FACULTY OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

Bachelor of Engineering (BE) Degree – 147 Credits

Sem	Course Code	Course Title	Credit	Pre-Req	Co-Req
1	CIVE 201	Statics	3		
1	CSIS 206	Principles of Programming	3		
1	ENGL 203	English Communication Skills III	3		
1	MATH 200	Calculus I	3		
1	MATH 211	Linear Algebra I	3		
1	MECH 211	Mechanical Drawing I	1		
1	MECH 212	Instrumentation and Experimentation I	1		
1	MECH 233	Workshop Technology	1		
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
2	CHEM 202	Basic Chemistry	3		
2	CIVE 202	Mechanics of Materials	3	CIVE 201	
2	MATH 202	Calculus II	3	MATH 200	
2	MATH 246	Probability for Engineers	3	MATH 200	
2	MECH 221	Engineering Dynamics	3	MATH 200	
2	MECH 290	Introduction to the Engineering Design Process	1		
2	ENGL 2XX	English Elective	3	ENGL 203	
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
3	GENG 221	Engineering Ethics	3	ENGL 203 MECH 290	
3	MATH 230	Numerical Analysis I	3	CSIS 206 MATH 200	
3	MATH 270	Differential Equations	3	MATH 200	
3	MECH 222	Science of Materials	3		ENGL 101
3	MECH 231	Circuit Fundamentals	3	MATH 211	
3	MECH 232	Thermodynamics	3		
3	MECH 234	Mechanical Drawing II	1	MECH 211	

Sem	Course Code	Course Title	Credit	Pre-Req	Co-Req
4	GENG 222	Sustainable Development for Engineers	3	ENGL 203 MECH 290	
4	GENG 311	Engineering Management and Economics	3		
4	LISP 200	Information Skills and Search Techniques	1		ENGL 102
4	MECH 241	Computational Techniques in Mechanical Engineering	3	CSIS 206 MATH 230 MECH 221	MATH 270 MECH 243
4	MECH 242	Engineering Vibrations	3	MATH 270 MECH 221	
4	MECH 243	Fluid Mechanics	3		MATH 202
4	MECH 244	Instrumentation and Experimentation II	1	MECH 212	
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
5	ELEN 201	Instrumentation Lab	1		
5	ELEN 349	Introduction to Control Systems	3	MATH 270 MECH 231 MECH 241	
5	MECH 311	Mechanical Design I	3	CIVE 202	
5	MECH 314	Gas Dynamics	3	MECH 243	
5	MECH 328	Basic Manufacturing	3	MECH 222 MECH 234	MECH 387
5	MECH 387	Design Tools in Mechanical and Aeronautical Engineering	3	CIVE 202 MECH 243 MECH 234	
5	MECH 389	System Design	3	MECH 290 GENG 221 GENG 222	MECH 387
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
6	CSPR XXX	Cultural Studies	3		
6	ELEN 360	Electric Motors and Drives	3	ELEN 221 or MECH 231 and MATH 211	
6	MECH 315	Mechanics of Machines	3	MATH 230 MECH 221	
6	MECH 321	Heat Transfer	3	MECH 243	

6	MECH 324	Steam and Gas Turbines	3	MECH 232	
6	MECH 325	Instrumentation and Experimentation III	1	MECH 244	
6	MECH 390	Undergraduate Design Project	1	MECH 389 or AERO 316	LISP 200
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
7	MECH 411	Advanced Mechanics of Materials	3	CIVE 202 MECH 311	
7	MECH 412	Mechanics of Composite Materials	3	CIVE 202	
7	MECH 413	Internal Combustion Engines	3	MECH 232	
7		Elective	3		
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
8	GENG 400	Engineering Seminars	1		
8	GENG 490	Graduation Project	3		
8	MECH 421	Refrigeration and Air Conditioning	3	MECH 321	
8	MECH 422	Mechanical Design II	3	MECH 311 CIVE 202	
8	MECH 423	Advanced Manufacturing Processes	3	MECH 323	
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
9	MECH 480	Field Training	3		
Sem	**Course Code**	**Course Title**	**Credit**	**Pre-Req**	**Co-Req**
10	GENG 490	Graduation Project (Reactivation)	0		
10	MECH 410	Material Characterization Lab.	1	CIVE 202 MECH 222 MECH 325	
10	MECH 415	Turbomachinery	3	MECH 324 or AERO 344	
10	MECH 517	Finite Element Methods in Mech. and Aero. Eng.	3	CIVE 202	
10		Elective	3		
		TOTAL	**147**		

The BE program in Mechanical Engineering does not offer any tracks.

It is highly advisable that mechanical engineering students take CIVE 201 prior to MECH 221, and MECH 232 prior to MECH 243.

*One of the BE electives has to be a technical elective to be selected from courses from within the Mechanical Engineering Department. Any 300, 400 or 500-level MECH course (with prerequisite taken) that is not a required BS or BE course can be taken as a technical elective. The other BE elective can be either a technical elective from within the department (as defined above), or a course from outside the department with prior approval of the Chairperson of the Mechanical Engineering Department.

COURSE DESCRIPTIONS

MECH 211 MECHANICAL DRAWING I **1.2: 1 cr. E**

Engineering drawings are the language of the engineers and technicians. Therefore, the intent of this course is to equip students with the fundamentals of this unique language, to give them the necessary skills, and to prepare complete, concise, and accurate communications through engineering drawings using AutoCAD.

MECH 212 INSTRUMENTATION AND EXPERIMENTATION I **0.3: 1 cr. E**

This lab course, the first in a series, is designed to introduce students to instrumentation and experimentation, in order to apply learnt methodologies and techniques to various experimental cases and build lab competencies through practical experiments. Typical experiments are in the areas of Basic Physics, Science of Materials, Engineering Dynamics, Mechanics of Materials, Mechanical Testing, Mechanisms, etc. Special emphasis is exercised on safety within a mechanical engineering laboratory environment, on modern data acquisition techniques as well as data presentation and reporting. The course also helps students develop the ability to work within a team and understand the measurement theory and confidence in measurement.

MECH 221 ENGINEERING DYNAMICS **3.0: 3 cr. E**

This course covers the concepts of kinematics and kinetics of particles: Force, acceleration, work, energy and momentum. Two-dimensional kinematics and kinetics of rigid bodies, translational and rotational motions.

Pre-requisite: MATH 200

MECH 222 SCIENCE OF MATERIALS **3.0: 3 cr. E**

Historically, the development and advancement of societies have been intimately tied to the members' ability to produce and manipulate materials to fill their needs. In fact, early civilizations have been designated by the level of their materials' development (Stone Age, Bronze Age, and Iron Age). This course covers introductory and fundamental concepts of materials, their science, their engineering and their different application, with a special focus on metals, ceramics and composites.

Co-requisite: ENGL 101

MECH 231 CIRCUIT FUNDAMENTALS **3.0: 3 cr. E**

This is an introductory course to electric circuit theory and electronics. Topics covered include fundamental definitions and laws; DC circuit analysis; mesh and nodal analysis; circuit theorems and analysis tools, AC circuit analysis, three-phase circuits, and basic electronic circuits and devices.

Pre-requisite: MATH 211

MECH 232 THERMODYNAMICS **3.0: 3 cr. E**

This is an introductory course which aims at providing students with theoretical background and the practical knowledge necessary to perform classical engineering analysis of basic open and closed thermodynamic systems.

The course is concerned with:

- the meaning of Thermodynamics and its areas of application,
- the various approaches to the study of Thermodynamics,
- concepts of open and closed Thermodynamic systems,
- the phases and properties of pure substances, states, processes and cycles,
- Work and Heat, laws of mass conservation and energy conservation (1st law of

Thermodynamics),
Directional flow of Energy, Heat Engines and Refrigerators, The 2nd law of Thermodynamics, Efficiency, COP, Carnot Cycles, Irreversibility, Entropy.

MECH 233 WORKSHOP TECHNOLOGY **0.3: 1 cr. E**

This course constitutes a general introduction to the different activities in a mechanical engineering workshop environment. In addition to safety considerations, topics include metal and sheet metal work including cleaning, sizing, tolerances, marking, scribing, cutting, shaping, filing, drilling, grinding, tapping, joining, welding, riveting, surface finishing, cleaning, storing, etc. Students are given tasks on the above in the form of engineering drawings and need to conclude them using different hand tools, power tools and various other manufacturing machines.

MECH 234 MECHANICAL DRAWING II **0.3: 1 cr. E**

Engineers often need to provide assembled drawings and to give detailed information related to surface quality and tolerance. In addition, the elements of special machines such as fasteners and gears need to be provided in some engineering drawings. Therefore, the course aims to equip the students with 3D solid mechanical modeling knowhow. Learning this course is based on the ability to use SolidWorks.

Pre-requisite: MECH 211

MECH 241 COMPUTATIONAL TECHNIQUES IN MECHANICAL ENGINEERING **3.0: 3 cr. E**

This course intends to enhance the students' computational capacities by exposing them to mechanical engineering problems that are best solved or analyzed numerically. Applications from mechanics, thermo-fluids, heat transfer, and design are all considered. Special emphasis is put on pre- and post-processing and the importance of appropriate presentation and animation.

Pre-requisites: MATH 230, CSIS 206, MECH 221
Co-requisites: MECH 243, MATH 270

MECH 242 ENGINEERING VIBRATIONS **3.0: 3 cr. E**

"Vibration is the branch of engineering that deals with repetitive motion of mechanical systems from machine parts to large structures". This course covers fundamental principles of mechanical vibrations. The basic concepts of understanding vibrations, analyzing vibrations and predicting the behavior of vibrating systems form the topics of this course.

Pre-requisites: MECH 221, MATH 270

MECH 243 FLUID MECHANICS **3.0: 3 cr. E**

This course covers fundamental fluid properties; pressure distribution; hydrostatic forces on surfaces; buoyancy; integral relations for a control volume; Reynolds transport theorem, conservation of mass, linear momentum equation, Bernoulli and energy equations; differential relations for fluid flow; fluid acceleration field, mass conservation, linear momentum and energy equations; stream function; vorticity and irrotationality; frictionless irrotational flows, dimensional analysis and similarity; principle of dimensional homogeneity, Pi theorem, non-dimensionalization of the basic equations; modelling and its pitfalls; viscous flow in ducts; Reynolds number regimes, head loss, friction factor, minor or local losses in pipe systems.

Co-requisite: MATH 202

MECH 244 INSTRUMENTATION AND EXPERIMENTATION II 0.3: 1 cr. E
This lab course, the second in a series, is designed to consolidate theories gained in other courses taken up to the second year and build lab competencies through practical experiments. Typical experiments are in the areas of Fluid Mechanics, Thermodynamics, Steam Engine and Mechanics of Materials, etc. Special emphasis is exercised on modern data acquisition techniques as well as data presentation and reporting.

Pre-requisite: MECH 212

MECH 290 INTRODUCTION TO THE ENGINEERING DESIGN PROCESS 0.3: 1 cr. E
This course is a general introduction to the engineering profession, its main attributes, its design process, and its evolution over time. It emphasizes the engineering design process, its phases, challenges and constraints. The qualities and attributes of a modern day engineer as expected by professional engineering societies and boards; including integrity, professionalism, ethical conduct, care for the environment, as well as the role of the engineer in society are treated.

MECH 311 MECHANICAL DESIGN I 3.0: 3 cr. E
This course covers concept of stress, and principal stresses. Static failure theories for ductile and brittle materials and their applications. Curved beams, deflection of structural members, analysis and design of pressure vessels, columns, and shafts.

Pre-requisite: CIVE 202

MECH 314 GAS DYNAMICS 3.0: 3 cr. E
This course is composed of two parts; 1-D Compressible Flows and Boundary Layers:

Part I: Boundary Layer Theory
The Boundary Layer Phenomenon (Observations, Causes, Forms and Effects), Boundary Layer Properties, Fundamental Equations for Viscous Flows (Navier-Stokes Equations & Momentum Integral Equation), The Boundary Layer Approximation, Exact Solution of Laminar Boundary Layers (Blasius), Approximate Solution Laminar Boundary Layers (Von-Karman), Turbulent Boundary Layers, Prandtl's Mixing Length Theory, Solution of Turbulent Boundary Layer.

Part II: Compressible Flows
Tools of the Trade: Revision of some basic concepts from Thermo-Fluids, Speed of Sound and Mach Number, Classification of Flows, Stagnation Properties, Isentropic Flows, Effect of area change on fluid speed & Mach number, Energy Equation for compressible flows, isentropic Flow Relations, Choking, Converging-Diverging Nozzles, Gas Tables, Normal Shock Waves and Operating Characteristics of Converging-Diverging Nozzles, Adiabatic Flow in Constant Area Ducts with Friction (Fanno Flows), Frictionless Flow in Constant Area Ducts with Heat Transfer (Rayleigh Flows).

Pre-requisite: MECH 243

MECH 315 MECHANICS OF MACHINES 3.0: 3 cr. E
This course provides principles of degrees of freedom of mechanisms. Kinematic analysis of linkages. Cam synthesis, kinematic requirements, and graphical and analytical design. Gear and gear trains. Introduction to synthesis of mechanisms.

Pre-requisite: MATH 230, MECH 221

MECH 321 HEAT TRANSFER **3.0: 3 cr. E**

This course covers fundamental concepts of Conduction, Convection, and Radiation. Students should identify the physical origins of transport processes, perform Heat Transfer Engineering calculations, apply Heat Transfer principles to tackle real-life applications, and perform problems-solving techniques applying appropriate simplifying assumptions.

Co-requisite: MECH 243

MECH 324 STEAM AND GAS TURBINES **3.0: 3 cr. E**

This course concentrates on power producing cycles, it is the second course in Thermodynamics. It is concerned with practical cycle variations leading to efficiency and/or work ratio augmentation. The course starts with a quick review of basic thermodynamics. It then presents different heat engine cycles, the basis of internal combustion engines. It also covers gas turbine units for power generation and aircraft propulsion applications. Steam power plants are also investigated based on Rankine cycle and their different modifications. Finally, combined steam-gas cycles are covered.

Pre-requisite: MECH 232

MECH 325 INSTRUMENTATION AND EXPERIMENTATION III **0.3: 1 cr. E**

This lab course, the third in a series, consolidates theories gained in other courses taken up to the third year and build lab competencies through practical experiments. Typical experiments are in the areas of Gas Dynamics, Heat Transfer, Power and Refrigeration Systems, Automatic Controls, Mechanical Testing, Vibrations, Mechanisms, etc. Special emphasis is exercised on modern data acquisition techniques as well as data presentation and reporting.

Pre-requisite: MECH 244

MECH 328 BASIC MANUFACTURING **3.0: 3 cr. E**

The choice and design of manufacturing processes are key functions for the quality and cost-effectiveness of industrial production. Therefore, knowledge of manufacturing techniques is essential for mechanical engineers. Process designers should also have an understanding of this field because the responsibility for production costs begins with them. The students should be enabled to understand and evaluate work content and to plan simple manufacturing tasks. Knowledge should be conveyed in the following areas: Information about various processes and facilities for the production of individual parts, and mass production, as well as the integration of knowledge from the economic, and materials science fields.

Pre-requisites: MECH 222, MECH 234
Co-requisites: MECH 387

MECH 387 DESIGN TOOLS IN MECHANICAL AND AERONAUTICAL ENGINEERING 3.0: 3 cr. E

This computer-based course introduces the Finite Element Method and Computational Fluid Dynamics tools for designing, modelling, simulating, and analyzing practical engineering problems with hands-on experience using commercial software packages used in the industry. It tackles hand sketching, CAD modeling and CAE analysis in both FEM and CFD domains. The students are expected to self-learn certain topics not covered in the lectures. They are also expected to demonstrate their design skills through homework and a final group design project. This course also focuses on communication and teamwork skills through different assessments, especially through the group design project.

Pre-requisites: CIVE 202, MECH 234, MECH 243

MECH 389 SYSTEM DESIGN **3.0: 3 cr. E**

This course, the first in a series of two (MECH 389 and MECH 390), provides mechanical engineering students with some applied practical experience in various design aspects of engineering. In a typical class, 12 to 15 students will start working together on a major system design project that has to be defined, discussed, and agreed upon at the beginning of the semester. They will conduct a literature survey on the subject, analyzing its components, and developing the materials necessary for its execution. The class will then be subdivided into small groups (3 to 4 students per group) with each group concentrating on a specific component of the global system. By the end of this course, the groups should be ready to integrate their acquired knowledge and their contributed parts into the global system in order to deliver the intended product and report on it by the end of the following semester under MECH 390 course.

Pre-requisites: GENG 221, GENG 222, MECH 290
Co-requisite: MECH 387

MECH 390 UNDERGRADUATE DESIGN PROJECT **0.3: 1 cr. E**

This course encompasses the Bachelor of Science degree project executed by a group of students, usually 3-4 in a group. It is a capstone project with a culminating design experience that is typically offered in the second semester of the senior year. The students apply an integrated knowledge from their program of study to design a system in order to meet a desired need. This course builds on the System Design course, MECH 389, and allows students the opportunity to execute their design. Student teams revisit and complete the Embodiment and the Detail Design phases of the Engineering Design Process. Students revisit as well identified codes and standards and apply such knowledge to the development of their design. Student teams produce a design solution subject to realistic constraints by taking into consideration public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. Mathematical formulation of the problem is developed as well as a simulation and or a physical prototype is developed. The team-design project is communicated to the public via three means: A Poster, a presentation, and a technical report.

Pre-requisite: MECH 389 or AERO 316
Co-requisite: LISP 200

MECH 410 MATERIAL CHARACTERIZATION LAB. **0.3: 1 cr. E**

This course introduces the theoretical and practical framework for different methods used in the characterization of engineering materials. The laboratory portion of this course offers intensive instruction in the most widely practiced light microscopy methods and associated sample preparation. Particular emphasis will be placed on Microstructure characterization: grain sizing, phase identification, fiber orientation and fractography: cracks, fracture type, loading.

Pre-requisites: MECH 222, MECH 325, CIVE 202

MECH 411 ADVANCED MECHANICS OF MATERIALS **3.0: 3 cr. E**

This course provides theories of stress and strains. Linear elastic general anisotropic, orthotropic and isotropic material behaviors. Formulation of elasticity and boundary conditions. Plane stress and plane strain. Navier equations. Calculus of variations and its application to elasticity. Energy formulation. Unsymmetrical bending and shear center. Torsion of beams of noncircular cross-sections. If time permits, beams on elastic foundations will be covered as well.

Pre-requisites: MECH 311, CIVE 202

MECH 412 MECHANICS OF COMPOSITE MATERIALS **3.0: 3 cr. E**

This course offers an introduction to composite materials, macromechanics of a lamina, 3-D constitutive equations, plane stress, lamina constitutive equations, thin plate theory, classical lamination theory, thermo-elastics lamination theory, failure analysis and design of laminate.

Pre-requisite: CIVE 202

MECH 413 INTERNAL COMBUSTION ENGINES **3.0: 3 cr. E**

This course provides the fundamentals of how the design and operation of spark-ignition engines affect their performance and fuel requirements. We will study fluid flow, thermodynamics, combustion, heat transfer and friction phenomena, and fuel properties, relevant to engine power, efficiency, and emissions. We will also examine the design features and operating characteristics of different types of engines: Spark-ignition and diesel engines.

Pre-requisite: MECH 232

MECH 414 PROCESS CONTROL SYSTEMS **3.0: 3 cr. E**

The course builds upon the foundation developed in previous course in Control System Theory. It covers advanced topics in analysis of process control systems such as Feedback control; Modeling and computer simulation of control systems; Discrete time models; Process control techniques; State Space methods applied to process control systems; Logic programming and devices.

MECH 415 TURBOMACHINERY **3.0: 3 cr. E**

This course covers fundamental principles of turbomachinery. The objective is to introduce students to several types of turbomachines. Basic concepts and performance of turbines (gas, steam, wind, and hydraulic), compressors, fans, and pumps are incorporated. Axial and radial turbomachines are covered. Students are expected to have solid background in fluid mechanics and thermodynamics.

Pre-requisite: MECH 324 or AERO 344

MECH 421 REFRIGERATION AND AIR CONDITIONING **3.0: 3 cr. E**

The course covers basic refrigeration cycles, psychrometrics and psychrometric processes, ventilating, U-values, heating and cooling loads, air-conditioning systems, ducts and pipe design.

Pre-requisite: MECH 321

MECH 422 MECHANICAL DESIGN II **3.0: 3 cr. E**

This course aims to develop working ability for analysis, synthesis, and design with various mechanical elements such as permanent and nonpermanent joints, springs, bearings, breaks, clutches, flywheels, belts, shafts and axles.

Pre-requisites: MECH 311, CIVE 202

MECH 423 ADVANCED MANUFACTURING PROCESSES **3.0: 3 cr. E**

This course teaches students different areas of manufacturing processes. It introduces students to Metal cutting, ASTM Standards, Surface finishing, Casting, Extrusion, Planning, Quality Control, Production and large volume manipulation. It also covers statistical techniques and decision-making. Students will develop professional and practical skills of different manufacturing and production areas to assist them in obtaining jobs.

Pre-requisite: MECH 323

MECH 425 MECHATRONICS **3.0: 3 cr. E**
This course introduces students to sensors and transducers, signal conditioning, measurement systems, pneumatic and hydraulic actuation systems, mechanical and electrical actuation systems, dynamic responses of systems, system transfer, frequency response, adaptive control, microprocessors, PLC, communication systems, fault finding.

MECH 426 PLUMBING ENGINEERING **3.0: 3 cr. E**
This course covers basic principles of plumbing engineering in buildings through water supply requirement, tanks, pumps, drainage and venting, rainwater systems, septic tanks, pits and submersible pumps, firefighting, and gas systems.

Pre-requisite: MECH 314

MECH 427 FACILITY PLANNING AND CONTROL **3.0: 3 cr. E**
This course offers students, knowledge that is required for the planning, construction and commissioning of production facilities. Apart from this amount of knowledge the project engineers have to feature a certain amount of character traits, the so-called “soft skills”. Furthermore, due to strong international competition the project engineers are under an enormous cost- and time pressure. This shows the importance of good facility planning. Furthermore, a company has only long-term survival chances if the product development times are minimized and quality control measures at every stage of product life cycle can be applied. This leads to the definition of relevant product-quality features and the specification of target values and tolerances. It is close to the process design and procurement. This is about the optimal design of production conditions and the selection of suitable precursors.

MECH 428 SPECIAL TOPICS IN THERMAL SCIENCES **3.0: 3 cr. E**
This course covers some of the topics of particular interest to the thermal engineer but not covered in other courses. The main focus of the course is combustion and multiphase flows. A number of practical applications are included and these range from analytical direct application to numerical modeling and computational exercises.

Pre-requisite: MECH 232
Co-requisite: MECH 511

MECH 450 ADVANCED ENGINEERING ANALYSIS FOR MECHANICAL ENGINEERS 3.0: 3 cr. E
This course covers the formulation of one-dimensional and multi-dimensional heat equation, equation of vibrating string, vibration of membrane, and the steady state heat equation. Analytical and numerical methods of solution are also discussed as well as the method of characteristics, self-similar techniques, method of separation of variables, and Eigenvalue and Eigen function expansion. It also provides an introduction to the Calculus of Variations and Euler equation with application to mechanical engineering problems (subject to time availability). In addition, it covers the introduction to research, research papers outline, methods of research, literature review, and research evaluation and critique.

Pre-requisite: MATH 230, MATH 202

MECH 480 FIELD TRAINING **0.0: 3 cr. E**
Prior to MS graduation, students are expected to undergo a two- to four-month training program at an institution whereby they get exposed and engaged in activities related to their field of studies, thereby gaining experience and demonstrating their skills.

MECH 511 COMPUTATIONAL FLUID DYNAMICS 3.0: 3 cr. E
This course offers an introduction to computational techniques theory in fluid mechanics and heat transfer. It also provides detailed tutorials for applying these techniques using a widely adopted commercial CFD package, FLUENT. Students should identify the various numerical schemes together with their properties and limitations and be capable of applying them in solving fundamental and real-life thermo-fluids problems.

Pre-requisite: MECH 314

MECH 512 SOLAR ENERGY 3.0: 3 cr. E
The course provides a brief overview and historical background about the development solar energy and related applications. It outlines the fundamental principles of solar energy, as well as thermodynamic analyses applied in solar energy field. It reviews the optics of solar radiations and covers the radiation characteristics of materials. As an application to the theory, the course covers flat and curved solar collectors, water heating using solar energy, and solar ponds.

Pre-requisite: MECH 232

MECH 513 ROBOTICS 3.0: 3 cr. E
The course deals with the basic components of robotics systems, kinematics for manipulators, selection of coordinate frames, homogeneous transformations, solutions to kinematics equations, lagrangian equations and manipulator dynamics, motion planning, position, velocity and force control, controller design, digital simulations.

Pre-requisite: MECH 221

MECH 514 FATIGUE AND FRACTURE MECHANICS DESIGN 3.0: 3 cr. E
This course focuses on the fundamental concepts and background required for fatigue and fracture mechanics principles applied to pressurized and un-pressurized structural components with and without cracks. Specific topics covered include: Quick review on the mechanics of deformable bodies, Material properties, Stress intensity calculation for fatigue evaluation, S-N traditional method, Stress life model, Strain life model, Linear Elastic Fracture Mechanics (LEFM) principles, Crack-tip stress intensity factor calculations and handbooks use, Crack growth models, The use of Finite Element analysis in fatigue life calculations.

Pre-requisite: CIVE 202

MECH 517 FINITE ELEMENT METHODS IN MECH. AND AERO. ENG. 3.0: 3 cr. E
This course offers finite element formulations in one, two and three dimensions in solids. Structural analysis, vibrations and heat transfer. Computer implementations and projects.

Pre-requisite: CIVE 202

MECH 521 MODERN THERMO-MECHANICAL TREATMENT PROCESSES 3.0: 3 cr. E
The ongoing trend towards lightweight components aims in the integration of elevated mechanical properties and geometries adapted to the load profile. [STE09]. Based on theoretical fundamentals of materials science, mechanics and production technology, the application of locally and temporally differential thermo-mechanical effects to initial homogeneous workpiece materials combines thermally-controlled material flow with functional grading of mechanical properties [SAB09]. This new approach is explained and deepened with examples from current research and development.

Pre-requisite: MECH 222

MECH 522 METAL FORMING TECHNOLOGIES **3.0: 3 cr. E**
Classification of forming processes, Material behavior, Related and logarithmic strain, Strain rate, Flow curves, Introduction into the calculation of forming processes.

Pre-requisite: MECH 521

MECH 523 FORMING MACHINES AND MATERIALS **3.0: 3 cr. E**
Classification of forming machines, Work-dependent forming machines, Path-dependent forming machines, Force-dependent forming machines, Industrial use of forming machines, Accuracy characteristics of forming machines, Workpiece materials, Tool materials, Materials characterization.

Pre-requisite: MECH 521

MECH 525 COMPOSITES PROCESSES AND APPLICATIONS **3.0: 3 cr. E**
This course introduces definitions and classifications for major types of composite structures, structure of the matrix, reinforcement forms, thermosets, thermoplastics, reinforcing agents, fibre forms, different processing techniques of polymer (open mould and closed mould processes), wet lay-up processes, bag moulding and curing processes, autoclave moulding process, transfer moulding, compression moulding, injection moulding, filament winding and pultrusion, machining and joining processes.

MECH 526 ADVANCED FLUID MECHANICS **3.0: 3 cr. E**
Analysis of important inviscid flows, Potential Flows, Stokes' Theorem, Circulation, Vorticity, Velocity Potentials and Stream Functions, Uniform Flows, Sources and Sinks, Vorticies and Doublets, Superposition, Lift and Drag over Cylinders, Transformations. Further Considerations of Viscous Flows, Boundary Layers in External and Bounded Flows and Subject to Pressure Gradients, Boundary Layer Separation and Separation Control. Advanced experimental Techniques in Flow Measurement.

Pre-requisite: MECH 243

MECH 527 INTRODUCTION TO CONTINUUM MECHANICS **3.0: 3 cr. E**
This course introduces tensor algebra and analysis with emphasis to second order tensors. Some fundamental theorems of vector calculus. Kinematics of motion. Balance equations of forces, mass, linear momentum, angular momentum, energy and entropy. Constitutive equations for linear and nonlinear isotropic and anisotropic materials.

Pre-requisite: CIVE 202

MECH 528 ADVANCED NUMERICAL ANALYSIS **3.0: 3 cr. E**
This course covers various numerical techniques for interpolation, integration, solution to systems of ordinary differential equations and introduction to solutions of partial differential equations, with emphasis on convergence, accuracy, and stability and formulation of high order methods.

Pre-requisite: MATH 230

MECH 529 THEORY OF PLATES AND SHELLS **3.0: 3 cr. E**
This course aims to offer theory of plates: Thin plate theory; shear deformation; small and large displacement theories; Von Karman theory; Reduced theory; buckling of thin plate; Thin shell theory: theory of surface; thin shell equations; bending; membrane.

Pre-requisite: CIVE 202

MECH 530 MULTI-RIGID BODY DYNAMICS I **3.0: 3 cr. E**

This course provides concepts of vector differentiation. Kinematics: angular velocity, angular acceleration, differentiation in various reference frames, generalized speeds, partial angular velocities, and partial velocities. Mass distribution. Generalized forces and generalized inertia forces.

Pre-requisite: MECH 221

MECH 531 MULTI-RIGID BODY DYNAMICS II **3.0: 3 cr. E**

This course introduces several energy functions: potential energy and contributing potential energy, dissipative functions, kinetic energy. Formulation of equations of motions: Dynamical equations and their linearization, systems at rest in a Newtonian reference frame and steady motion. Extraction of information from equations of motion: Energy integral and momentum integrals. Numerical integration of differential equations of motion.

Pre-requisite: MECH 530

MECH 532 THEORY OF ELASTICITY **3.0: 3 cr. E**

This course covers Three-dimensional stress and strain at a point; equations of elasticity in Cartesian and curvilinear coordinates; methods of formulation of equations for solution; plane stress and plane strain; energy formulation. Solutions to problems of interest in Cartesian and curvilinear coordinates.
Pre-requisite: CIVE 202

FACULTY OF ENGINEERING GENERAL COURSES

GENG 221 ENGINEERING ETHICS **3.0: 3 cr. E**

This course introduces and reinforces the concepts, theories, and practice of engineering ethics and aims at providing basic knowledge of ethics for engineers in different types of work roles. It prepares the engineering students for identifying, taking responsibility for, and finding solutions to potential ethical problems/cases. It provides students with an interactive study of ethical theory and the development of professionalism and helps them think more clearly and deeply about ethical issues of the natures that engineers often face in professional practice, and explore resources, strategies, and options for dealing with such complications. Students review case studies of ethical conflicts in engineering practice. The course also covers engineering codes of ethics and requires students to resolve theoretical situations through the application of ethical codes.

(A core BS course as of 2023/24 to replace a CSPR XXX course for students who started from year 2022/2023. Previous students can take it as an equivalent of a CSPR XXX course if they have not already taken the required 3 CSPR XXX courses)

Pre-requisite: CHEN/CIVE/ELCP/MECH/290 (according to discipline), ENGL 203

GENG 222 SUSTAINABLE DEVELOPMENT FOR ENGINEERS **3.0: 3 cr. E**

This course introduces the fundamental and advanced concepts of sustainable development. It transitions students' understanding of the UN Sustainable Development Goals (SDGs) to focus specifically on the critical role of engineers in achieving these SDGs. Students should then be able to resolve problems by adopting sustainability principles, which should in turn reflect on the students' multidisciplinary design ability to ensure a proper sustainable design process to improve and preserve the quality of life for future generations.

(A core BS course as of 2023/24 to replace a CSPR XXX course for students who started from year 2022/2023. Previous students can take it as an equivalent of a CSPR XXX course if they have not already taken the required 3 CSPR XXX courses)

Pre-requisite: CHEN/CIVE/ELCP/MECH/290 (according to discipline), ENGL 203

GENG 311 ENGINEERING MANAGEMENT AND ECONOMICS **3.0: 3 cr. E**

Engineers with excellent managerial skills and superior economic acumen are needed as leader of the new century engineering world. This course prepares engineers to fulfill their managerial responsibilities and acquire useful economic perspectives. This course is organized to contain two major parts: (I) Functions of engineering management, and (II) Economic fundamentals for engineering managers. Part (I) introduces the basic functions on engineering management such as planning, organizing, leading and controlling, while part (II) covers the fundamentals of engineering economics.

GENG 400 ENGINEERING SEMINARS **2.0: 1 cr. E**

This module consists of lectures and seminars covering recent research and advances in various fields and applications of engineering disciplines.

GENG 402 PROJECT MANAGEMENT **3.0: 3 cr. E**

To make available the fundamentals of project management with the most workable types of organizations and the necessary capabilities that must be included to reasonably ensure success and minimize the possibility of failure. The course consists of construction contracting for contractors, owners, and engineers: bidding, industry structure, types of contracts, and delivery systems of construction, planning, estimating, quantity take-off and pricing, labor and equipment estimate, proposal preparation, contract documents to prepare detailed estimates, permits, risk management, and taxes. Basic critical path planning and scheduling with activity on nodes and activity on arrows, monitoring, updating, controlling, crashing, resource leveling, resource allocation, and least cost scheduling including time-cost trade-off analysis. Computer applications using the Primavera software.

GENG 490 GRADUATION PROJECT **3.X: 3 cr. E**

An approved final design project.

Refer to General Listing of Course Descriptions for:

CHEM XXX
Refer to the Faculty of Arts and Sciences

CIVE XXX
Refer to the Department of Civil Engineering

CSIS XXX
Refer to the Faculty of Arts and Sciences

CSPR XXX
Refer to the Faculty of Arts and Sciences

ELEN XXX
Refer to the Department of Electrical Engineering

ENGL XXX
Refer to the Faculty of Arts and Sciences

ENMG XXX
Refer to the Department of Engineering Management

GENG XXX
Refer to the Faculty of Engineering Requirements

LISP XXX
Refer to the Faculty of Arts and Sciences

MATH XXX
Refer to the Faculty of Arts and Sciences

MGMT XXX
Refer to the Faculty of Business and Management

MRKT XXX
Refer to the Faculty of Business and Management