جامعة حائل
University of Ha'il

MECHANICAL ENGINEERING ACADEMIC PROGRAM

2019

Contents

Introduction

The Department of Mechanical Engineering is one of the six departments of the College of Engineering at the University of Hail. The Department is committed to the preparation of distinct mechanical engineers in the fields of mechanical engineering and its applications in accordance with international standards to meet the needs of industry, government and the private sector. It is also keen that the graduates are fully aware of the ethics of the profession and the requirements of environmental protection. Furthermore, the graduates are encouraged to contribute to the development of mechanical sectors by carrying out research projects.

Mechanical engineers are concerned with the design, improvement, and installation of integrated systems of people, materials, and energy in production of either goods or services. They engineer processes and systems that improve quality and productivity. They are primarily interested in problems that involve economizing the use of money, materials, time, human effort, and energy. They are more concerned with the big picture of mechanical management and production – rather than with detailed development of processes.

The Department of Mechanical Engineering offers an undergraduate program in mechanical engineering. The program focuses on the science and technology of mechanical systems. It emphasizes the analysis and design of systems to produce goods and services efficiently. Particular attention is devoted to both the physical processes involved and the environment.

Co-op program has been implemented in many technical universities worldwide. The student usually leaves the school for one or more semesters and joins a relevant industry, where he is exposed to real life applications of what has been taught at the university. This exposure provides the student with a more mature outlook and has a significant effect on his understanding of his role as a practicing engineer.

Program vision

The vision of the Department of mechanical Engineering is to excel and lead locally, regionally, and globally in providing engineering courses and research and social services of high quality.

Program mission

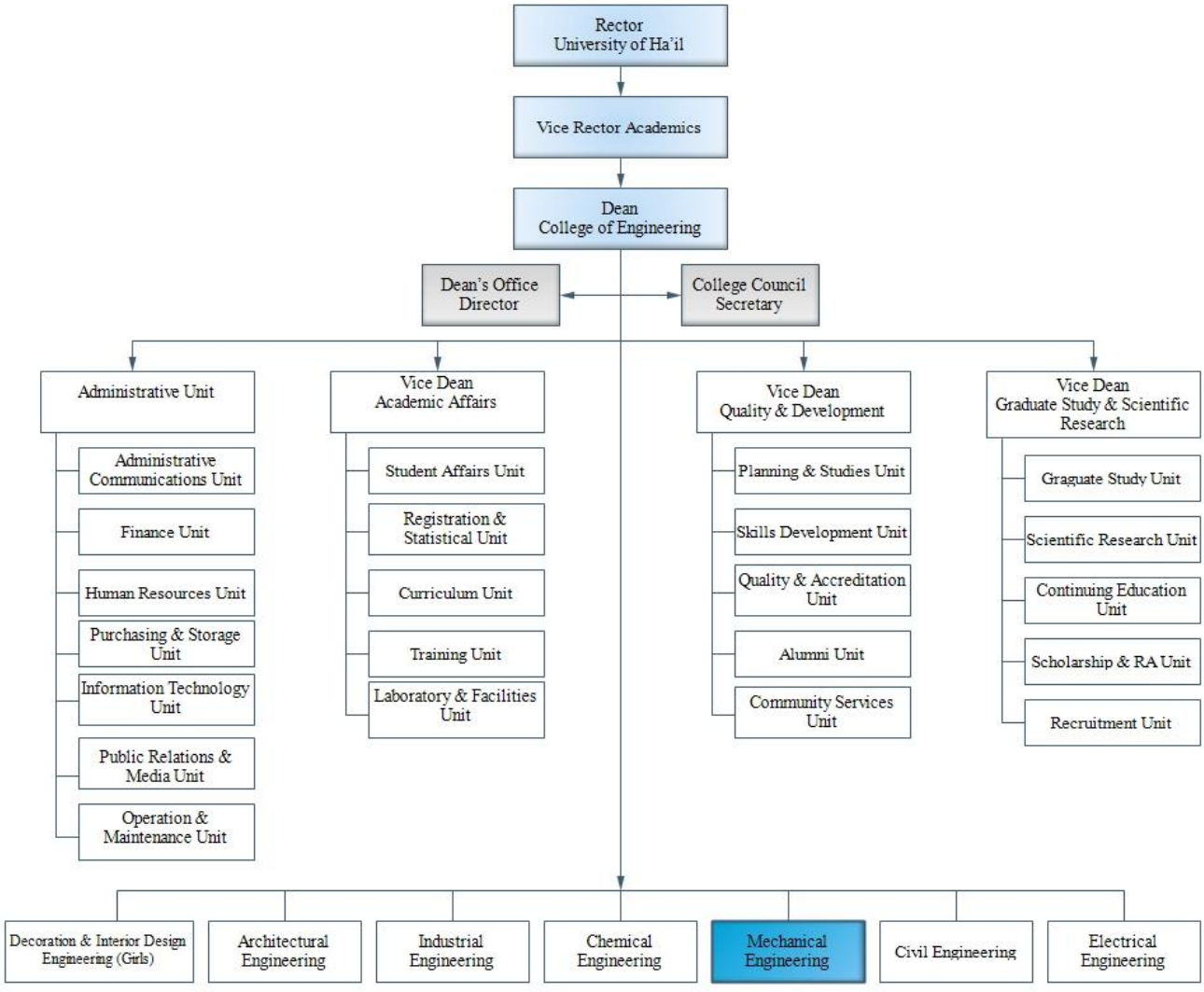
The mission of the Mechanical Engineering Department aims to professionally prepare creative mechanical engineers who are capable of fulfilling the technological needs of society, conducting world-class basic and applied research, and supporting the development of more competitive and new industry.

Program objectives

The graduates of Mechanical Engineering program are expected to attain the following Program Educational Objectives (PEOs) within a few years of graduation:

1. Graduates will work as professionals and meet their employers' expectations in the various sectors of interest in mechanical engineering.
2. Graduates will be able to pursue advanced study or opt for research and lifelong learning if desired.
3. Graduates will become leaders within their profession whether it be industry, academia, or service.
4. Graduates will demonstrate commitment to community service and sustainable development.

Organization chart of program



Admission requirements

1. The applicant must be a Saudi National or born to a Saudi Mother, or those excluded by laws and regulations or the national interest.
2. Students must be a holder of a valid high school secondary education (grade 12th) certificate (scientific and engineering track) or its equivalent from inside or outside the kingdom.
3. The period of the obtained high school secondary education (grade 12th) certificate (scientific and engineering track) or its equivalent, not more than two to five years if there are available study seats, and the University Council may make an exception from this condition if convincing reasons are available.
4. The applicant must maintain good conduct.
5. The applicant must not be dismissed from the University of Hail or from another university for an academic or disciplinary term.
6. To be medically fit.
7. The applicant must pass the General Aptitude Test (GAT) and the Scholastic Achievement Admission Test for scientific (Sc) tracks in particular.

Graduation requirements

A student graduates after successfully completing the graduation requirements according to the degree plan, provided his cumulative GPA not less than "Pass". Following the recommendation of the Department Council, the College Council may determine certain additional courses the student should take to improve his cumulative GPA if he has passed the required courses, but with low GPA.

1. The student is required to pursue his major degree plan and complete all requirements before graduation.
2. The deanship of Admissions & Registration will provide the relevant departments with copies of the academic records of all candidates for graduation. The department will

then review these records to ensure that the student have satisfied all graduation requirements and will provide the Deanship of Admissions & Registrations with a list of the students who qualify for graduation.

3. A student must attain a cumulative GPA and major GPA of 1.00 or above to graduate.
4. To obtain any degree from UOH, the student must have studied at UOH a minimum of 36 credit-hours, including at least 18 credit hours in his major field.
5. The Deanship of Admissions & Registration prepares and issues the official graduation certificates and degrees and maintains copies of these documents.

Academic reference standards of program

Introduction

Based on the mandate of the Education and Training Evaluation Commission (ETEC), issued by Royal Decree No. 108, dated 14/2/1440 H, ETEC is mandated to "building systems for evaluation and accreditation - including institutional and programmatic - in education and training, including rules, standards, frameworks and indicators and its terms, procedures, approval, and application." And based on the authority's keenness to build and develop high quality national academic programs, the authority has worked on preparing specialized academic standards for Mechanical Engineering programs.

The standards contribute to setting the minimum curriculum requirements of Mechanical Engineering undergraduate programs to assure their academic quality and to assure their ability to produce highly qualified professionals in the field of Mechanical Engineering with the knowledge and skills required by the market and the national needs, in line with best practices and academic requirements for this field.

ETEC had previously published Key Learning Outcomes for Engineering Programs (attached in Appendix C). This work extends the description of learning outcomes to engineering discipline-level. The developed learning outcomes for Mechanical Engineering in this report are defined as the Specialized Learning Outcome for Mechanical Engineering Programs.

This document is developed by the ETEC in cooperation and coordination with different entities in the field of Mechanical Engineering, such as the Saudi Council of Engineers, and with the involvement of different stakeholders from government bodies, the private sector, and academia.

Goals

The main objective of this work is to develop specialized Learning Outcomes (SLOs) that should be -minimally- achieved by Mechanical Engineering students just before graduation. It will direct programs and course design and organization, building the curriculum map including the appropriate teaching and learning strategies, assessment tools, evaluation strategy, and link academic and professional aspects.

Methodology

This document describes the minimum knowledge units (KUs) and learning outcomes (LOs) in the field of Mechanical Engineering, which graduates are expected to obtain upon completion of the program. The KU specialized learning outcomes specify the minimum of what students should know or be able to do after successfully completing the KU. The methodology follows the following phases: 1. Identifying International Benchmarks. 2. Identifying Curriculum General Criteria 3. Identifying the General Knowledge Units. 4. Identifying the Specialized Knowledge Units for each General Knowledge Unit. 5. Identifying the Specialized Learning Outcomes for each Specialized Knowledge Unit. It is important for educational institutions to take into account the depth and expansion; and to include LOs related to communication skills and values in the curricula. Educational institutions can offer the desired elective KUs that are relevant to their programs and students can choose from them to complete their graduation requirements. It is important to note that a KU is not necessarily a credit course. A KU may be covered by one or more credit courses and a credit course may cover one or more KUs partially or completely. The KUs are derived from analyzing 10 QS high ranked international programs.

Scope and Uses

This document covers the bachelor's degree programs in the field of Mechanical Engineering. The document can be used and applied to Mechanical Engineering programs offered by higher educational public and private institutions in Saudi Arabia.

Terms

ETEC: Education and Training Evaluation Commission – Saudi Arabia.

ETEC's Key Learning Outcomes for Engineering Programs: A document published by the Education and Training Evaluation Commission (ETEC) describes the minimum level of what engineering students, from any engineering program, will be able to do just before graduation published by ETEC's.

Essential Knowledge Units (EKU): The required topics in mathematics and basic sciences.

General Knowledge Units (GKU): Knowledge Units that introduce students to the main topics in Engineering. All students majoring in any field of Engineering should complete these GKU's.

Key Learning Outcomes (KLOs): It describes what students are expected to know and will be able to do by the time of graduation. These relate to the knowledge, skills, and behaviors that students acquire as they progress through the program.

Knowledge Units (KUs): Thematic groupings that encompass multiple related topics, where the topics cover the required curricular content for each KU. Each KU contains a set of learning outcomes.

Learning Outcomes (LOs): Phrases describing what a learner should know, understand, and be able to do at the end of the program. They represent the bottom line of the learning process.

NQF: NATIONAL QUALIFICATIONS FRAMEWORK.

Specialized Key Learning Outcomes (SLOs): The specificity needed for interpretation of the general criteria as applicable to a given discipline.

Specialized Knowledge Units (SKU): Knowledge Units that introduce students to intermediate and advanced topics in a major.

Key Learning Outcomes for Engineering Programs

ETEC published in 2020 the Key Learning Outcomes for Engineering Programs (KLOs).

These KLOs for Engineering apply to all engineering disciplines and do not target any specific discipline in engineering alone.

Program intended learning outcomes (PLOs)

KLOs for Engineering are defined so that by successfully completing the engineering program, Engineering Graduates will be able to:

KLO1: Identify, formulate, solve complex engineering problems using principles of engineering sciences, mathematics, and natural sciences, and to validate the obtained solution.

KLO2: Design solutions for complex engineering problems that meet specified needs with consideration for public health, safety, welfare, and environmental, sustainability, and economic factors, as well as other realistic constraints related to the design solution, while complying with relevant standards and design codes.

KLO3: Conduct investigations of complex engineering problems through developing and executing relevant experiments, and analyzing and interpreting data, supported by engineering judgment to achieve valid conclusions.

KLO4: Create, select, adapt and apply appropriate techniques, resources and modern engineering and IT tools to solve complex engineering problems with understanding of the limitations.

KLO5: Identify and evaluate the issues and constraints of sustainability, economy, environment, politics, health and safety, and society that are relevant to professional solving of complex engineering problems.

KLO6: Recognize ethical and professional responsibilities in engineering situations and commit to the professional ethics and norms of engineering practice to make informed judgments.

KLO7: Apply modern project management techniques, economic and decision-making techniques, and to work effectively as a member or leader in teams, preferably in a multidisciplinary setting.

KLO8: Communicate effectively on engineering activities with a range of audiences.

KLO9: Engage in life-long learning for acquiring and implementing knowledge, as needed, using suitable learning strategies.

Study plan of program

FIRST YEAR (Freshman)

FIRST SEMESTER							
CODE		COURSE TITLE	CRED	LECT	LAB	PRE-REQUISITE	CO-REQUISITE
CHEM	101	General Chemistry I	4	3	3		
ENGL	100	English Language	2	2	0		
MATH	101	Calculus I	4	4	0		PHYS 101
PHYS	101	General Physics I	4	3	3		MATH 101
IC	111	Islamic Culture	2	2	0		
PE	101	Physical Education I	1	0	2		
TOTAL (CREDIT)			17				

SECOND SEMESTER							
CODE		COURSE TITLE	CRED	LECT	LAB	PRE-REQUISITE	CO-REQUISITE
ENGL	102	English Composition II	3	3	0	ENGL 100 or ENGL 101	
MATH	102	Calculus II	4	4	0	MATH 101	PHYS 102
PHYS	102	General Physics II	4	3	3	PHYS 101	MATH 102
ICS	103	Computer Programming in C	3	2	3	MATH 101	
ARB	100	Arabic Language Skills	2	2	0		
PE	102	Physical Education II	1	0	2	PE 101	
TOTAL (CREDIT)			17				

SECOND YEAR (Sophomore)

FIRST SEMESTER							
CODE		COURSE TITLE	CRED	LECT	LAB	PRE-REQUISITE	CO-REQUISITE
MATH	201	Calculus III	3	3	0	MATH 102	
CE	201	Statics	3	3	0	PHYS 101	
ME	203	Thermodynamics I	3	3	0	MATH 102, PHYS 102	
ME	210	ME Drawing & Graphics	3	2	3		
ME	215	Materials Science for ME	4	3	3	CHEM 101, MATH 102, PHYS 102	
ENGL	214	Technical Report Writing	3	3	0	ENGL 102	
TOTAL (CREDIT)			19				

SECOND SEMESTER							
CODE		COURSE TITLE	CRED	LECT	LAB	PRE-REQUISITE	CO-REQUISITE
ME	201	Dynamics	3	3	0	CE 201	
ME	204	Thermodynamics II	3	3	0	ME 203	
MATH	202	Elem. Diff. Equations	3	3	0	Math 201	
CE	203	Structural Mechanics	3	3	0	CE 201, MATH 102	
ME	206	Manufacturing Processes I	4	3	3	ME 210, ME 215	
EDUC	115	Work Values and Ethics	2	2	0		
TOTAL (CREDIT)			18				

THIRD YEAR (Junior)

FIRST SEMESTER							
CODE		COURSE TITLE	CRED	LECT	LAB	PRE-REQUISITE	CO-REQUISITE
EE	202	Fund. of Elec. Circuit	3	2	3	MATH 102, PHYS 102	
CRCL	115	University Life Skills	3	3	0		
MATH	303	Methods of Applied Mathematics	3	3	0	MATH 202	
ME	307	Machine Design I	3	3	0	ME 206, CE 203, ME 210	
ME	311	Fluid Mechanics	3	3	0	ME 201, ME 204, MATH 201	
ISE	205	Engineering Probability & Statistics	3	3	0	MATH 201	
TOTAL (CREDIT)			18				

SECOND SEMESTER							
CODE		COURSE TITLE	CRED	LECT	LAB	PRE-REQUISITE	CO-REQUISITE
ME	306	Manufacturing Process II	3	2	3	ME 206, ME 215	
EE	306	Electromechanical Devices	3	2	3	MATH 102, PHYS 102, EE202	
ME	308	Machine Design II	4	3	3	ME 210, ME 307	
ME	309	Mechanics of Machines	3	3	0	ME 201	
ME	315	Heat Transfer	3	3	0	ME 311	
ME	316	Thermo-Fluids Laboratory	1	0	3	ME 311	ME315
ETEC	115	Computer and Information	2	2	0		
TOTAL (CREDIT)			19				

SUMMER SESSION

CODE	COURSE TITLE	CRED	LECT	LAB	PRE-REQUISITE	CO-REQUISITE
ME 399	Cooperative Work (Cont.)	0	0	0	ENGL 110, ME 315, ME 307, ME 309, junior standing and approval of the Department	
TOTAL (CREDIT)		9				

FOURTH YEAR (Senior)

FIRST SEMESTER						
CODE	COURSE TITLE	CRED	LECT	LAB	PRE-REQUISITE	CO-REQUISITE
ME 401	Cooperative Work (Cont.)	0	0	9	ME 399	
TOTAL (CREDIT)		9				

SECOND SEMESTER						
CODE	COURSE TITLE	CRED	LECT	LAB	PRE-REQUISITE	CO-REQUISITE
ME 413	System Dynamics & Control	3	2	3	ME 201, MATH 202	
GS XXX	General Studies Elective	3	3	0		
ME 4XX	ME Elective I	3	3	0		
ME 4XX	ME Elective II	3	3	0		
ME 415	Senior Design Project	3	1	6	ME 401	
EDUC 125	Entrepreneurship	2	2	0		
TOTAL (CREDIT)		17				

Courses description

The following section gives a brief description of the contents of core mechanical engineering courses.

ME 201: Dynamics (Credits 3)

The course includes the following topics: Kinematics of rectilinear and curvilinear motion of particles. Kinematics of rotation and plane motion of rigid bodies. Dynamics of particles and systems of particles. Work and energy relations. Impulse and momentum principles. Dynamics of rigid bodies in plane motion.

Prerequisite: CE 201

ME 203 – Thermodynamics I (Credits 3)

System and control volume concepts. Properties of a pure substance. Work and heat. The first law of thermodynamics as applied to a system and a control volume, internal energy, enthalpy. The second law of thermodynamics. Carnot cycle, entropy, reversible and irreversible processes. Applications of steady-state, steady-flow, uniform state, uniform-flow, and other processes.

Prerequisite: MATH 102, PHYS 102

ME 204 – Thermodynamics II (Credits 3)

Vapor power cycles, Rankine, reheat, and regenerative cycles. Maxwell relations, ideal and real gases, equations of state, generalized charts. Gas-vapor mixtures, psychrometric charts, ideal solutions. Chemical reactions. Fuels and combustion processes.

Prerequisite: ME 203

ME 205: Materials Science for Non-ME (Credits 3)

Introduction to the properties of engineering materials: mechanical, electrical, and chemical. Fundamentals of crystallography. Impurities and imperfections in solids. Atomic diffusion. Single phase metals and alloys; elastic and plastic deformation, recrystallization, and grain growth. Multi-phase materials; phase diagrams with emphasis on iron-iron carbide system. Heat treatment process, such as annealing, normalizing, and quenching. Studies of widely used engineering materials, steels, plastics, ceramics, concrete, and wood.

Prerequisite: CHEM 102, MATH 102

ME 206 – Manufacturing Processes I (Credits 4)

Manufacturing methods of metals and plastics including metal casting, forming, machining, welding, and plastic processing. Laboratory experiments and demonstrations in material behavior, forming, casting, welding, and machining operations, metrology and dimensional control.

Prerequisite: ME 210, ME 215

ME 210: Mechanical Engineering Drawing and Graphics (Credits 3)

The course introduces the student with the basics of Engineering Drawing and Graphics; Topics include Graphical interpretation of orthographic projection to include auxiliary views, section views, dimensioning, translation of design instructions into detail and assembly drawings, drawing conventions including weldments, piping, referencing and surface finish notation, election of tolerances based on design requirements.

Computer Usage of the 75 hours available for this course, 18 hours will be spent on traditional drafting and the remaining 57 hours on computer drafting. Students will use an up-to-date version of Solid Works to construct orthographic drawings during this course. Students will access models of typical mechanical components and view these models from various directions. These models and viewing techniques will assist students to better visualize in 3-D space.

Pre/Co-Requisites: None

ME 215: Materials Science for Mechanical Engineers (Credits 4)

Atomic bonding in solids, bonding forces and energies, primary and secondary bonds. The structure of crystalline solids, lattice, unit cells and crystal systems, density computations, crystal directions and planes, linear and planar atomic densities. Impurities and imperfections in solids: point, line and interfacial defects. Atomic vibration and diffusion. Mechanical properties of materials. Elastic and plastic deformation and recrystallization. Phase diagrams of single and multi-phase materials with emphasis on iron-iron carbide system. Thermal processing of metals and alloys, composite materials, polymers.

Prerequisite: CHEM 101, MATH 102, PHYS 102

ME 307 – Machine Design I (Credits 3)

Design process, review of stress, strain and deformation analysis as applied to mechanical design; properties of materials; review of static failure theories; designing against fatigue failures; element design; shafts, keys, couplings, power screws, bolted, riveted, and welded joints.

Prerequisite: ME 206, ME 210, CE 203

ME 308 – Machine Design II (Credits 4)

Design of elements: bearings (journal and anti-friction), springs, spur, helical, bevel and worm gears; flexible drives (belts and chains); clutches and brakes; design optimization. Laboratory sessions to supplement and to apply the material covered in the lectures. Consideration of manufacturing aspects of the design (limits and fits). Study of projects considering the different stages of their design, manufacturing, and assembly.

Prerequisite: ME 307

ME 306: Manufacturing Processes II (Credits 3)

Principles applied to metal working, casting, welding, and machining processes. Design and process considerations. Modern welding processes. Non-traditional material removal processes. Powder and metal processing. Automation. Numerical control machining. Introduction to statistical manufacturing process control. Laboratory demonstrations and experiments on these principles and processes.

Prerequisite: ICS 101, ME 206

ME 309 – Mechanics of Machines (Credits 3)

Kinematics of mechanisms, vector method of analysis of plane mechanisms. Static and dynamic analysis of machines, inertia forces, gyroscopic forces. Static and dynamic balancing, balancing machines. Dynamics and balancing of reciprocating engines. Flywheels, kinematic and dynamic analysis of cam mechanisms. Elements of mechanical vibrations, critical speeds, and torsional vibrations.

Prerequisite: ME 201

ME 311: Fluid Mechanics (Credits 3)

Definition and properties of fluids. Fluid statics with applications. Basic fluid dynamic equations of continuity, energy, and momentum, with applications to different flow situations and flow measurement. Viscous effects, boundary layer concepts, laminar and turbulent flow in pipes, open channel flow, fluid dynamics, forces on immersed bodies. Modeling and dimensional similarity. Introduction to turbomachinery.

Prerequisite: ME 201, ME 204, MATH 201

ME 315: Heat Transfer. (Credits 3)

An introduction to heat transfer by conduction, radiation, and convection. Steady-state analysis of heat transfer through composite plane, cylindrical and spherical walls with convection and radiation boundary conditions, internal energy generation and extended surfaces (fins). Significance of multi-dimensional effects. Unsteady heat transfer in plates, cylinders, and spheres. Numerical solution of heat conduction problems. Practical analysis of convection with application to heat exchangers. Blackbody and graybody radiation systems. Students will be assigned several homework problems that will involve the use of the computer to solve practical problems.

Prerequisite: ME 311

ME 316: Thermo-Fluid Lab. (Credit 1)

This lab course deals with fluid mechanics and heat transfer. All experiments conducted in this lab combine elements of theory and practice. Many of the concepts and basic theories which the students learn in the lectures of ME 311 and ME 315 are demonstrated and confirmed in the lab through different experiments.

Prerequisite: ME 311 ***Co-requisite:*** ME 315

ME 413: System Dynamics and Control (Credits 3)

Dynamics of mechanical, fluid, electrical and thermal systems. Equations of motion. Dynamic response of elementary systems. Transfer functions and pole-zero diagrams. Simulation of dynamics of complex systems. Dynamic stability of systems. Open and closed-loop systems. Basic control actions. Laboratory sessions involving use of computers for simulation of dynamic systems and analysis of control systems.

Prerequisite: ME 201, MATH 202

ME 399 Cooperative Work (Credits 0)

A continuous period of 8 weeks of summer training spent in the industry working in any of the fields of mechanical engineering. The training should be carried out in an organization with an interest in one or more of these fields. On completion of the program, the student is required to submit a formal written report of his work.

Prerequisites: ENGL 110, junior standing and approval of the Department.

ME 401 – Mechanical Engineering Cooperative Work (credits 9)

A period of 28 weeks of industrial employment for Mechanical Engineering students to work in appropriate industries or firms. Students are evaluated on their performance on the job and are required to submit an extensive formal report on their experience.

Prerequisite: ENGL 110, ME 307, ME 309, ME 315

Mechanical Engineering Elective Courses, ME Electives (ME 4XX)

Course Code	Course Name	Credit Hours		
		LT	LB	CR
ME 410	Casting And Welding Engineering	3	0	3
ME 411	Plastics and Plastics Processing	3	0	3
ME 412	Fundamentals of Heat Treatment	3	0	3
ME 414	Corrosion Engineering I	3	0	3
ME 416	Mechanical Vibrations	3	0	3
ME 417	Optimization of Mechanical Systems	3	0	3
ME 418	Quality in Manufacturing	3	0	3
ME 419	Computer Integrated Manufacturing	3	0	3
ME 420	Iron and Steel Making	3	0	3
ME 422	Thermal Desalination Systems	3	0	3
ME 423	Refrigeration & Air Conditioning	3	0	3
ME 425	Internal Combustion Engines	3	0	3
ME 426	Renewable Energy	3	0	3
ME 427	Turbo machinery	3	0	3
ME 428	Fluid Power Systems	3	0	3
ME 429	Fundamentals of Aerodynamics	3	0	3
ME 430	Energy Conversion	3	0	3
ME 431	Design and Rating of Heat Exchangers	3	0	3
ME 435	Thermal power Plants	3	0	3

General Studies Electives (GS XXX)

Course Code	Course Name	Credit Hours		
		LT	LB	CR
GS 321	Principles of Human Behavior	3	0	3
GS 423	Industrial Relations	3	0	3
GS 424	Planning and Social Development	3	0	3
GS 427	Man and Environment	3	0	3
MGT 301	Management	3	0	3

ME 410 Casting And Welding Engineering (Credits 3,0,3)

Metallurgical and engineering principles applied to melting, casting, and solidification. Testing and evaluation of castings. Foundry processes. Introduction to metallurgy of welding. Materials and process selection, codes and specifications, weldment design and testing. Welding defects. Analysis of industrial welding processes

Prerequisite: ME 206, ME315

ME 411 Plastics and Plastics Processing (Credits 3,0,3)

Thermoplastic and thermosetting polymers, their properties and engineering applications. Plastic manufacturing processes, equipment, and mold design. Plastic materials and process selection.

Prerequisite: ME 306

ME 412 Fundamentals of Heat Treatment (Credits 3,0,3)

Principles of phase, transformations, heat treatment. Mechanical properties as applied to ferrous and non-ferrous metals and alloys. Heat treatment processes, including normalizing, hardening, tempering, annealing, surface hardening. Applications of heat treatment and surface hardening techniques

Prerequisite: ME 206, ME315

ME 413: System Dynamics and Control (Credits 3,0,3)

Dynamics of mechanical, fluid, electrical and thermal systems. Equations of motion. Dynamic response of elementary systems. Transfer functions and pole-zero diagrams. Simulation of dynamics of complex systems. Dynamic stability of systems. Open and closed-loop systems. Basic control actions. Laboratory sessions involving use of computers for simulation of dynamic systems and analysis of control systems.

Prerequisite: ME 201, MATH 202

ME 414 Corrosion Engineering I (Credits 3,0,3)

Corrosion is concerned with the degradation and failure over time of all engineering materials due to their exposure to various environments such as seawater, atmosphere, and chemicals. Apart from the high cost of repair, the corroded structures may also endanger people's safety and result in loss of life. This course will expose prospective materials engineers on the importance of understanding the principles and mechanisms of corrosion and methods to control corrosion.

Prerequisite: ME 215, EE 306

ME 416 Mechanical Vibrations (Credits 3,0,3)

Free and forced vibrations; Applications to systems with one-, two-, and multi-degree of freedom; Viscous, hysteretic, and Coulomb damping; Response to general periodic excitations; Transient vibration and the phase method; Principal and coupled coordinates; Dynamic vibration absorbers; Energy methods and Rayleigh's principle; Laboratory sessions on vibration measuring instruments, vibration measurement techniques, and experiments to illustrate various vibration phenomena studied.

Prerequisite: ME 201, ME 309

ME 417 Optimization of Mechanical Systems (3-0-3).

Formulation and simulation of mechanical engineering systems involving dynamics, kinematics, and machine design and thermo-fluid systems; The concept of optimization; Analytical and numerical methods such as unconstrained and constrained optimization, Lagrange multipliers, linear programming for optimum design of mechanical systems. Lab demonstration sessions involve formulation and solution of optimization problems using computers and existing software packages during the design process.

Prerequisites: ME 307

ME 418 Quality Improvement in Manufacturing (Credits 3,0,3)

Introduction to principles and philosophies of total quality management; Advance methods for process control, Six sigma approach to quality, Quality function deployment (QFD) and Taguchi approach to quality, and Parameter Optimization.

Prerequisite: STAT 319

ME 419 Computer Integrated Manufacturing (Credits 3,0,3)

High volume discrete parts production systems; CAD/CAM fundamentals; Numerical Control (NC) manufacturing systems. Part Programming; NC justification, advances in NC (CNC, DNC, adaptive control); Tooling for NC and CNC; Overview of group technology, flexible manufacturing systems (FMS), and robotics in manufacturing. Related laboratory experiments, CNC Programming, and projects will be done on CNC machines and associates CAD/CAM software available in ME Workshop.

Prerequisite: ME 306 and ICS 103

ME 420 Iron and Steel Making (Credits 3,0,3)

Introduction to extractive metallurgy and iron ore dressing including the following topics: iron ores, mining, and ore dressing. Production of pig iron. The blast furnaces. Production of steel. Bessemer process, basic oxygen process, open-hearth process, direct reduction process, and electric-furnace process. Continuous casting.

Prerequisite: ME 215

ME 422 Thermal Desalination Systems (3-0-3)

Seawater composition. The need for water desalination. Classification of desalination processes. Single effect evaporation. Thermal vapor compression systems. Multiple effect evaporation. Multistage flash distillation, once through MSF, Brine mixing and recirculation MSF. Reverse osmosis. Desalination using renewable energy sources. Economic analysis of desalination processes

Prerequisite: ME 315, ME204

ME 423 Refrigeration & Air Conditioning (Credits 3,0,3)

Simple and compound refrigeration cycle, Compressors capacity and dimensions, Actual cycle, Review of moist air, Psychrometric and air conditioning processes. Summer and winter air conditioning cycles, ventilation, classification of central air conditioning systems, cooling load calculation, air duct design, air fan power and selection.

Prerequisite: ME 315, ME204

ME 425 Internal Combustion Engines (Credits 3,0,3)

Types of engines and their operation; Four and two stroke engines; Thermodynamics of engine cycles; Engine design and performance parameters; Operating characteristics of spark and compression ignition engines; Thermochemistry in-cylinder combustion and combustion abnormalities; Analysis of fuel-air cycles; Analysis of intake, fuel, and exhaust systems; Turbocharging and supercharging; Performance characteristics of actual engines.

Prerequisite: ME 204

ME 426 Renewable Energy (Credits 3,0,3)

Reserves of non-renewable fuels; Prospects of renewable energy, and its sources and pattern of usage; characteristics of renewable sources: intermittent, low power density etc.; use of renewables in small scale systems. Current technology: wind wave, tidal, passive and active solar, biological and examples of devices; Energy management, interaction of nontechnical requirements (social, economic, political, environment) in engineering design and innovation; case-study.

Prerequisite: ME 204

ME 427 Turbo machinery (Credits 3,0,3)

Thermo-fluid dynamics aspects of fluid flow, kinematic relations, and efficiencies of turbomachines. Two dimensional cascades; Turbine and Compressor cascade correlations and performance. Axial Turbines (two-dimensional analysis), Axial Flow Compressors and Fans (two-dimensional analysis), Centrifugal

Compressors and Fans, Radial Flow Turbines, and preliminary design fundamentals of turbomachines and three-dimensional considerations.

Prerequisite: ME 204, ME 311

ME 428 Fluid Power Systems (Credits 3,0,3)

Study of fluid power systems as used in industrial applications to transmit power by the flow of hydraulic fluids. Fluid power circuit diagrams including components such as valves, pumps, motors, filters, reservoirs, and accumulators. Analysis of fluid leakage, hydrostatic transmissions, hydraulic stiffness, and performance of positive displacement pumps and motors.

Prerequisite: ME 311

ME 429 Fundamentals of Aerodynamics (Credits 3,0,3)

Inviscid incompressible flow to include potential function, stream function, circulation and basic flows; Kutta Joukowski theorem. Aerofoil theory and wing theory. Drag, aircraft propulsion and propeller; Static performance problem; Special performance problem; Introduction to stability and control, Longitudinal stability, and control; Lateral and directional stability and control.

Prerequisite: ME 311

ME 430 Energy Conversion (Credits 3,0,3)

Introduces basic background, terminology, and fundamentals of energy conversion. Discusses current and emerging technologies for production of thermal, mechanical, and electrical energy. Topics include fossil and nuclear fuels, solar energy, wind energy, fuel cells, and energy storage. Thermodynamic power cycles for power production: Rankine and Brayton; internal combustion power cycles. Introduction to exergy.

Prerequisite: ME 204, ME 315

ME 431 Design and Rating of Heat Exchangers (Credits 3,0,3)

Heat transfer mechanism leading to basic heat exchanger equations; classification and analyses of heat exchangers including geometry; heat transfer and flow friction characteristics; compact and shell and tube heat exchanger application and design procedures; fouling and its effect on life cycle analysis; maintenance methodology; flow induced vibration and noise in heat exchangers.

Prerequisite: ME 315

ME 435 Thermal Power Plants (Credits 3,0,3)

Forms of energy, oil, gas and coal. Combustion processes, energy cycles. Steam generators and their component design. Turbines. Load curves. Field trips to power plants and other energy installations.

Prerequisite: ME 204, ME 315

Program key performance indicator (KPIs)

No	KPIs Code	KPIs	Target	Measurement Methods	Measurement Time
1	KPI-P-01	Percentage of achieved indicators of the program operational plan objectives	80%	Percentage of performance indicators of the operational plan objectives of the program that achieved the targeted annual level to the total number of indicators targeted for these objectives in the same year	At the end of the academic year
2	KPI-P-02	Percentage of faculty and program staff who are aware of the program / institution's mission using a questionnaire / interview to the total number of faculty and staff.	80%	Percentage of faculty and program staff who are aware of the program / institution's mission using a questionnaire / interview to the total number of faculty and staff	At the end of the academic year
3	KPI-P-03	Average of overall rating of final year students for the quality of learning experience in the program on a five-point scale in an annual survey	4	Average of overall rating of final year students for the quality of learning experience in the program on a five-point scale in an annual survey	At the end of the academic year
4	KPI-P-04	Average students overall rating for the quality of courses on a five-point scale in an annual survey	4	Average students overall rating for the quality of courses on a five-point scale in an annual survey	At the end of the academic year
5	KPI-P-05	Proportion of students who completed the program in minimum time in each cohort	80%	Proportion of students who completed the program in minimum time in each cohort	At the end of the academic year
6	KPI-P-06	First year student retention rate	90%	Percentage of first-year undergraduate students who continue at the program the next year to the total number of first-year students in the same year	At the end of the academic year

No	KPIs Code	KPIs	Target	Measurement Methods	Measurement Time
7	KPI-P-07	Student performance in the professional and/or national examinations	80%	Percentage of students or graduates who were successful in the professional and / or national examinations , or their score average and median (if any)	At the end of the academic year
8	KPI-P-08	Graduates employability and enrolment in postgraduate programs	80%	Percentage of graduates from the program who within a year of graduation were: a .employed b .enrolled in postgraduate programs during the first year of their graduation to the total number of graduates in the same year	At the end of the academic year
9	KPI-P-09	Average number of students per class (in each teaching session/activity : lecture ,small group , tutorial, Laboratory)	15	Average number of students per class (in each teaching: session/activity lecture , small group tutorial , laboratory),	At the end of the academic year
10	KPI-P-10	Average of overall rating of employers for the proficiency of the program graduates on a five-point scale in an annual survey	4	Average of overall rating of employers for the proficiency of the program graduates on a five-point scale in an annual survey	At the end of the academic year
11	KPI-P-11	Student`s evaluation of the value and quality of the field activities	80%	Percentage of students' satisfaction with the presence and quality of field activities during the semester and the academic year at the program / college / university.	At the end of the academic year
12	KPI-P-12	Average of students' satisfaction rate with the various services offered by the program (restaurants, transportation, sports facilities, academic advising,...) on a five-point scale in an annual survey	4	Average of students' satisfaction rate with the various services offered by the program (restaurants, transportation ,sports facilities ,academic advising (... ,on a five point scale in an annual survey	At the end of the academic year

No	KPIs Code	KPIs	Target	Measurement Methods	Measurement Time
13	KPI-P-13	Ratio of the total number of students to the total number of full-time and full-time equivalent teaching staff in the program	15:1	Ratio of the total number of students to the total number of full-time and full-time equivalent teaching staff in the program	At the end of the academic year
14	KPI-P-14	Percentage of teaching staff distribution based on: a .Gender b .Branches c .Academic Ranking	80%	Percentage of teaching staff distribution based on : a .Gender b .Branches c .Academic Ranking	At the end of the academic year
15	KPI-P-15	Proportion of teaching staff leaving the program annually for reasons other than age retirement to the total number of teaching staff.	0%	Proportion of teaching staff leaving the program annually for reasons other than age retirement to the total number of teaching staff	At the end of the academic year
16	KPI-P-16	Percentage of full-time faculty members who published at least one research during the year to total faculty members in the program	100%	Percentage of full-time faculty members who published at least one research during the year to total faculty members in the program	At the end of the academic year
17	KPI-P-17	The average number of refereed and/or published research per each faculty member during the year (total number of refereed and/or published research to the total number of full-time or equivalent faculty members during the year)	1:1	The average number of refereed and/or published research per each faculty member during the year (total number of refereed and/or published research to the total number of full-time or equivalent faculty members during the year)	At the end of the academic year
18	KPI-P-18	The average number of citations in refereed journals from published research per faculty member in the program (total number of citations in refereed journals from published research for full-time or equivalent faculty members to the total research published)	2:1	The average number of citations in refereed journals from published research per faculty member in the program (total number of citations in refereed journals from published research for full-time or equivalent faculty members to the total research published)	At the end of the academic year

No	KPIs Code	KPIs	Target	Measurement Methods	Measurement Time
19	KPI-P-19	Percentage of faculty members with qualifications and experience of the courses they are studying compared to the total number of courses offered during the academic year	100%	Percentage of faculty members with qualifications and experience of the courses they are studying compared to the total number of courses offered during the academic year.	At the end of the academic year
20	KPI-P-20	Number of full-time faculty other staff and administrators engaged in a community service activity during the academic year compared to the total number of faculty ,other staff and administrators	80%	Number of full-time faculty ,other staff and administrators engaged in a community service activity during the academic year compared to the total number of faculty, other staff and administrators	At the end of the academic year
21	KPI-P-21	Average of beneficiaries' satisfaction rate with the adequacy and diversity of learning resources (references ,journals, databases… etc (.on a five point scale in an annual survey.	80%	Average of beneficiaries' satisfaction rate with the adequacy and diversity of learning resources (references, journals ,databases… etc (.on a five-point scale in an annual survey	At the end of the academic year

Facilities

Computing Resources

The ME department has two computer labs located in the first floor of the college room F126 and F127, each lab is equipped with 25 desktop computers with high performances (recently updated with newest versions). These two labs are used principally in Computer Aided Design and Manufacturing. In fact, each computer contains software's such as SOLIDWORKS, AUTOCAD, CATIA, MASTERCAM, etc., which are CAM/CAD softwares. MATLAB, C++, ANSYS used in programming, system dynamics and simulation. In addition, these laboratories serve students for their assignments/projects and related work. Because students can access this lab at any time, they are able to complete coursework assignments in a timely manner, as well as projects in collaboration with their contemporaries, without the restrictions normally associated with facility operating hours. The two laboratories are equipped with smart video projectors and white boards, connected to the online printer if the students need to print out their drawings for example. Available software packages are listed in Table 7.4, along with specialty engineering software used by students in the mechanical Engineering program.

Available software packages

Software	Used for	Course (s)
SOLIDWORKS	Solid modeling and drawings; structural analysis (FEA) and geometric dimensioning and tolerancing (GD&T);	ME210 ME308 Training
AUTOCAD	Drawing and Graphics	ME210 Training
CATIA, MASTERCAM	Solid modeling and aided manufacturing	ME419 training
ANSYS	Finite elements analysis (FE) applied on mechanical problems and thermodynamic	Research training
MATLAB	Introductory programming course; Scientific computation in MAE;	System dynamics ME413

	Calculations and data analysis; Analysis of experimental data	
VR turning, VR milling	Adjust and program CNC machines	ME419 training
Quick CAM 2D, Quick TURN 2D design	CAM for turning and milling processes linked with the real CNC machines of the ME department	ME419 training
C++	Programming	ETEC 115
Microsoft office	Student`s usual use to prepare reports homework's and assignments	Reports

Guidance

The students of ME program are provided with guidance regarding the use of tools, equipment, machines, computing resources, workshops, and laboratories. Instructors ensure proper use of equipment and that safety rules are being complied with during the lab sessions. In fact, he helps students to carry out their experiments, he answers any question students may have regarding running experiments; he collects and grades reports documenting students' results and comments on each experiment. Specialized instructors are always present to provide students with equipment and/or tools they may need. IT professionals, helping students using the labs with any technical issue that might face them, supervise lab computers. The ME department has assigned a specialized supervisor (from the faculty member staff) for each laboratory and workshop at the aim to ensure the safe use of tools and equipment's.

The students are guided in the following ways:

Written instructions in the form of lab manuals
Audio-visual aids
Practical demonstrations in person
Extensive training

Maintenance and Upgrading of Facilities

The laboratory equipment and tools are maintained according to supplier recommendations by the lab supervisors. Each lab has been supplied with a logbook; any functional problems in equipment is reported by faculty members in the logbook with date name and the problem description. Once the equipment is fixed, the lab supervisor completes the logbook by date and signing the form. Periodic inspection is undertaken by the concerned lab supervisor to check the condition of the equipment and tools. Requests for replacements and/or upgrades are sent to the head of department for his necessary actions. Annual requests for the replacement or upgrade of major research and teaching equipment are sent to the college dean.

In 2018, the college of engineering formed a permanent committee for laboratories and equipment headed by the college Dean. Their principal members are from the ME department. The committee follows up and studies the status of all teaching and research laboratories through periodic visits. During these visits, the committee members write an inspection report (audit) containing the preventive and corrective actions needed for each laboratory. In addition, the committee treats the requests of equipment upgrading. The ME department upgrading request containing the list of tools, and equipment's and their characteristics is included in Appendix C.

Library Services

Following the agreement signed between the University of Ha'il and the Saudi Digital Library (SDL), which is one of the most prominent forms in supporting the UOH Ha'il, where it provides sophisticated information services, as well as providing digital information resources in various forms, and making it accessible to faculty staff, researchers, and students. It provides the largest gathering of e-books in the Arab world offering more than 310000 e-books in full text in various scientific specializations. The faculties and the students have access to the world's major providers of scientific, technical, and medical information and online versions of many journals of more than 300 global publishers such as Elsevier, Springer, Pearson Wiley, Taylor & Francis, McGraw-Hill Yale University, Oxford University, Harvard University...

The College of Engineering has allocated a space for a library with the principal furniture, several book titles are purchased in multiple volumes belonging to various departments of the college. All faculty members and students of various departments of the college utilize the College library facilities.

Medical Services

University has its own Medical Centre that is accessible to all faculty members and students. The Medical Centre provides all basic facilities, such as lab examination, X-Ray, medicines etc. Apart from General Practitioner, the Medical Centre also has specialists to cater for necessary advice. In a situation where the treatment is not within the scope of the Medical Centre, the faculty members and students may be referred to three of the Government Hospitals.

Overall Comments on Facilities

All Laboratory and Library facilities are well suited to serve their purpose. These facilities are provided to safely accomplish the program educational objectives and provide a conducive learning environment. Excellent classrooms, laboratories and associated equipment are available to foster faculty-student interaction and to create a climate that encourages professional development and professional activities. Computing and information infrastructures are in place to support the instructional and scholarly activities of the faculty as well as the students.

Graduates' employment opportunities

The Mechanical Engineering program at the University of Hail provides depth and breadth in the subject area. The curriculum is designed to ensure that the students receive in depth mechanical engineering knowledge and practical experience in the core mechanical engineering disciplines. In addition, the students are required to study courses in mathematics, physical sciences, English language and humanities. Furthermore, the curriculum offers a broad undergraduate education to develop analytical skills and practical design knowledge that ensures long-term career flexibility. Throughout its duration, the program delivers design and a laboratory experience as well as it enhances teamwork and communication skills. A sample of related occupations is shown below:

- All sectors of activity whether in industry, agriculture or services.
- Energy field on both new methods for energy generation such as solar, fuel cell and wind generated power, and also on the design of traditional electrical power plants equipped with reactors, pressure piping, heat exchangers and other specialized components.
- Designing the various parts and supervising maintenance in various industries (oil, petrochemicals, automobile, aeronautics, steel, metallurgy…).
- Developing the systems that improve and speed up production processes in manufacturing companies of all kinds.
- Involving with the design, research, development, manufacture, testing, distribution, support, maintenance and recycling of devices and products.
- Performing in government research, assist on key policy decisions regarding technology development and use.

Overall, our Mechanical Engineering students are provided with a broad-based education that allows them to engage in a wide variety of challenging, interesting and rewarding careers in private and government activities or to start their own business.