Academic Reference Standards Implemented in the Study Programs

Benha Faculty of Engineering

Quality Management Unit
Benha- 2017

Civil Engineering Department

National Academic Reference and Standards (NARS) Characterization of Civil Engineering

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.

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

NARS for Civil Engineer

Knowledge & Understanding:

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

a1) 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.
a2) Properties, behavior and fabrication of building materials.
a3) Projects and construction management including planning, finance, bidding and contracts.

Intellectual Skills:

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

b1) Select appropriate building materials from the perspective of strength, durability, suitability of use to location, temperature, weather conditions and impacts of seawater and environment.
b2) Select and design adequate water control structures, irrigation and water networks, sewerage systems and pumping stations.
b3) 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.

b4) Define, plan, conduct and report management techniques.

b5) Assess and evaluate different techniques and strategies for solving engineering problems.

Practical & Professional Skills:

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

c1) Use laboratory and field equipment competently and safely

c2) Observe, record and analyze data in laboratory and in the field

c3) Practice professionally construction management skills. Prepare technical drafts and detailed drawings both manually and using CAD

c4) Carry out maintenance of all types of roadways and traffic systems

c5) Prepare quantity surveying reports

c6) Plan, design, construct, operate, control and carry out maintenance of all types of roadways and traffic systems

Mechanical Engineering Department

NARS Characterization of Mechanical Design and Production Engineering

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.

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.

NARS for Mechanical 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.

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:

a1) Concepts, principles and theories relevant to Mechanical Engineering and manufacture.
a2) The constraints within which his/her engineering judgment will have to be exercised.
a3) The specifications, programming and range of application of CAD and CAD/CAM facilities.
a4) Relevant contemporary issues in mechanical engineering.
a5) Basic electrical, control and computer engineering subjects related to the discipline.
a6) The role of information technology in providing support for mechanical engineers.
a7) Engineering design principles and techniques.
a8) Management and business techniques and practices appropriate to engineering industry.

Intellectual Skills:

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

b1) Apply the principles of mathematics, science and technology in problem solving scenarios in mechanical engineering.
b2) Analyze and interpret data, and design experiments to obtain primary data.
b3) Evaluate and appraise designs, processes and products, and propose improvements.
b4) d) Interpret numerical data and apply analytical methods for engineering design purposes.
b5) Use the principles of engineering science in developing solutions to practical mechanical engineering problems.
b6) Select appropriate manufacturing method considering design requirements.

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:

c1) Prepare engineering drawings, computer graphics and specialized technical reports and communicate accordingly.
c2) Employ the traditional and modern CAD and CAD/CAM facilities in design and production processes
c3) Use basic workshop equipment safely;
c4) Analyze experimental results and determine their accuracy and validity;
c5) Use laboratory equipment and related computer software;

c6) Operate and maintain mechanical equipment.
c7) Prepare the process plan for manufacturing.

NARS Characterization of Mechanical Power and Energy Engineering

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:

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

Mechanical Power and Energy Engineers may work in:

a) Processing or user industries.
b) Power stations and petrochemical plants.
c) Management in industries.
d) Establishments concerned with cars, ships, energy generation or aerospace and refrigeration and air conditioning.
e) Safety and environmental concerns.
f) Research

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.

NARS 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.

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:

a1) Fundamentals of thermal and fluid processes

a2) Internal combustion, pumps, turbines and compressors, classification, construction design concepts, operation and characteristics
a3) Fluid power systems
a4) The constraints which mechanical power and energy engineers have to judge to reach at an optimum solution.
a5) Business and management techniques and practices appropriate to mechanical power and energy engineering applications.
a6) Mechanical power and energy engineering contemporary issues.
a7) Basic theories and principles of some other engineering and mechanical engineering disciplines providing support to mechanical power and energy disciplines.

Intellectual Skills:

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

b1) Evaluate mechanical power and energy engineering designs, processes and performances and propose improvements.
b2) Analyze and interpret data, and design experiments to obtain new data.
b3) Evaluate the power losses in the fluid transmission lines and networks
b4) Analyze the performance of the basic types of internal combustion engines and hydraulic machines
b5) Analysis of fluid power systems, subsystems and various control valves and actuators

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:

c1) Use basic workshop equipment safely and appropriately.
c2) Prepare engineering drawings, computer graphics and specialized technical reports.
c3) Write computer programs pertaining to mechanical power and energy engineering.
c4) Describe the basic Thermal and fluids processes mathematically and use the computer software for their simulation and analysis
c5) Design, operate, repair and maintain fluid hydraulic power systems for diverse applications
c6) Carry out preliminary designs of fluid transmission networks, internal combustion and steam engines and solve their operational problems.
c7) Work in mechanical power and energy operations, maintenance and overhaul.

NARS Characterization of Mechatronics Engineering

Introduction:

Mechatronics is about today's world. It's where electronics, computers and mechanics converge to bring the automated devices we use in our everyday 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.

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

NARS for Mechatronics Program:

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

Knowledge and Understanding:

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

a1) Basic science and engineering fundamentals in mechanics, electronics and software in their interfacing;
a2) Fundamentals of problem identification, formulation and solution in the inter-disciplinary fields of Mechatronics;
a3) The principles of sustainable design and development;

Intellectual Skills:

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

b1) In addition to the intellectual skills of engineers, the graduates of mechatronics engineering program should be able to:
b2) Identify at an appropriate level the design, production, interfacing and software needs of different parts of Mechatronics systems.
b3) Create solutions to Mechatronics systems especially to manufacturing, maintenance and interfacing problems in a creative way, taking account of industrial and commercial constraints.

Practical & Professional Skills:

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

c1) Compete, in-depth, in at least one engineering discipline, namely mechanics, electronics or interfacing and software;
c2) Manage field problem, identification, formulation and solution;
c3) Utilize practical systems approach to design and performance evaluation;
c4) Apply the principles of sustainable design and development;

Electrical Engineering Department

Academic Reference Standards (ARS) Characterization of Communication and Computer Engineering

Introduction:

Communication and Computer engineering (CCE) is a discipline that embodies the science and technology of design, construction, implementation, and maintenance of software and hardware components of modern communication and computing systems, traditional communication, modern and digital communication, electronic systems, and computer-controlled equipment.

Communication and Computer engineering has traditionally been viewed as a combination of communication engineering (CE), computer science (CS) and electrical engineering (EE). Communication and Computer engineering is a field that experiences effects from rapid technological development in different real life applications.

Communication and Computer engineering programs use basic sciences, mathematics, communications, signal processing, engineering and electronics, physical and human sciences to provide new communication and computer technologies and systems that make human applications easier, more productive, faster and also enjoyable to use.

Communication and computer engineer is a person trained to be proficient in the design and implementation of communication and computer systems, both hardware and software. He should essentially be able to design communication systems, digital control circuitry and program it to function correctly.

To perform these tasks, the communication and computer engineer must be knowledgeable in related mathematics, physics sciences, electronics, communications, signal processing, 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.

Communication and Computer Engineer May Work In:

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

The Attributes of a Communication and Computer Engineering:

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

a) Managing projects related to communication/computer systems in diverse fields of applications.
b) Use current advanced techniques, skills, and tools necessary for computing practices to specify, design, and implement computer-based systems.
c) Implementing phases of the communication/computer system development life cycle, procurement and installation of hardware, software, design, data manipulation and system operations.
d) Recognize the information requirements of various business activities on both operational and decision making levels.

e) Tackling business problems using system analysis tools and techniques.

f) Demonstrate inductive reasoning abilities, figuring general rules and conclusions about seemingly unrelated events.

ARS For Communication Computer Engineering Programs

Knowledge and Understanding:

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

a1) Communication systems, classic, modern, digital and satellite.
a2) 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.
a3) Quality assessment of computer systems.
a4) Related research and current advances in the field of computer software and hardware.
a5) Technologies of data, image and graphics representation and organization on computer storage media.
a6) Modern trends in information technology and its fundamental role in business enterprises.
a7) RF circuit design, microwave circuits, and antenna theory.

Intellectual Skills:

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

b1) Select the appropriate mathematical tools, computing methods, design techniques for modeling and analyzing communication and computer systems.
b2) Select, synthesize, and apply suitable communication techniques and IT tools to computer engineering problems.
b3) 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.
b4) Identifying symptoms in problematic situations.
b5) Innovating solutions based on non-traditional thinking and the use of latest technologies.
b6) Capability of integrating computer objects running on different system configurations.

Practical and Professional Skills:

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

c1) Design and operate communication and computer-based systems specifically designed for business applications.

c2) Use appropriate specialized computer software, computational tools and design packages throughout the phases of the life cycle of system development.
c3) Design circuits and systems and write computer programs on professional levels achieving acceptable quality measures in software development.
c4) Conducting user support activities competently.
c5) Use advanced testing equipment to design, test, and debug communication/computer systems.
c6) Earn ethical and/or legalism skills.

Benchmarking:

Department of Communications and Computer Engineering. Graduate School of Science and Engineering. Tokyo Institute Of Technology. Location: Ookayama campus South Building3.
Address: 2-12-1 Ookayama, Meguro-ku, Tokyo 152-8550, JAPAN.

ARS Characterization of Electrical Power and Control Engineering

Introduction:

Electrical power 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. Prime movers and 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 control systems for

improving performance, operation and control of industrial processes.

Control engineering discipline is the branch of electrical engineering that applies control theories to design control systems with desired behaviors.

Industrial control system is a general term that encompasses several types of control systems used in industrial production, including supervisory control and data acquisition (SCADA) systems, distributed control systems (DCS), and other control system configurations such as programmable logic controllers (PLC) often found in the industrial sectors and critical infrastructures.

Industrial control systems are typically used in industries such as electric, water and wastewater, oil and natural gas, transportation, chemical, pharmaceutical, pulp and paper, food and beverage, and discrete manufacturing (e.g., automotive, aerospace, and durable goods.

The electrical power and control engineering program consists of two main fields, namely electrical power engineering subjects and automatic control engineering subjects. These are essentially supported by two main topics: electrical machines 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.

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 control engineers are as follows:

a) Electrical distribution companies
b) Electrical generation companies
c) Electrical power stations
d) Electrical transmission companies and energy control centers
e) Ministry of electricity and energy and associated organizations
f) New and renewable energy authority
g) Oil and Petrochemicals sectors
h) Electrical equipment and components factories
i) Different production line factories
j) Process control design centers
k) Water treatment and desalination companies
l) Chemical industries
m) Automotive and aerospace industries
n) Electronics industries
o) Underground and other transportation organizations

The Attributes of Electrical Power and Control Engineering:

In addition to the attributes of general engineering, 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) Design and supervise the construction of industrial process plants and automation control.
e) Prepare and review simple sketches, specifications and data sheets for electric power generation, transmission and distribution systems as well as industrial control systems.
f) Perform review of supplier documentation for compliance with specifications.
g) Develops load lists.
h) Develops low voltage power systems.

ARS FOR ELECTRICAL POWER AND CONTROL ENGINEERING

Knowledge and Understanding:

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

a1) Analytical and computer methods appropriate for electrical power and control engineering.
a2) Design methods and tools for electrical power and control equipment and systems.
a3) Principles of operation and performance specifications of electrical and electromechanical engineering systems.
a4) Basics of electrical power system theories.
a5) Basics of design concepts for underground, cable tray, grounding, and lighting systems.
a6) Applications of electrical power and control equipments.
a7) Basics of low, medium, and high voltage power systems.
a8) Theories and techniques for calculating short circuit, motor starting current, and voltage drop.
a9) Principles of performing electrical system calculations, including load flow, earthling and equipment sizing.
a10) Principles of power system protection and distribution.
a11) Principles of automatic control theory and its applications.
a12) Principles of Modern and intelligent control theory and its applications.
a13) Principles of Microprocessor systems.
a14) Design of controllers and/or compensators for systems especially power systems.

Intellectual Skills:

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

b1) Identify and formulate engineering problems to solve problems in the field of electrical power and control engineering.
b2) Analyze design problems and interpret numerical data and test and examine components, equipment and systems of electrical power and control.
b3) Integrate electrical, electronic and mechanical components and equipment with transducers, actuators and controllers in creatively computer controlled systems.
b4) Analyze the performance of electric power generation, control and distribution systems.
b5) Assess the steady-state and transient performance of linear systems.
b6) Suggest solutions to improve the performance and stability of electromechanical systems.
b7) Analyze control systems and evaluate their responses to external inputs.
b8) Implement different software package used in industrial field, Ladder (bit logic, counter, timer, special functions, analog input and analog output), graph-set (sequential functions, alternative processes and exclusive processes,..), function blocks (Siemens software and common applications), statement list.
b9) Design of DCS and SCADA Application systems.

Practical and Professional Skills:

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

c1) Design and perform experiments, as well as analyze and interpret experimental results related to electrical power and control systems.
c2) Test and examine components, equipment and systems of electrical power and control.
c3) Integrate electrical, electronic and mechanical components and equipment with transducers, actuators and controllers in creatively computer controlled systems.
c4) Specify and evaluate manufacturing of components and equipment related to electrical power and control.
c5) Apply modern techniques, skills and engineering tools to electrical power and control engineering systems.
c6) Suggest solutions to improve the performance and stability of systems.
c7) Practical implementation of solutions.
c8) Design with the, Proportional Integral (PI), Proportional Integral Derivative (PID), Phase-Lead, Phase-Lag, Lead-Lag and (Lag-Lead) Controller in state space.
c9) Earn ethical and/or legalism skills.

Benchmarking

The Electrical Power & Control Technology program.

Texas State Technical College.

Location :TSTC WACO, 3801 CAMPUS DRIVE, WACO, TX 76705.

ARS Characterization of Biomedical Engineering

Introduction:

Biomedical Engineering Program is to provide undergraduate students with quality education using engineering and scientific principles with methods for developing theoretical and practical skills that cover the design of medically-related devices and systems (H/W & S/W), soft skills (management of healthcare technology), communication skills, team building and basic economic/business…etc.

Biomedical engineering is a broad discipline which covers engineering applications in the fields of biology and physiology. This requires knowledge of advanced mathematics (including differential equations and statistics), science, problem solving at the interface of engineering and biology; measurements and data interpretation from living systems, addressing the problems associated with the interaction between living and non-living materials and systems, system design and information processing especially in hospitals, clinical engineering, medical equipments and biomechanics.

A B.Sc. degree in Biomedical Engineering is designed for students who seek careers as engineers in hospitals, R&D engineering in the medical device industry, 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.

Biomedical Engineering graduates may work in:

Private and governmental firms, where it is required to design, manufacture, operate, develop, or maintain medical equipments. The graduate is able to work in hospitals as clinical engineers, medical equipment importing and development companies. The graduate is also able to work in the systems and computer field.

Graduate Attributes:

The Biomedical Engineering program aims to qualify the graduates with technical and practical skills which enable them to solve engineering problems with biological or medical relevance, the ability to appreciate, communicate, and integrate contributions from multiple disciplines to address biological and medical problems and to continue their studies in professional schools and graduate programs. The following are the aimed graduate attributes:

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, health and safety.
i) Demonstrate knowledge of contemporary engineering issues.
j) Display professional and ethical responsibilities; and contextual understanding
k) Engage in self- and life- long learning.

Knowledge and Understanding:

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

a1) Concepts and theories of mathematics and sciences, appropriate to the discipline.
a2) Basics of information and communication technology (ICT).
a3) Characteristics of engineering materials related to the discipline.
a4) Principles of design including elements design, process and/or a system related to specific disciplines.
a5) Methodologies of solving engineering problems, data collection and interpretation.
a6) Quality assurance systems, codes of practice and standards, health and safety requirements and environmental issues.
a7) Business and management principles relevant to engineering.
a8) Current engineering technologies as related to disciplines.
a9) Topics related to humanitarian interests and moral issues.
a10) Technical language and report writing.

a11) Professional ethics and impacts of engineering solutions on society and environment.
a12) Contemporary engineering topics.
a13) The economics, regulatory environment, and societal environment of biomedical research, process development, or product development.
a14) The constraints within which his/her engineering judgment will have to be exercised.
a15) Principles of biological signals and images used for diagnosis.
a16) Basic electrical, control and computer engineering subjects related to the discipline.
a17) The role of information technology in providing support for biomedical engineers.
a18) Engineering design principles and techniques.
a19) Management and business techniques and practices appropriate to biomedical engineering.
a20) The role of biomedical engineer in a hospital.

Intellectual Skills:

The graduates of the Biomedical engineering program should be able to:

b1) Select appropriate mathematical and computer-based methods for modeling and analyzing problems.
b2) Select appropriate solutions for engineering problems based on analytical thinking.
b3) Think in a creative and innovative way in problem solving and design.
b4) Combine, exchange, and assess different ideas, views, and knowledge from a range of sources.
b5) Assess and evaluate the characteristics and performance of components, systems and processes.

b6) Investigate the failure of components, systems, and processes.
b7) Solve engineering problems, often on the basis of limited and possibly contradicting information.
b8) Select and appraise appropriate ICT tools to a variety of engineering problems.
b9) Judge engineering decisions considering balanced costs, benefits, safety, quality, reliability, and environmental impact.
b10) Incorporate economic, societal, environmental dimensions and risk management in design.
b11) Analyze results of numerical models and assess their limitations.
b12) Create systematic and methodic approaches when dealing with new and advancing technology.

b13) Apply the principles of mathematics, science and technology in problem solving scenarios in biomedical engineering.
b14) Analyze and interpret data, and design experiments to obtain primary data.
b15) Evaluate and appraise designs, processes and products, and propose improvements.
b16) Interpret numerical data and apply analytical methods for engineering design purposes.
b17) Use the principles of engineering science in developing solutions to practical clinical engineering problems.
b18) Obtain, analyze, and interpret data from biological and medical systems.

Professional and Practical Skills:

On successful completion of the program, the graduates of the Systems and engineering program should be able to:

c1) Apply knowledge of mathematics, science, information technology, design, business context and engineering practice integrally to solve engineering problems.
c2) Professionally merge the engineering knowledge, understanding, and feedback to improve design, products and/or services.
c3) Create and/or re-design a process, component or system, and carry out specialized engineering designs.
c4) Practice the neatness and aesthetics in design and approach.
c5) Use computational facilities and techniques, measuring instruments, workshops and laboratory equipment to design experiments, collect, analyze and interpret results.
c6) Use a wide range of analytical tools, techniques, equipment, and software packages pertaining to the discipline and develop required computer programs.
c7) Apply numerical modeling methods to engineering problems.
c8) Apply safe systems at work and observe the appropriate steps to manage risks.
c9) Demonstrate basic organizational and project management skills.
c10) Apply quality assurance procedures and follow codes and standards.
c11) Exchange knowledge and skills with engineering community and industry.
c12) Prepare and present technical reports.
c13) Design, conduct, and document experiments involving biological or medical systems.
c14) Design systems, devices, and/or processes for use in medical or biological applications.
c15) Formulate the problems in medical signal and image processing.
c16) Analyze experimental results and determine their accuracy and validity.

c17) Use laboratory equipment and related computer software.
c18) Operate and maintain medical equipments.
c19) Write down software programs for database management and for the interfacing and operation of medical devices.
c20) Design of medical equipment prototypes.

General and Transferable Skills:

The graduates of the Biomedical engineering program should be able to:

d1) Collaborate effectively within multidisciplinary team.
d2) Work in stressful environment and within constraints.
d3) Communicate effectively.
d4) Demonstrate efficient IT capabilities.
d5) Lead and motivate individuals.
d6) Effectively manage tasks, time, and resources.
d7) Search for information and engage in life-long self learning discipline.
d8) Acquire entrepreneurial skills.
d9) Refer to relevant literatures.
d10) Function on multidisciplinary teams, consisting of engineers, scientists, clinicians, and non-technical personnel.
d11) Independently acquire knowledge and to communicate effectively their work and ideas in oral and written forms.
d12) Recognize contemporary issues, professional responsibilities, and ethical responsibilities in biomedical engineering with an awareness of the need for continued learning.