanization and food processing subjected to economic, environmental and social constraints.
d) Analyze interdisciplinary mechanical, electrical, hydraulic and civil systems.
e) Use and/or develop computer software related to farm machinery and processing equipment and processes.
f) Adapt with technological evolutions.
g) Lead or supervise a group of designers, technicians and work force.

13.3 NATIONAL ACADEMIC REFERENCE STANDARDS FOR MECHANICAL APPLICATIONS IN AGRICULTURE ENGINEERING PROGRAMMES

In addition to the NARS for Engineering the following academic reference standards represent the general expectations about the qualifications attributes capabilities that the graduates of the mechanical engineering applications in agriculture programs should be able to demonstrate.

13.3.1 Knowledge and Understanding:

In addition to the knowledge and understanding of engineers, the graduates of mechanical applications in agriculture engineering program should demonstrate knowledge and understanding of:

a) Basic agricultural sciences related to engineering activities (land, plant production, animal production and food processing).
b) Characteristics and properties of soil and materials.
c) Contemporary issues in agricultural mechanization and agricultural products' processing.
d) Basic theories and fundamentals of other engineering disciplines providing support the mechanical engineering applications in agriculture.
e) Business, management and planning techniques and practices appropriate to engineering applications in agriculture.

13.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of mechanical applications in agriculture engineering program should be able to:

a) Search for information about mechanical engineering and its applications in Agriculture.

b) Evaluate discipline's designs, processes and performances and propose improvements.
c) Analyze and interpret data, and design experiments to obtain new data.

13.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of mechanical applications in agriculture engineering program should be able to

a) Prepare engineering drawings, computer graphics and specialized technical reports.
b) Use computational tools and packages and write computer programs pertaining to agricultural mechanization and food processing.
c) Work in operation and maintenance of plants.
d) Apply the appropriate tools from mathematics, basic science, agriculture basic science, technology and the know-how gained from the professional experience to analyze agricultural mechanization and processing problems to meet certain needs.
e) Use basic workshop and farm tools and equipment safely and appropriately.

SECTION 14 NARS CHARACTERIZATION OF MECHANICAL DESIGN AND PRODUCTION ENGINEERING

14.1 INTRODUCTION

Mechanical engineers should be curious about how things are made and work. They have a desire to solve problems and a talent for understanding the operation of mechanical devices. Mechanical engineers conceive, plan, design and direct the production, distribution and operation of a wide variety of devices, machines and systems, environmental control and materials processing, transportation and handling. Design and production mechanical engineers analyze their design using the principles of motion, energy, and momentum to insure that the product functions safely, efficiently, reliably, and manufactured at a competitive cost with minimized environmental hazards.

Mechanical engineering; design and production, is a broad discipline which covers the fields of solid and fluid mechanics, thermodynamics, engineering design, production technology, economics and management. Basic studies are devoted to mechanical properties of materials, machine design, dynamics and control, instrumentation, fundamentals of fluid flow, energy and power systems. Mechanical Engineering covers the design, analysis, testing and manufacturing of products that are used in every facet of modern society. Undergraduate educational programs in mechanical engineering design and production are, therefore, specifically designed to provide a wide variety of topics. These include power systems, fluid and thermal sciences related to discipline, automatic control, reliability, quality assurance and control, mechanical design and manufacturing.

A B.Sc. degree in design and production mechanical engineering is designed for students who seek careers as engineers in industry, army, consulting firms and private and governmental agencies. This degree is also appropriate for students who plan to be researchers or who intend to pursue an advanced degree in engineering. A typical program curriculum incorporates analytical tools, creative thought and diversity of skills as well as the state of art of the profession.

Design and production mechanical engineer may work in:

Private and governmental firms, where it is required to design, manufacture, operate, develop or maintain mechanical systems and equipment such as; industrial machinery, automotive, aerospace, power generation and air conditioning equipment.

14.2 THE ATTRIBUTES OF MECHANICAL DESIGN AND PRODUCTION ENGINEER

In addition to the general attributes of engineer, the design and production engineer should be able to:

a) Work with mechanical design and manufacturing systems.

b) Use of mathematics and physical and engineering sciences and systems analysis tools in components and machines and produce design and manufacture.
c) Use different instruments appropriately and carry-out experimental design, automatic data acquisition, data analysis, data reduction and interpretation, and data presentation, both orally and in the written form.
d) Use the computer graphics for design, communication and visualization.
e) Use and/or develop computer software, necessary for the design, manufacturing and management of industrial systems and projects.
f) Analyze multi-disciplinary mechanical, electrical, thermal and hydraulic systems.
g) Lead or supervise a group of designers or technicians and other work force.

14.3 NARS FOR MECH. ENGINEERING DESIGN & PRODUCTION

The following academic reference standards represent the general expectation about the qualifications attributes and capabilities that the graduates of Mechanical design and production engineering programs should be able to demonstrate.

14.3.1 Knowledge and Understanding:

In addition to the knowledge and understanding of engineers, the graduates of mechanical design and production engineering program should demonstrate knowledge and understanding of:

a) Concepts, principles and theories relevant to Mechanical Engineering and manufacture;
b) The constraints within which his/her engineering judgment will have to be exercised;
c) The specifications, programming and range of application of CAD and CAD/CAM facilities
d) Relevant contemporary issues in mechanical engineering.
e) Basic electrical, control and computer engineering subjects related to the discipline
f) The role of information technology in providing support for mechanical engineers
g) Engineering design principles and techniques
h) Management and business techniques and practices appropriate to engineering industry.

14.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of mechanical engineering design & production program should be able to:

a) Apply the principles of mathematics, science and technology in problem solving scenarios in mechanical engineering;

b) Analyze and interpret data, and design experiments to obtain primary data;
c) Evaluate and appraise designs, processes and products, and propose improvements;
d) Interpret numerical data and apply analytical methods for engineering design purposes
e) Use the principles of engineering science in developing solutions to practical mechanical engineering problems.
f) Select appropriate manufacturing method considering design requirements.

14.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of mechanical engineering design & production program should be able to:

a) Prepare engineering drawings, computer graphics and specialized technical reports and communicate accordingly.
b) Employ the traditional and modern CAD and CAD/CAM facilities in design and production processes
c) Use basic workshop equipment safely;
d) Analyze experimental results and determine their accuracy and validity;
e) Use laboratory equipment and related computer software;
f) Operate and maintain mechanical equipment.
g) Prepare the process plan for manufacturing

SECTION 15 NARS CHARACTERIZATION OF MECHANICAL POWER AND ENERGY ENGINEERING

15.1 INTRODUCTION

Mechanical Power and Energy Engineering gains importance progressively due to the increased level of prosperity and technology that consume extra power. This discipline is mainly concerned with thermo-fluid sciences that are the basis for energy conversion and power generation. In addition, Mechanical Power and Energy engineers are concerned with other important issues like the pollution control, energy management, heating, ventilation and air-conditioning, transport phenomena, combustion, fluid flow,…etc.

The development of mechanical power engineering has been fundamental to the advancement of civilization. Mechanical Power Engineering is the science and technology of energy and its conversion to mechanical power. This includes the major flow and combustion processes occurring in different systems.

Energy takes a number of different forms, such as mechanical energy, electrical energy, nuclear energy, chemical energy, kinetic energy, and solar energy. Energy is used to do the work, and the relationship between work and energy (or heat) is called thermodynamics.

Applied thermodynamics deals with such special applications of energy transfer as power generation, refrigeration and gas compression. The energy transfers are made during processes which use certain fluid contained in or flowing through a system.

The techniques for calculating and evaluating internal combustion engine performance, combustion and emissions processes and design features represent one of major subject of the mechanical power engineering.

A basic knowledge of the principles of energy; its use, its transfer, and its conversion from one form to another is also one of the important subjects in mechanical power engineering. It requires understanding of different subjects such as physics, chemistry, turbo-machinery, and mathematics.

As the population of the world grows and as fuels become scarcer, it becomes more and more important for man to be able to control energy consumption to a high level; first, to obtain higher efficiencies from heat or power cycles; second, looking for alternative fuels (cheap, less polluted, high heat release); third, need to remove pollutants formed during processes of energy conversion; and forth, apply safety measures. Moreover, aeronautical and space developments of recent decades have brought special challenges; achieving high heat release, working with special materials and suppressing acoustic interaction. It is a challenge now for mechanical power and energy engineers to search for alternative fuels as a new source for energy, to link between chemical, physical and thermo-fluid properties to energy transfer characteristics in different applications such as power stations, turbo-machinery, vehicles, boilers, gas and steam turbines. Moreover, it is very important to model energy transfer processes aiming at obtaining high efficiency and less pollutants. It is thus a mandatory to encourage a diversity of subjects' provision, to encourage institutions to explore new ways of enhancing knowledge and understanding of students, and to instill a sense of excitement of their students

Mechanical Power and Energy Engineers help to:

- Develop power stations, boilers, gas or steam turbine, internal combustion engines, refrigeration systems ….etc.
- Develop safety control system in the above equipment.
- Enhance the liquid, vapor and gas network piping and ducting systems.
- Develop methods for reducing the pollutant emissions from different systems.
- Improve the maintenance and the performance of the combustion equipment, turbo-machinery and refrigeration systems.

Mechanical Power and Energy Engineers may work in:

- Processing or user industries.
- Power stations and petrochemical plants.
- Management in industries.
- Establishments concerned with cars, ships, energy generation or aerospace and refrigeration and air conditioning.
- Safety and environmental concerns.
- Research

15.2 THE ATTRIBUTES OF A MECHANICAL POWER AND ENERGY ENGINEER

In addition to the general attributes of engineer, the Mechanical Power/Energy engineer should be able to:

a) Evaluate the sustainability and environmental issues related to mechanical power systems.
b) Use energy efficiently.
c) Apply industrial safety.
d) Apply and integrate knowledge, understanding and skills of different subjects and available computer software to solve real problems in industries and power stations.
e) Lead or supervise a group of engineers, technicians and work force.
f) Carry out preliminary designs of fluid transmission and power systems, investigate their performance and solve their essential operational problems.
g) Design, operate and maintain internal combustion and steam engines.

15.3 NATIONAL ACADEMIC REFERENCE STANDARDS FOR MECHANICAL POWER AND ENERGY ENGINEERS

In addition to the NARS for Engineering the following academic reference standards represent the general expectations about the qualifications attributes capabilities that the graduates of mechanical power and energy programs should be able to demonstrate.

15.3.1 Knowledge and Understanding:

In addition to the knowledge and understanding of engineers, the graduates of mechanical power and energy engineering program should demonstrate knowledge and understanding of:

a) Fundamentals of thermal and fluid processes
b) Internal combustion, pumps, turbines and compressors, classification, construction design concepts, operation and characteristics
c) Fluid power systems
d) The constraints which mechanical power and energy engineers have to judge to reach at an optimum solution.
e) Business and management techniques and practices appropriate to mechanical power and energy engineering applications.
f) Mechanical power and energy engineering contemporary issues.
g) Basic theories and principles of some other engineering and mechanical engineering disciplines providing support to mechanical power and energy disciplines.

15.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of mechanical power and energy engineering program should be able to:

a) Evaluate mechanical power and energy engineering designs, processes and performances and propose improvements.
b) Analyze and interpret data, and design experiments to obtain new data.
c) Evaluate the power losses in the fluid transmission lines and networks
d) Analyze the performance of the basic types of internal combustion engines and hydraulic machines
e) Analysis of fluid power systems, subsystems and various control valves and actuators

15.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of mechanical power and energy engineering program should be able to:

a) Use basic workshop equipment safely and appropriately.
b) Prepare engineering drawings, computer graphics and specialized technical reports.
c) Write computer programs pertaining to mechanical power and energy engineering.
d) Describe the basic Thermal and fluid processes mathematically and use the computer software for their simulation and analysis
e) Design, operate, repair and maintain fluid hydraulic power systems for diverse applications
f) Carry out preliminary designs of fluid transmission networks, internal combustion and steam engines and solve their operational problems.
g) Work in mechanical power and energy operations, maintenance and overhaul.

SECTION 16 NARS CHARACTERIZATION OF MECHATRONICS ENGINEERING

16.1 INTRODUCTION

Mechatronics is about today's world. It's where electronics, computers and mechanics converge to bring the automated devices we use in our every day lives, both in the home and at work. As society advances technologically, demands have been increasing for mechanical devices with embedded electronics, sensors, actuators and related systems.
Mechatronics engineering is strongly based on Mechanical Engineering, but is a distinctly different discipline. The program provides an interdisciplinary, tightly focused approach to designing automated devices, preparing professionally trained Mechatronics engineers who can have an immediate impact in industry.
Mechatronics Programs combine core undergraduate courses in mechanical, selected electronics and software engineering with several option-specific courses in an interdisciplinary approach. Graduates enjoy professional skills in classical machine design and analysis, as well as electronic instrumentation, computer control systems, and software engineering.
As such, Mechatronics Program Graduates are concerned with the design, automation and operational performance of electro-mechanical systems. They typically use their skills and knowledge about mechanical and electronic processes as well as computers to develop new solutions to industrial problems. In addition, they often become involved in providing technical advice or assistance relating to the creation of new products.

Career Opportunities
Mechatronics engineers work with the electronic and computer control systems which nearly all machinery relies on for efficient and reliable operation. They are employed by product developers and manufacturers, large and small, by the mining industry, by the aerospace and defense sectors, and by the government and industry research groups. Wherever there is potential for improvement through the integration of computer and electrical hardware with mechanical systems there is a need for mechatronics engineers. As more industries seek to apply the evolutionary advances in computers, electronics, sensors, and actuators to improve their products, processes and services, the demand for Mechatronics Engineers is forecast to be high and ever increasing.

16.2 THE ATTRIBUTES OF MECHATRONICS ENGINEER

In addition to the general attributes of an engineer, the program aims at preparing students for a professional or research career in mechatronics which involves aspects of machines and processes with electronics and computing (such as robotics, industrial control and automation systems). Successful integration of material from these disciplines is an essential part of the program. Therefore, In addition to the general attributes of engineer, the mechatronics engineer should be able to:

a) Use of mathematics, physical science and systems analysis tools in components and system design.

b) Students will learn engineering sciences and demonstrate the application of this knowledge to electro-mechanical systems.
c) Solve problems in the areas of integrated mechanics, electronics, computers and software systems.
d) Analyze and investigate the inter-disciplinary characteristics of mechanical, electrical and hydraulic systems.
e) Graduates should have wide choices leading to specialization in mechanics, electronics, design, computer software or other areas

16.3 NARS FOR MECHATRONICS PROGRAM

In addition to the general attributes of the engineer, the graduates of mechatronics programs should be able to demonstrate.

16.3.1 Knowledge and Understanding:

In addition to the knowledge and understanding of engineers, the graduates of mechatronics engineering programs should demonstrate knowledge and understanding of:

a) Basic science and engineering fundamentals in mechanics, electronics and software in their interfacing;
b) Fundamentals of problem identification, formulation and solution in the inter-disciplinary fields of Mechatronics;
c) The principles of sustainable design and development;

16.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of mechatronics engineering program should be able to:

a) Identify at an appropriate level the design, production, interfacing and software needs of different parts of Mechatronics systems.
b) Create solutions to mechatronics systems especially to manufacturing, maintenance and interfacing problems in a creative way, taking account of industrial and commercial constraints.

16.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of mechatronics engineering program should be able to:

a) Compete, in-depth, in at least one engineering discipline, namely mechanics, electronics or interfacing and software;
b) Manage field problem, identification, formulation and solution;
c) Utilize practical systems approach to design and performance evaluation;
d) Apply the principles of sustainable design and development;

SECTION 17 NARS CHARACTERIZATION OF METALLURGICAL ENGINEERING

17.1 INTRODUCTION

Historically, the development and advancement of societies have been intimately tied to the members' ability to produce and manipulate materials to fulfill their needs. In fact, early civilizations have been designated by the level of their materials development (Stone Age, Bronze Age, and Iron Age). Furthermore, it was discovered that the properties of a material could be altered by heat treatments and by the addition of other substances. At this point, materials utilization was totally a selection process. Thus, tens of thousands of different materials have evolved with rather specialized characteristics that meet the needs of modern and complex society; these include metals, plastics, glasses, and fibers. Materials that are utilized in high-technology (or high-tech) applications are sometimes termed advanced materials. Advanced materials include semiconductors, biomaterials, and what may term "materials of the future" (that is, smart materials and Niño-engineered materials).

Until very recent times the general procedure utilized by scientists has been to begin by studying large and complex structures, and then to investigate the fundamental building blocks of these structures that are smaller and simpler. This approach is sometimes termed "top down" science. However, with the advent of scanning probe microscopes, which permit observation of individual atoms and molecules· It has become possible to manipulate and move atoms and molecules to form new structures and, thus, design new materials that are built from simple atomic-level constituents (i.e., "materials by design"). This ability to carefully arrange atoms provides opportunities to develop mechanical, electrical, magnetic, and other properties that are not otherwise possible. This is called the "bottom-up" approach, and the study of the properties of these materials is termed "nanotechnology"; the "Niño" prefix denotes that the dimensions of these structural entities are on the order of a nanometer (10^{-9} m).

Metallurgical Engineering (as a branch of materials engineering) is the science and technology of processing materials to extract, refine and recycle metals. These processes include the development and use of metals and alloys that have specific physical and mechanical properties. Extractive metallurgy is the practice of separating metals, usually in the form of a metal oxide, from their ores, and refining them into pure metals. In order to convert a metal oxide to a metal, the metal oxide should be reduced either chemically or electrolytically.

Metallurgy, in production engineering, is concerned with the production of metallic components for use in consumer or engineering products. This involves the production of alloys, shaping, heat treatment and the surface treatment of the product. The task of the metallurgist is to achieve required design criteria, such as cost, weight, strength, toughness, hardness, corrosion resistance and performance under different working conditions.
Metals are shaped by processes such as casting, forging, rolling, extrusion, sintering, metalworking, machining and fabrication. With casting, molten metal is

poured into a shaped mould. In forging, a red-hot billet is hammered into a final shape. In rolling, a billet is passed through successively narrower rollers to create a final sheet. In extrusion, a hot and malleable metal is forced under pressure through a die, which shapes it before it cools. With sintering, a powdered metal is compressed into a die at high temperature. Metallurgy is also applied to electrical and electronic materials whereas metals such as aluminum, copper, tin and gold are used in power lines, wires, printed circuits boards and integrated circuits.

Metallurgists are studying correlations between processing, structure, properties and performance. Structure related to sub-atomic structure, atomic structure, and microstructure examinations. Great correlations revealed between microscopic examination as well as failure mode analysis for metals and alloys. Optical and electron microscopes and mass spectrometers are some examples of tools used for microscopic examination of metals. Metallurgists are also studying crystallography, the effects of temperature and heat treatment on the component phases of alloys and the properties of those alloy phases. The metals properties (macroscopic) are tested using different testing machines and devices. The tests revealing tensile strength, compressive strength, hardness, creep strength, fatigue strength and other properties.

The central themes are:

- How to extract, purify and shape metals and alloys.
- The link between structure (on length scales from sub-nm to mm) and chemical, physical and mechanical properties.
- How to control microstructure through processing that can be used to optimize engineering performance. Modeling is increasingly used to predict both microstructure and properties.
- Protection of metallic structures against corrosion and degradation.

Metallurgical engineers help to:

- Extract and develop the metals and alloys required for new products.
- Develop protection methods against degradation.
- Find better and low-cost manufacturing routes and enhance the performance of existing metals and alloys.
- Consider the environmental impact and sustainability of their products.
- Discover how to optimize the selection of materials and create sophisticated databases from which properties and service behavior can be predicted.

Metallurgical engineers may work in:

- Extraction of metals and alloys.
- Manufacturing, processing or user industries.
- Research.
- Production.
- Management or sales.
- Mass-produced artifacts such as: Cars, tableware, or building materials or specialist products such as those needed for micro-electronics, sports equipment, replacement body parts, energy generation or aerospace.

NARS Characterization is Framed so as to:

- Encourage diversity of provision and

- Encourage institutions to explore new ways of enhancing the knowledge and understanding of their students and instilling a sense of the excitement of this rapidly developing discipline.

17.2 THE ATTRIBUTES OF A METALLURGICAL ENGINEER

In addition to the general attributes of engineer, the metallurgical engineer should be able to:

a) Acquire knowledge of basic principles of metallurgy, supported by the necessary background science.
b) Apply advanced science and engineering principles to metallurgical systems.
c) Have an integrated understanding of the scientific and engineering principles underlying the four major elements of the field of Metallurgical Engineering; processing, structure, properties and performance, related to metallurgical systems appropriate to the field.
d) Apply and integrate knowledge from each of the four elements of the Metallurgical Engineering to solve materials selection and design problems.
e) Recognize of the importance of metals and alloys to industry and society.
f) Use the relevant mathematical and computational skills and the available computer soft ware in solving metallurgical engineering problems.
g) Lead a group of peers, technicians and other work force.

17.3 NATIONAL ACADEMIC REFERENCE STANDARDS FOR METALLURGICAL ENGINEER

In addition to the NARS of Engineering the following academic reference standards represent the general expectation about the qualifications attributes and capabilities that the graduates of Metallurgical engineering programs should be able to demonstrate.

17.3.1 Knowledge and Understanding

In addition to the knowledge and understanding of engineers, the graduates of metallurgical engineering program should demonstrate knowledge and understanding of:

a) Basic topics related with metals and alloys.
b) The role of information technology in providing support for metallurgical engineers.
c) Engineering principles relevant to materials selection.
d) Processing of metals and alloys.
e) The materials aspects of design.
f) Organisations, their internal structures and management, including the management of human resources, financial resources and operations.

17.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of metallurgical engineering program should be able to:

a) Select and identify an appropriate material and manufacturing route for the design of a component;
b) Select materials from an environmentally appreciative viewpoint.

c) Interpret numerical data and apply mathematical methods to the analysis of materials engineering and management problems.
d) Propose and assess options for the improvement of operations.
e) Explain experimental results in terms of theoretical mechanisms and concepts.
f) Evaluate and present practical data in a suitable format.

17.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of metallurgical engineering program should be able to:

a) Use appropriate mechanical testing, corrosion testing, optical, X-ray, and electron metallographic, and chemical analysis methods for metals and alloys.
b) Use appropriate computer software for design and modeling exercises.
c) Propose and assess options for the improvement of operations.
d) Utilize materials engineering principles to develop new materials/processing routes for improved performance of engineering systems.

SECTION 18 NARS CHARACTERIZATION OF MINING ENGINEERING

18.1. Introduction

Mining engineering is concerned with the proving, planning, developing, extraction and processing of ores containing valuated minerals or metals. It is one of the most critical contributions to social and economic life.

Mining is not done in isolation, nor is it an entity unto itself. It is preceded by geologic investigations that locate the deposit and economic analysis that prove it financially. Following extraction of the mineral or ore, the run of mine material is generally prepared or beneficiated in procedures termed mineral processing. The product of those processes may be undergoing further concentration, refinement, or fabrication during conversion, smelting or refining to provide consumer products. The end step in converting a useful mineral into a usable product is marketing.

Mining techniques also are applied to the removal of earth or rocks for military or civil purposes. In military or civil mining the objective is to produce a stable opening of desired size, orientation, and permanence. Examples are vehicular tunnels, storage reservoirs, waste disposal chambers, archaeological excavations and military installations. They are excavated using methods that are borrowed from mining. Since the objective is the excavation or opening itself rather than the material extracted, however, other kinds of conditions or circumstances may govern, such as time, shape, or life.

Mining, mineral processing and their supporting activities involve most of the engineering disciplines, science and others. Consequently, the information needs of the mining engineer truly can be termed special. In his profession, the mining engineer needs knowledge of civil, mechanical, electrical and metallurgical engineering and geology and chemistry. A person may become a mining engineer by education followed by experience in the field. The mining engineer can devote a portion of his career or all of to a specialized type of mining or to a phase of mining activity.
The modern mining industry is a high technology business; mining today involves automated equipment, computer-aided design and control systems; and an industry committed to safety and environmental responsibility.

To become a mining engineer require gaining a thorough knowledge of general engineering principles followed by studying courses specific to mining and mineral processing. These courses are designed to cover a wide and diverse range of subjects in order to meet the challenge that will be faced in the mining industry.

<u>Mining Engineers work in:</u>

Private and governmental companies where it is required to discover, evaluate, recover and process mineral deposits from the earth. The majority are employed in either the design or supervision of mineral extraction and processing systems.

They may also go into such related work as environmental control, safety, research or education. Some mining engineers, along with geochemists, geophysicists and geologists, work in mineral exploration; others work with metallurgical and other engineers to appraise new ore deposits. They study rock formations and water, soil and plant characteristics for signs of mineral or ore deposits.

Employment as an engineer in a producing mine is only one of the many career opportunities following a B.Sc. in Mining Engineering. Specialist consulting firms, construction engineering and surveying companies, government agencies, mining equipment suppliers and financial organizations are some of the businesses in which mining engineers are found.

18.2. THE ATTRIBUTES OF MINING ENGINEERS

In addition to the general attributes of engineer, the mining engineer should be able to:

a) Participate in the activities of the discovery, development, exploitation, and use of natural mineral deposits.
b) Develop preliminary plane and manage the operations of extraction, processing and sometimes the primary refinement, of the raw material.
c) Apply the safety regulations and industrial hygiene precautions during the execution of mining operations, including risk assessment of any associated specific hazards,
d) Apply the geologic data, techniques and principles for site characterization and environmental remediation.
e) Operate the basic mining instrumentation and equipment
f) Use effectively the modern surveying equipment

18.3. NARS FOR MINING ENGINEERING

The following academic reference standards represent the general expectation about the qualifications attributes and capabilities that the graduates of Mining Engineering programs should be able to demonstrate.

18.3.1 Knowledge and Understanding

In addition to the knowledge and understanding of engineers, the graduates of mining engineering program should demonstrate knowledge and understanding of:

a) Principles and techniques of mineral exploration and valuation.
b) Explosives and blasting techniques applied for both mining and civil engineering purposes.
c) Surveying and remote sensing techniques applied for the planning, design and layout of surface and underground mining workings.
d) Rock mechanics and engineering principles and applications for rock stability, tunneling, supporting, drilling and slope design.
e) Planning and design of surface and underground mining operations.
f) Systems and industrial engineering skills for optimization of the mining process and reliability.

g) Chemical and environmental engineering skills for reclamation, mineral processing and environmental management.
h) Environmental impact assessment of mining and control of mine climate through the application of mine ventilation and air conditioning techniques.
i) Principles and applications of mineral processing techniques for design of mineral up-grading flow sheets.
j) Risk, hazards, industrial hygiene, health and safety.

18.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of mining engineering program should be able to:

a) Analyze the results of surveying and remote sensing techniques applied for the planning, design and layout of surface and underground mining workings.
b) Optimizes of the mining process and reliability.
c) Assessment of Environmental impact of mining and control of mine climate
d) Analyze the geologic data, techniques and principles for the location, planning, design, constructions, operation and maintenance of engineering structures. This work also includes site characterization and environmental remediation.
e) Interpret the results geophysical survey measurements during the exploration for minerals,

18.3.3. Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of mining engineering program should be able to:

a) Use computer programming, simulation, modeling, and information technology techniques to deal with mining systems.
b) Apply of modern science and engineering in the discovery, development, exploitation, and use of natural mineral deposits.
c) Supervise the operations of extraction, processing and sometimes the primary refinement, of the raw material.
d) implement the safety regulations and industrial hygiene precautions during the execution of mining operations, including risk assessment of any associated specific hazards,
e) Apply of geologic data, techniques and principles for the location, planning, design, constructions, operation and maintenance of engineering structures. This work also includes site characterization and environmental remediation.
f) apply the geophysical survey measurements and interpret the results in terms of geologic features of the economic deposit sought during the exploration for minerals,
g) Operate standard mining instrumentation and equipment such as that used for exploration, rock characterization, stopping, ventilation, transportation, drainage, etc.
h) Execute surveying works using modern equipment and contouring and mapping software.

SECTION 19 NARS CHARACTERIZATION OF NUCLEAR AND RADIATION ENGINEERING

19.1 INTRODUCTION

The definition of engineering is as applicable to nuclear as it is to other disciplines: "Engineering is applied science concerned with using the earth's resources for supplying human needs in the form of structures, machines, transportation, etc." Nuclear engineering is concerned with the engineering aspects of the uses of nuclear processes for supplying human needs. Nuclear processes cover a wide range of technology, all the way from the splitting of heavy atoms (fission), to the joining of light elements (fusion), to generate electricity, to the use of radiation for medical or industrial diagnostics. The career opportunities for nuclear engineers are equally broad.

The undergraduate education of a nuclear & radiation engineer provides the knowledge to perform a great variety of engineering assignments. Compared with the more traditional disciplines, the nuclear engineer is a cross between mechanical engineer and physicist. The mechanical engineering aspect appears because of the heavy emphasis on thermal hydraulics in the proposed curriculum. The physics aspect appears because the nuclear engineering student should understand modern and nuclear physics in order to understand core and radiation physics.

The undergraduate nuclear engineering student should solve complicated problems requiring the extensive use of computers. This provides the capability to tackle complicated problems that extend beyond the field of nuclear engineering. In essence, the nuclear engineer should graduate with the technical foundation to solve or contribute to the solution of a broad range of technical problems – with particular strength in nuclear phenomena.

Nuclear & Radiation Engineer may work in:

- Atomic Energy Authority, at the existing research reactors besides the various labs of different nuclear applications
- The Nuclear Power Plant Authority
- The Nuclear Safety Center
- Different industrial facilities utilizing radioisotopes in their diagnostics and quality control
- All different medical establishments applying nuclear medicine in patients' examination and treatment

19.2 THE ATTRIBUTES OF A NUCLEAR & RADIATION ENGINEER

In addition to the general attributes of an engineer, the nuclear & radiation engineer should be able to:

a) Apply mathematics, physical sciences and system analysis tools in monitoring and surveillance of nuclear reactors.
b) Handle safely radioactive materials and equipment.

c) Design and develop experimental setups for the application and measurements of radioisotopes in industry, agriculture, medicine, and other applications.
d) Apply computer codes for the analysis of nuclear systems.
e) Develop computer software for the reactor safety analysis as well as for the evaluation of the radiation effects on materials.
f) Simulate nuclear processes and building experimental setups to monitor system performance.
g) Lead or supervise a group of technicians in the nuclear field.

19.3 NARS FOR NUCLEAR & RADIATION ENGINEERING

In addition to the NARS of Engineering the following academic reference standards represent the general expectations about the qualifications attributes and capabilities that the graduates of Nuclear & Radiation engineering programs should be able to demonstrate.

19.3.1 Knowledge and Understanding:

In addition to the knowledge and understanding of engineers, the graduates of nuclear & radiation engineering program should demonstrate knowledge and understanding of:

a) Essential facts, concepts, principles, and theories relevant to Nuclear & Radiation Engineering.
b) Relevant contemporary issues, nuclear safety measures and nuclear waste treatment.
c) The environmental effects of nuclear reactors and radiations;
d) The role of information technology in providing support for nuclear & radiation Engineering.
e) The effects of radiation on materials properties and performance.

19.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of nuclear and radiation engineering program should be able to:

a) Simulate and design experimental setups, analyze and interpret the obtained data and scale it up to the real systems.
b) Evaluate and assess the effects of radiation on environment and public at large.
c) Develop solutions to applied problems using radiation.
d) Analyze different components of a nuclear power plant and innovate new approaches to develop them.
e) Create new applications of radioisotopes in industry, medicine, etc.
f) Design radiation monitoring and measuring systems.
g) Develop computer programs to simulate existing problems.
h) Improve performance of existing nuclear systems.

19.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of nuclear and radiation engineering program should be able to:

a) Operate and monitor performance of nuclear reactors.
b) Use radiation measuring and monitoring equipments.
c) Create new techniques for the applications of radioisotopes.
d) Develop new techniques in materials analysis and characterization.
e) Apply radiation monitoring and protection techniques for the safety of the environment.
f) Improve performance of existing nuclear systems.

Section 20 NARS CHARACTERIZATION OF PETROLEUM PRODUCTION ENGINEERING

20.1 INTRODUCTION

Petroleum engineers should be curious about the design and utilization of wells and well systems for producing oil, gas and other natural resources from the earth. They have a desire to solve problems and a talent for under standing exploration and drilling, well completion and work over operations, reservoir, petro physics, and production optimization from oil and gas wells. Also, petroleum engineers conceive, plan, design, convey fluids into, out of or through the earth is subsurface for scientific, industrial and other purposes. Petroleum engineers should be able to manage the technology and information in global oil and gas recovery operations. They understand, analyze, design the exploration of oil and gas reservoirs, drilling and production operations at safely, efficiently, reliably, and competitive or economical visible cost with minimized environmental hazards.
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Petroleum production engineering is a broad discipline that covers the fields of petroleum (oil and gas) exploration and drilling, well completion and work over operations, natural and artificial production operations, reservoir rock and fluid properties, enhanced oil recovery and formation evaluation, oil and gas reserves, computer applications in petroleum engineering, reservoir models and simulation, and petroleum economics. Basic studies are devoted to the knowledge of mathematics through differential equations, geosciences, fluid flow, engineering mechanics, thermodynamics, economics and probability and statistics.

Petroleum production engineering covers the application, design, analysis the recent advances in petroleum exploration and drilling, production optimization, reservoir management. Thus, the undergraduate educational programs in petroleum engineering are, therefore, specifically designed to provide a wide variety of topics. These include petroleum exploration, well construction (drilling and completion) production operations (natural and artificial) and work over, formation evaluation , petroleum reservoirs, enhanced oil recovery , natural gas engineering , and numerical simulation for petroleum exploration, drilling and, petroleum production , and petroleum reservoirs at optimum economical basis and minimum environmental hazards .

A B. Sc. degree in petroleum production engineering is designed for students who seek careers as engineers in upstream petroleum industry (joint ventures oil companies, services of companies, operating oil companies) consulting firms and private and governmental agencies. This degree is also appropriate for students who plan to be researchers or who intend to pursue an advanced degree in engineering. A typical program curriculum incorporates analytical tools, creative thought and diversity of skills as well as the state of art of the profession.

Petroleum engineer may work in:

Upstream petroleum industries, where it is required to apply, design, operate and develop systems or methods in the following fields:

- Petroleum exploration and drilling of oil, gas and water wells at services, joint ventures, and operating oil companies (national and international companies)
- Petroleum (oil and gas) production operations and work over at national and international oil companies.
- Petroleum reservoir engineering discipline at national and international oil and companies.
- Petroleum research exploration and production (E&P) disciplines at private, governmental agencies, universities, and national or international oil companies.
- Well services activities at oil services companies, and operating oil companies.
- Safety, environmental, training sectors at all oil companies (joint ventures, services, and operating companies)

20.2 THE ATTRIBUTES OF PETROLEUM ENGINEER

In addition to the general attributes of engineer, the petroleum engineer should be able to:

a) Apply his knowledge in petroleum exploration and well construction (drilling and completion) production and reservoir engineering, well services and enhanced oil recovery methods.
b) Apply/Adopt system analysis tools in well design, reservoir simulation, production optimization and well services interpretation, and drilling optimization.
c) Use and/or develop computer software, necessary for design, communication and visualization of industrial systems and projects.
d) Analyze, synthesize, and design open–ended petroleum engineering systems, understand the associated uncertainties, and evaluate the economic impact.
e) Contribute in the activities of petroleum exploration and drilling, production and reservoir engineering, formation evaluation and well logging (well services) enhanced oil recovery methods, and projects.
f) Use and/or develop computer software, necessary for the design, analysis, interpretation, and solving problems in petroleum exploration and drilling, production and reservoir engineering, well services, management services.
g) Find better lower-cost methods used in enhanced oil recovery (EOR).
h) Lead or supervise a group of designers or technicians and other work force.

20.3 NARS FOR PETROLEUM ENGINEERING

The following academic reference standards represent the general expectation about the qualifications attributes and capabilities that the graduates of petroleum engineering programs should be able to demonstrate.

20.3.1 Knowledge and Understanding:

In addition to the knowledge and understanding of engineers, the graduates of petroleum production engineering program should demonstrate knowledge and understanding of:

a) Exploration methods of petroleum (Oil & Gas) reservoirs
b) Oil well drilling, completion and work-over operations.
c) Formation evaluation, well logging, well test analysis, modeling and simulation.
d) Natural gas engineering and Petroleum (Oil & Gas) reservoir engineering
e) Properties of reservoir rock and fluid in oil and gas bearing formation.
f) Directing and monitoring oil and gas drilling operations.
g) Conducting feasibility assessment studies for developing new oil and gas fields.

20.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of petroleum production engineering program should be able to:

a) Evaluate and appraise designs, processes(operations), equipment and machinery , and propose improvements;
b) Use the principles of engineering science in developing solutions to practical petroleum engineering problems.
c) Design case studies in exploration , drilling, production, oil and gas reservoirs
d) Identify maps.
e) Analyze well logs and testing.
f) Design of well drilling operations.
g) Select the best method to be used in enhanced oil recovery methods (EOR)

20.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of petroleum production engineering program should be able to:

a) Carry out specialized engineering design in petroleum exploration and drilling, production and reservoir engineering projects.
b) Design maps.
c) Analyze well logs and testing.
d) Employ the traditional and recent advances technologies in petroleum engineering branches.
e) Use basic workshop equipment and machinery safely;
f) Manage well drilling operations.
g) Operate and maintain mechanical equipment and machinery, apparatus in oil and gas fields.
h) Apply different methods to enhance oil recovery (EOR)

SECTION 21 CHARACTERIZATION OF MARINE ENGINEERING (MARINE – OFFSHORE)

21.1 INTRODUCTION

The Marine Engineering program prepares a well qualified marine engineer who plays a significant role in shipping industry and marine business. Their responsibility will be the provision, management, design, selection to do installation, operation and maintenance of the engineering systems and associate equipment encountered in the shipping sector as well as marine industry.

The program of study in marine engineering covers the principles of ship design, construction, operation and different ship power plants and systems as well as offshore structure design, operation and maintenance.

Topics as strength, stability and sea keeping qualities, internal arrangement, resistance and propulsion characteristics of ship's hulls as well as shipyard technology are included. The various types of propelling machineries and auxiliaries as well as different marine systems onboard ships are included. Moreover, corrosion and fatigue in ships' structures and other metallurgical problems are taken into considerations. In addition to the marine engineering, the department offers specialization in offshore engineering.

21.2 THE ATTRIBUTES OF MARINE AND OFFSHORE ENGINEER

In addition to the general attributes of engineers, the marine (offshore) engineer should have the ability to:

a) Perform efficiently in marine and offshore systems and subsystems design and manufacturing
b) Adopt recent industry standard computer CAD/CAM packages specially written for marine vehicle structures, offshore platforms, piping systems, …etc
c) Implement analytical tools and mathematical manipulations to design and assess marine vehicles hull, machinery, equipment, and outfitting.
d) Select the proper ship/ rigs building materials regarding functionality, strength, maintainability and cost.
e) Follow up the continuously changing amendments pertaining to marine and offshore International Conventions and associated National Authority Regulations.
f) Use of computer visual aids (graphs, animations, audio, video, and other media) to illustrate and highlight design features.
g) Specify marine/offshore projects maintenance, scheduling and inspection plans.
h) Manage shipbuilding/ offshore projects economic, ecologic, ergonomic, and safety aspects.
i) Conform to rules and regulations related to prevent marine pollutions and any other health or emission hazards.
j) Analyze multi-disciplinary mechanical, electrical, control and marine and offshore hydrodynamic systems.

21.3 NARS FOR MARINE AND OFFSHORE ENGINEER

The following academic reference standards represent the general expectations about the qualifications attributes and capabilities that the graduates of Marine Engineering and Offshore programs should be able to demonstrate.

21.3.1 Knowledge and Understanding:

In addition to the knowledge and understanding of engineers, the graduates of marine-offshore engineering program should demonstrate knowledge and understanding of:

a) Essential facts, concepts, principles and theories relevant to Marine and offshore Engineering;(e.g. floatation, intact and damage stability, environmental loadings, safety of lives at sea, marine pollution prevention, …etc).
b) The Classification societies rules minimum requirements constraints within which his/her engineering judgment will have to be exercised.
c) A number of engineering science disciplines such as Mechanical, Electrical, Control, Aerodynamic and Structural Engineering as linked to Marine and Offshore Engineering.
d) The professional and ethical responsibilities of marine and offshore engineers.
e) Risk and hazards in shipbuilding offshore industry and repair yards and employing of safe engineering practice.
f) Environmental impacts of ship and offshore operations.
g) Ship /platform project management, design, fabrication, launching and fitting preceded by feasibility studies.
h) Codes of practice, Guidelines and Recommendations, in marine and offshore engineering issues.
i) Related research methods and approaches to innovate new and advanced marine vehicles for both commuters and offshore supply vessels.
j) Methods of energy savings on board marine vessels and offshore platforms.
k) Energy sources and methods of exploring both offshore conventional and renewable energies.
l) Characteristics and properties of materials relevant to ship and offshore structures and the associated systems.

21.3.2 Intellectual Skills

In addition to the intellectual skills of engineers, the graduates of marine and offshore engineering program should be able to:

a) Use the principles of engineering science in developing solutions to practical marine and offshore engineering problems.
b) Solve marine and offshore engineering problems
c) Evaluate marine designs, systems processes and components performances, and suggest improvements;
d) Assess risks involved in real and practical situations (e.g. shipbuilding yards, ship launching, ship accidents ...), and take appropriate steps to manage those risks.

e) Develop a link between land based designs and their marine and offshore counterparts.
f) Device preparedness plans for inshore and offshore stations suitable for combating emergency situations arising in seaways
g) Think systematically along the design process, analyze marine and offshore structure plan, propose alternative solutions, and select the optimum solutions considering contradicting requirements and priorities.
h) Search for information in support of marine and offshore engineering related problem solving, design and development, followed by critical evaluation of alternatives and performance data.
i) Refer to professional scientific literature in the field of marine and offshore effectively.
j) Use computational tools and packages pertaining to the marine and offshore discipline

21.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of marine and offshore engineering program should be able to:

a) Follow up and gain skills in using marine/offshore software in solving practical problems.
b) Apply engineering common sense, knowledge and understanding to appraise, improve, and modify existing marine vehicles and offshore platform designs.
c) Conduct innovative and specialized marine and offshore designs.
d) Incorporate engineering knowledge, past accumulated experience, intellectual judgement to marine and offshore systems and subsystems
e) Disseminate knowledge and intellectual skills to marine and offshore engineering community and industry
f) Apply safety measures to in site marine and offshore engineering projects
g) Prepare and give technical presentations to help increase awareness of industry community to new and updated marine and offshore issues.
h) Plan and manage projects time schedules and deadlines effectively.
i) Prepare technical and working drawings using CAD facilities.
j) Demonstrate organizing ability and management skills to marine and offshore projects.
k) Get familiar with allow up and gain skills in using “recommendation and guidelines” type reports issued by concerned bodies in the field of marine and offshore engineering.
l) Follow Up the continuous updates, revisions and amendments issued by international classification society rules and regulations and the related national and local regulations.
m) Practice testing and assessment of systems and equipment on board marine vehicles and offshore rigs and conduct quay and sea trials tasks
n) Integrate knowledge of mathematics, science, information technology, design, business context and engineering practice to solve marine and offshore related problems
o) Employ combined computational and measuring tools to design experimental test setup, collect, reduce, analyze data and interpret results.

SECTION 22 NARS CHARACTERIZATION OF TEXTILE ENGINEERING

22.1 INTRODUCTION

Textile engineering is one of the fields that cover the sciences necessary to provide society and industry with their fundamental needs of textile products. The utilization of textiles in industrial, medical and smart applications greatly attributes to the current industrial boom. Such applications are engineered by professionals having wide knowledge of several basic sciences (physics, chemistry, math, polymers…) as well as machine design, operating systems of production lines, quality control, environmental protection, material usage and waste recycling.

Textile engineering includes the processing of synthetic fibers, controlling their chemical morphology, and producing them with different scales down to nanometer dimensions. This engineering discipline incorporates several specialties and links with many fields such as chemistry, physics, polymer science, mechanics, machine design, automatic control, computer technology and others.

TEXTILE ENGINEER MAY WORK IN: Plants for the production and manufacturing of man-made fibers, yarn, weaving, knitting, non-woven, garments and textile machines. He is also qualified to work in the finishing & dyeing sectors, fabric & apparel design centers, textile research institutes, textile testing and quality control centers.

22.2 THE ATTRIBUTES OF A TEXTILE ENGINEER

In addition to the general attributes of engineer, the textile engineer should be able to:

a) Professionally design and operate different processing systems in the textile industries and plan the related activities of maintenance, modernization and replacement.
b) Improve production plans and effectively apply the special safety measures to preserve inventories of row materials and semi-manufactured products as well.
c) Plan and manage the quality assurance activities in addition to insuring the protection of the production facility environment internally and externally.

22.3 NATIONAL ACADEMIC STANDARD REFERENCE (NARS) FOR TEXTILE ENGINEERING

The academic standards of the textile engineering graduates are as follows:

22.3.1 KNOWLEDGE AND UNDERSTANDING

In addition to the knowledge and understanding of engineers, the graduates of textile engineering program should demonstrate knowledge and understanding of:

a) Properties of the textile materials

b) Technologies of textile productions.
c) Systems of quality assurance for processing operations and final products.
d) Management systems and their application in textile industry.
e) Knowledge necessary to analyze the impact of textile engineering in global and social contest.

22.3.2 INTELLECTUAL SKILLS:

In addition to the intellectual skills of engineers, the graduates of textile engineering program should be able to:

a) Creative thinking in textile production system design and operation.
b) Selecting and applying the special tools and software packages used in textile engineering for modeling and analyzing design and production problems.
c) Identifying optimization criteria and assessing the delicate balance of cost, quality and effects on the environment in production operations.
d) Analyzing textile products and manufacturing processes and proposing improvement ideas.

22.3.3 Practical & Professional Skills

In addition to the practical and professional skills of engineers, the graduates of textile engineering program should be able to:

a) Operate and maintain safely & correctly the production machines specially used in textile industry.
b) Design new textile products and perform the required production experiments and tests.
c) Perform experiments in the special textile laboratories, record & analyze data, and write technical reports.
d) Plan and design production processes necessary for different textile products.