

# **COURSE DESCRIPTION**

## **APPLIED MECHANICAL ENGINEERING PROGRAM**

**KING SAUD UNIVERSITY- COLLEGE OF  
ENGINEERING- MUZAHMIA BRANCH**

### **DEGREE REQUIREMENTS**

**MAY, 2014**

## **COURSE DESCRIPTION**

### **MATH 140 - Introductory Mathematics**

**2(2-1-0)**

Basic Algebraic Operations, Equations and Inequalities, Graphs, Functions, Polynomials and Rational Functions, Exponential and Logarithmic Functions, Trigonometric Functions, Trigonometric Identities and Conditional Equations, Systems of Equations and Inequalities; Matrices, Sequences and Series.

Pre-requisites: *None*.

### **MATH 150 - Differential Calculus**

**3(3-1-0)**

Limits and Continuity: The Concept of Limit, Computation of Limits, Continuity and its Consequences, Limits Involving Infinity, Formal Definition of the Limit. Differentiation: The Concept of Derivative, Computation of Derivatives (The Power Rule, Higher Order Derivatives, and Acceleration), the Product and Quotient Rules, The Chain Rule, Derivatives of Exponential and Logarithmic Functions, Implicit Differentiation and Inverse Trigonometric Functions, the Mean Value Theorem. Applications of Differentiation: Indeterminate Forms and L'Hopital's rule, Maximum and Minimum Values, Increasing and Decreasing Functions, Concavity and the Second Derivative Test, Optimization, Related Rates.

Pre-requisites: *None*.

### **ENG 140 - English Language I**

**8(20-0-0)**

This initial stage of the course is designed to give the students a strong foundation in the language, improving their command of English as well as improving their vocabulary, reading, writing and communication skills. In the process of improving these skills, students will also develop their confidence in the language and also their presentation skills. These all contribute to the life skills of the student and help to prepare them for their future studies and careers beyond KSU. As the course progresses and students reach a higher level of English, the focus will switch to the academic side of the language. This will involve preparing students for the style of language they will need for their future studies.

Pre-requisites: *None*.

### **ENG 150 - English Language II**

**8(20-0-0)**

The final assessment for the course is the highly regarded International English Language Testing System (IELTS), which is used as a qualifying test for students wishing to attend university in many countries including the UK and Australia. Specialist material will be used to prepare students for this test with the aim of reaching an IELTS score of 5.0 by the end of the year.

Pre-requisites: *None*.

**IT 140 - Computer Skills**

**3(0-0-6)**

Basic Concepts of Information Technology, Using a computer and Managing Files, Word Processing, Spreadsheets, Databases, Presentation.

Pre-requisites: *None*.

**CHS 150 - Health & Fitness**

**1(1-1-0)**

Subjects about general health, body and brain fitness.

Pre-requisites: *None*.

**CUR 140 - Learning , Thinking and Research Skills**

**3(3-1-0)**

Learning skills: Self-management for learning, Learning tools, Reading strategies, Second language learning skills, Test administration. Thinking skills: Theory Of Inventive Problem Solving (TRIZ), Rounding Thinking, Expanding perception, Creative thinking. Research skills: Problem determining, Search for information strategies, Sites of sources, access this information, Using thin formation, Information construction, Information evaluation.

Pre-requisites: *None*.

**ENT 101 – Entrepreneurship**

**1(1-1-0)**

Subjects about fundamentals of entrepreneurship and its scientific applies, developing creative thinking, entrepreneur and analysis skills, developing thoughts and converting them to successful commercial projects, increasing of self-trust by speaking in business world language, skills for planning & organization to establish a commercial business, skills of teamwork administration and cooperation with colleagues.

Pre-requisites: *None*.

**COM 140 - Communication Skills**

**2(2-1-0)**

This course deals with communication skills as a tool for achieving personal psychological and social adaptability. It is one of the key skills in matrix of (self-development skills) this course covers skills related to communication sufficiency comprised of a wide array of major matrix of knowledge, skills and approaches comprised in four main sufficiency: Knowledge sufficiency, Social sufficiency, Comprehension sufficiency, Productive sufficiency.

Pre-requisites: *None*.

**IC I - Islamic Culture I** 2(2-0-0)

**IC II - Islamic Culture II** 2(2-0-0)

**IC III - Islamic Culture III** 2(2-0-0)

**IC IV - Islamic Culture IV** 2(2-0-0)

These courses aim to introduce the student to the Islamic culture; manifestation of the Muslims attitude towards other cultures; explaining the characteristics of Islam, such as: Universality, Comprehensibility, integrity, consistency with human nature (instinct), reason, and science. These courses also explain the Islamic tenet and its fundamentals, such as: To believe in Allah, the Hereafter, the Angles, the Holy Books, the Messengers, and Divine Destiny.

Each student is required to take one compulsory Islamic course and select 3 other courses (A total of 8 cr. hr.) from the Islamic Culture Courses pool provided by College of Education, department of Islamic Culture. Refer to section 2.2.2: (University Requirements).

Pre-requisite: *None*.

**MATH 1110 : Calculus for Engineers** 3(3-2-0)

Infinite series, convergence and divergence of infinite series, integral test, ratio test, root test and comparison test. Conditional convergence and absolute convergence, alternating series test. Power series, Taylor and Maclaurin series. Definite and indefinite integrals and the fundamental theorem of calculus. Double integral and its applications to area, volume, moments and centre of mass. Double integrals in polar coordinates. Triple integral in rectangular, cylindrical and spherical coordinates and applications to volume moment and center of mass. Vector fields, line integrals, surface integrals, Green's theorem, the divergence theorem, Stoke' theorem.

Pre-requisites: *MATH 140, MATH 150*

**MATH 1120 : Linear Algebra and Vector Analysis** 3(3-2-0)

Introduction of Linear Algebra. Matrices and their operations. Types of matrices. Elementary transformations. Determinants, elementary properties. Inverse of a matrix. Linear systems of equations. Methods for solving the system of linear equations. Vector Calculus and line and plane in space. Calculus of vector valued function. Notions of limit, continuity, differentiability and optimization of function of several variables. Functions in two or three variables, limits, continuity, partial derivatives, differentials, chain rule, directional derivatives, tangent planes and normal lines to surfaces. Eigen values and Eigen vectors. Laplace transforms.

Pre-requisites: *MATH 1110*

**MATH 1130 : Differential Equations****3(3-2-0)**

Various types of first order differential equations and their applications. Linear differential equations of higher order. Systems of linear differential equations with constant coefficients, reduction of order. Power series methods for solving second order differential equations with polynomial coefficients. Fourier series, Fourier series for even and odd functions. Complex Variables. Complex Fourier series. The Fourier Transform. Engineering Applications.

Pre-requisites: *MATH 1120*

**AGE 1150 : Engineering Probability and Statistics****3(3-1-0)**

Probability and probability distribution, Mathematical expectations of random variables. Discrete and continuous distributions. Sampling distributions, Estimation, testing of hypothesis, Regression and correlation. Distribution functions. Statistical Analysis. Statistical Design of Experiment. Engineering Applications.

Pre-requisites: *None*.

**PHYS 1210 : Physics for Engineers I****4(3-0-2)**

Review of kinematics, reference frames and relative motion. Newton's laws of motion, forces and fields. Work, energy and power. Oscillator motion. Electrostatics and Gauss' law. Magnetic fields and forces. Introduction to special relativity. Magnetostatics: magnetic fields and forces, Ampere's and Biot, Savart laws, Maxwell's equations, electromagnetic potentials. Electrostatics: Coulomb's law, electric field, Gauss's law, energy and potential, conductors, semiconductors and dielectrics, capacitance, Poisson's and Laplace's equations. Steady electric currents

Pre-requisites: *None*.

**PHYS 1220 : Physics for Engineers II****4(3-0-2)**

Quantum nature of light and matter. Schrodinger equation: one-dimensional potential problems. Elements of atomic structure; electron spin, exclusion principle. Plane and spherical wave propagation, phase and group velocity, wave equation in one, two and three dimensions. Introduction to sound waves. Fermat's principle, matrix optics, aberrations. Polarization. Interference and diffraction. Lasers, detectors, introduction to fiber optics.

Pre-requisites: *PHYS 1210*

**CHEM 1230 : Chemistry for Engineers****4(3 -0-2)**

Introduction to chemical and physical concepts, measurements and units, mole concept, chemical equation and quantitative equations, chemical bonding and molecular

geometry, gases and liquids (solutions), redox reaction, electro-chemistry, kinetics and equilibrium, acids and bases in solution (pH,  $K_w$ ), organic chemistry and polymers.

Pre-requisites: *None*.

**AGE 1310 : Basics of Engineering Drawing**

**3(1-0-4)**

Constructional geometry and basics of lettering; Sketching; Orthographic projection; Sectional and auxiliary views; Dimensioning; Introduction to computer graphics; Engineering applications.

Pre-requisites: *None*.

**AGE 1320 : Introduction to Manufacturing**

**2(1-1-2)**

Introduction to manufacturing; A morphological Process Model: Basic Structure and classification of Manufacturing Processes; Material, energy and information flow systems, examples of manufacturing processes: Mass conserving (forming), Mass reducing (machining) and mass addition (Joining and Assembly) processes; Workshop requirements, Basic industrial and workshop safety, Principles of basic bench work operations and workshop metrology; manufacturing materials; The classification and fundamentals of manufacturing systems; Workshops visits; Some practical experiments, measurements, assignments and manufacturing operations.

Pre-requisites: *None*.

**AGE 1510 : Technical Writing**

**2(2-1-0)**

Types of documents. Principles of organizing, developing and writing technical information. Report structure and components. Report forms and rhetorical patterns common to scientific and technical Disciplines. Technical writing conversions including headings, illustrations, style and tone. Extensive writing assignments for various report and document types.

Pre-requisites: *None*.

**MATH 2140 : Numerical Methods**

**3(3-2-0)**

Direct (Gauss-elimination and its variants) and iterative methods (Jacobi and Gauss-Seidel) for solving system of linear equations along with error estimate; System of nonlinear equations (Newton's method); Interpolation and Polynomial Approximations numerical differentiation. Numerical integration. Numerical solutions of differential equation. Engineering Applications

Pre-requisites: *MATH 1120, MATH 1130*

**AGE 2330 : Engineering Mechanics**

**3(3-1-0)**

Force systems; vector analysis, moments and couples in 2D and 3D. Equilibrium of force systems. Analysis of structures; plane trusses and frames. Distributed force system; centroids and composite bodies. Area moments of inertia. Analysis of beams. Friction. Kinematics of a particle: curvilinear motion, and relative motion; Kinematics of a rigid body in plane motion: relative velocity and acceleration, and rotating axes; Kinetics of particles: Newton's law, work and energy, impulse and momentum, and impact; Kinetics of a rigid body in plane motion: translation, fixed axis rotation, general motion, work and energy, and impulse and momentum.

Pre-requisites: *MATH 1110 and MATH 1120.*

### **AGE 2340 : Basics of Engineering Measurements**

**2(1-1-2)**

Measuring concepts; Engineering fundamentals: Engineering Problems and Fundamental Dimensions; System of Units and Unit Conversion: Types of instruments and measurands. Students T distribution; Errors in measurement; Uncertainty analysis of data; Evaluation of bias and precision uncertainty; Graphical presentation of data using Excel.; Analog and digital signals, Presentation of analog signals; Mean and RMS value of signals; Sampling of analog signals and associated errors; Digital signals; D/A and A/D converters. Analog and digital signal analysis; Data collection and analysis; Instrumentation specifications; Basic components of electrical and mechanical measurement system; Response of measurement system: Concept of order of measurement system; Time response of measurement system-Measurement of length; time; mass; force, electric current; temperature; energy and power. Laboratory experiments both on mechanical and electromechanical measuring systems. Emphasis is on measurement of uncertainty and calibration of sensors.

Pre-requisites: *AGE 1150.*

### **AGE 2410 : Computer Programming**

**3(2-1-2)**

Introduce the students to basic structures of computer and concepts of both procedural and object-oriented programming using programming language, provide them with basic techniques to formulate problems, and implement the solutions using programming language. Develop, write, test, and debug computer programs for solving engineering problems.

Pre-requisites: *None.*

### **AGE 2520 : Management Skills**

**2(2-1-0)**

This course is about essential business skills for engineering students. Students will be exposed to a wide range of topics including management essentials, solving problems analytically and creatively, communicating supportively, managing groups and teams, taking decisions, making oral and written presentations, negotiation skills and other skills.

Pre-requisites: *None*.

**AGE 3350 : Introduction to Design**

**1(1-1-0)**

Introduction to design process and phases. Enhancing on personal skills such as teamwork, leadership, written and oral presentation. Techniques for stimulation of ideas. Human factors in design. Searching, compiling, referencing and writing ethics. Guidelines for good written communication. Guidelines for slide preparation and good oral presentation. Delivering successful speeches. Writing memos and business letters. Introduction to academic and business proposals. Group dynamics, effective meetings, team-work, leadership and management skills. Engineering ethics and professional conduct. Intellectual property.

Pre-requisite: *AGE 1310*.

**AGE 4530 : Engineering Economy**

**2(2-1-0)**

Cost concepts. Time value of money operations. Measuring the worth of investments. Comparison of alternatives. Depreciation. Economic analysis of public projects.

Pre-requisites: *None*.

**AGE 4540 : Seminar**

**1(0-1-2)**

This course is to broaden and deepen students understanding of the different types of researches in the field of engineering. Also, to help students develop skills of analysis and criticism through training them in order to evaluate researches and design research plans. In this course a weekly seminar will be conducted by the different senior co-up graduation project teams as well as some invited speakers from industry. Student will widen his view of other engineering disciplines which has a positive impact in his future career where skills of working with teams of different specialties is a necessity.

Pre-requisites: *None*.

**AGE 4550 : Engineering Management**

**2(2-1-0)**

This course is an introductory course on project management. The course covers the project management process from the beginning to the end, focusing on practical skills that make students able to immediately complete projects on time and on budget, while achieving their targets.

Pre-requisites: *None*.

**AGE 4560 : Industry and Environment**

**2(2-1-0)**

This course focuses on drawing the attention of students on different aspects of environmental issues, legal aspects, and engineering solution. Hydrology and



hydrologic cycle; water and wastewater treatment are addressed. Air pollution, noise pollutions, industrial noise and radiation pollutions and their properties are well defined, explained and studied. Solid wastes, industrial wastes, hazardous wastes, and radioactive wastes and their management are identified and discussed. Eventually, site remediation, risk assessment, environmental regulations chapters are to be addressed as these topics have an important impact on students studying different engineering branches.

Pre-requisites: *None.*

**AME 2110 : Manufacturing Processes**

**4(3-1-2)**

Manufacturing: introduction, design for manufacture and assembly, basic manufacturing processes, roles of engineers in manufacturing, Metal Casting Processes and Equipment:, Solidification of metals, Expandable mold casting processes, Multiple-use-mold casting, melting and pouring, Metal forming processes: Bulk forming processes, Sheet forming processes, Machining processes: Conventional machining processes: Turning, Drilling, Milling, Grinding; Joining and assembly processes: Fusion welding processes, Solid state welding, adhesive bonding and mechanical fastening. Experiments and tests on, welding; casting; forming; and cutting.

Pre-requisites: *AME 2510*

Co-requisites: *AME 3320*

**AME 2210 : Mechanical Engineering Drawing**

**3(1-0-4)**

Auxiliary views; skew and inclined planes; Surface intersections; Developed views; Preferred numbers; Fits and tolerances; Machine components including fasteners and screws, gears, bearings , mechanical springs, etc.; Structural drawings; Assembly drawings; Graphical Interpretation of machine components and assemblies through the study of orthographic projection to include auxiliary views; section drawings and full dimensioning; translation of design instruction into detailed and assembly drawings; drawing conventions including weldments, piping, referencing and surface finish notation; selection of tolerances based on design requirements. Fundamentals of computer graphics and the use of Auto CAD computer drafting software.

Pre-requisites: *AGE 2310*

**AME 2310 : Mechanics of Materials I****3(3-1-0)**

Study of the mechanical behavior of solid bodies (Rods, shafts, beams, etc.) under various types of loading. Mechanical and thermal stresses and strains; Stress-strain relations; Axial deformation; Shear and bending moments in beams; Stresses in beams; Torsion of shafts, thin walled vessels; Combined loadings; Analysis of plane stress and plane strain; Stress and strain transformation.

Pre-requisites: *AGE 2330*.

**AME 2510 : Engineering Materials Science****4(3-1-2)**

Introduction to materials engineering; Atomic bonding; Structure and characteristics of metals; polymers and ceramics; Imperfections; Diffusion; Mechanical properties of metals, polymers, ceramics; Equilibrium-phase diagrams; Microstructures of alloys; Heat treatment of plain-carbon steels, cast irons and precipitation hardening. Experiments and tests on, heat treatment; mechanical properties; materials morphology and structure; and microscopy.

Pre-requisites: *PHYS 1220, CHEM 1230*

**AME 2710 : Engineering Thermodynamics****4(3-1-2)**

Basics concepts; Energy transfer; First law of thermodynamics; Second law of thermodynamics; Entropy; Carnot and reversed Carnot cycles; Rankin cycle; Vapor compression refrigeration cycle. Gas power cycles Availability; Ideal gas mixtures; Gas-vapor mixtures; Basics of Combustion;. Laboratory experiments concerning energy transfer, combustion, Basic vapor power Cycles. Working of gas turbine as a jet engine and a power plant.

Pre-requisites: *PHYS 1220*

Co-requisites: *AME 3810*

**AME 3010 : Mechanical Engineering Design****4(3-1-2)**

Design of Mechanical Elements: Screws and Fasteners; Joining Components and Methods; Springs; Gears: Spur, Helical; Shafts, Brakes and Clutches, Flexible elements; Rolling Element Bearings; Journal Bearings. Term project

Pre-requisites: *AME 3320*

**AME 3120 : Modern Production Management****3(3-1-0)**

Introduction to production and operation management. Decision making and production function. System concept. Analytical methods in production and operations managements. Capital costs and Investments; Waiting lines. Design of productive

systems; Process planning and layout of facilities; Job design and production standards and work measurements. Operation planning and control; Inventory, forecasting; scheduling and planning; Maintenance; Quality.

Pre-requisites: *AME 2110*

**AME 3320 : Mechanics of materials II**

**4(3-1-2)**

Introduction to design: design process, problem formulation, engineering model, factors of safety and codes, overall design considerations; Stresses: stress concentration factors, residual stresses; Deflection and Stiffness; Stability and Buckling; Theories of failure: failure under static loading, fatigue loading; fracture mechanics. Experiments and tests on, thin and thick cylinders; deflection; strain measuring gauges and applications; buckling; torsion, stress and strain measurements, materials testing and mechanical properties; and photoelasticity.

Pre-requisites: *AME 2310*

**AME 3330 : Mechanics of Machinery**

**4(3-1-2)**

Topological characteristics of planar mechanisms; Degree-of-freedom; Position, velocity and acceleration analysis of linkages: graphical and analytical methods; Static and dynamic force analysis of machinery: graphical and analytical methods; Flywheels; Cam mechanisms; Law of gearing; Simple and planetary gear trains; Labs; Gyroscopic motion; Balancing of Rotating masses; Gear train efficiency; Governors; etc, Term project.

Pre-requisites: *AGE 2330*.

**AME 3610 : System Dynamics and Control**

**4(3-1-2)**

Modeling of physical systems: mechanical, electrical, hydraulic, pneumatic, and thermal systems; Laplace Transformation; Transfer Functions and Block diagrams; Basic concepts of automatic control; Dynamic system response (time and frequency domains), and stability. Control systems design (P, PI, PD, PID controllers) Experiments and tests on system modeling; control of pneumatic systems, hydraulic systems, system response (1<sup>st</sup> and 2<sup>nd</sup> order systems), PID control for DC motor speed, Temperature and level control, etc.

Pre-requisites: *AGE 2330*

**AME 3720 : Heat Transfer**

**4(3-1-2)**

Steady and unsteady one and two-dimensional heat conduction; Numerical analysis of steady and unsteady conduction; Free and forced convection for external and internal flows; Heat exchangers; Properties and processes of radiation, radiation exchange

between surfaces. Laboratory experiments concerning different modes of heat transfer both as a single and combined mode involving air and water.

Pre-requisites: *AME 3810*

**AME 3810 : Fluid Mechanics**

**4(3-1-2)**

Dimensions and units; Fundamental concepts in fluids; Fluid statics; Control volume; Conservation of mass and momentum equations; Differential form of equations; Stream function and velocity potential; Euler's equations; Bernoulli's equation; Dimensional analysis and model studies; Internal incompressible viscous flow; External viscous flow. Laboratory experiments concerning basic principles of fluid motion and their application on forces on immersed bodies, free jets and flow in conduits.

Pre-requisites: *AME 2710*

**AME 4730 : Thermal-Fluid Systems**

**3(2-1-2)**

Design of piping systems; Performance and selection of pumps, compressors and fans; estimating heating and cooling loads in buildings; Selection of thermal-fluid system components. Laboratory experiments concerning piping systems, pumps and pump systems, Compressors and fans, Basic air conditioning processes and refrigeration.

Pre-requisites: *AME 3720*

**AME 4910: Cooperative Training (Part I):**

**0 credits**

This part starts typically during the summer session upon completion of 125 credit hours. In this part the student will spend the whole summer at a company in which his co-operative program will be performed. Based on his summer experience within the company and with the consultation of the industrial training advisor, he should develop a proposal about an engineering problem related to his major and the company requirements.

Pre-requisites: *Senior standing, Completion of 125 credit hours.*

**AME 4920: Cooperative Training (Part II):**

**9 credits**

Starts typically upon completion of the Summer Training (AME 4910), the student will hand-in his proposal at the beginning of the semester and after acquiring the program approval he will be assigned an academic advisor to follow up on his training progress with the cooperation of the industrial advisor. The student will spend the whole semester at the company. However, he is required to communicate regularly with his academic advisor to follow up on his training and project progress. In addition, the academic advisor will visit the student on site and he will be in close contact with his industry advisor. At the end of his co-op training, the student is required to submit a full professional technical report about his training experience and the engineering

skills and experience he has acquired. A public oral presentation by the student is required to be given in front of an examination committee that includes both advisors and other invited examiners and general audience and it is preferred to be given at the company site. The student's co-op final grade depends on his performance during training sessions, quality of work and report, presentation and the acquired engineering skills as well.

Pre-requisites: *AME 4910*.

### **AME 4930: Capstone Senior Design Project**

**3(1-0-4)**

Capstone Senior Design Project is a one-semester capstone experience in which senior students tackle engineering problems and attempt to formulate solutions. This project is a partnership program with industry that allows students working to solve actual problems encountered in industry. The project gives the students an opportunity to apply their skills in the real world and correlate their study with practical challenges. Towards the completion of the design project, students are allowed to work in teams or individually upon the obtaining of the program approval and their related academic and industrial supervisors. The major deliverable of the project is a comprehensive report that includes details of the background research, tasks, timelines, budget, preliminary feasibility studies, and project design steps. An oral presentation and poster demonstration are also required and will be evaluated by an examination committee to be chosen from industry experts as well as faculty members. The project grade reflects the student's ability to understand the engineering problem, formulate solution alternatives, identify the design constraints, and suggest a design proposal. Ethics in engineering practice and research, and professionalism are emphasized. Team design projects are highly encouraged.

Pre-requisites: *Senior standing, Completion of 125 credit hours*.

### **AME 3620 : Electrical Circuits and Machines**

**3(3-0-0)**

Circuit elements and laws, Thevenin and Norton equivalent circuits, voltage and current division, energy storage elements; circuit differential equations, AC circuits, sinusoidal sources and response of circuits to AC sources. Diodes, ideal diode and rectifiers, limiter, Zener diodes. Introduction to transistors and amplifiers, JFE transistor, bipolar junction transistor, integral circuits. Digital electronic circuits; diode gates, BJT switch and logic families. Introduction to digital logic circuits, sequential logic, hardware implementation of logic circuits. Introduction to machinery principles; Transformers: types and construction of transformers; Transformer ratings and related problems; DC machinery fundamentals: construction of DC machines, voltage and torque equations; DC generators: equivalent circuit, types. DC motors: equivalent circuit, DC motor starters; AC machine fundamentals; synchronous machines: construction, excitation, generator and motor operations; Induction motors: single and three-phase, and special purpose motors.

Pre-requisite: *PHYS 1220*.

**AME 4020 : Finite Element Method**

**3(2-0-2)**

Finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems. Finite element formulations for several important field equations are introduced using both direct and integral approaches. Finite element solutions to one- and two-dimensional mechanical engineering problems in solid mechanics, heat transfer, and vibrations; Galerkin's and variational finite element models; Commercial finite element analysis software ANSYS.

Pre-requisite: *AME 3010, AME 3720, AME 4920*.

**AME 4030 : Computer-Aided Design**

**3(3-1-0)**

Introduction to the use of the digital computer as a tool in engineering design and analysis of mechanical components and systems. Simulation of static, kinematic and dynamic behavior. Optimal synthesis. Computer generation of geometric models, calculation of design parameters, trade-off diagrams, and finite-element modeling and analysis. Structural component design using industry-standard software. Term projects.

Pre-requisite: *AME 3010, AME 4920*.

**AME 4040 : Conceptual Design**

**3(3-1-0)**

Systematic approach to design problems, morphology of design, feasibility study, preliminary design phase, detailed design phase, generation of ideas, evaluation of design concepts, use of computer techniques, designing for production, designing for ease of maintenance, assembly and detail drawings, reverse engineering. Term design projects.

Pre-requisite: *AME 3010, AME 4920*.

**AME 4050 : Materials Selection in Design**

**3(3-1-0)**

Classification of all engineering material; Materials properties; Performance indices; Materials selection charts; Performance indices with geometry factors; Case studies

Pre-requisite: *AME 3010, AME 4920*.

**AME 4130 : Metal Forming and Metal Cutting Analysis**

**3(3-1-0)**

Introduction: forming processes in industry, classification of forming processes, objectives of metal forming analysis. Yielding under combined stresses; Basic analytical methods; determination of flow patterns in metal forming; formability of sheet metals. Theory of metal cutting: mechanics of metal cutting, shear angle

relationships, theory of Ernst and Merchant; Temperature in metal cutting; Cutting tool geometry; Tool wear and tool life: types of wear, effects of cutting parameters, cutting fluids; Economics of metal cutting.

Pre-requisite: *AME 2110, AME 4920.*

**AME 4140 : Manufacturing Systems**

**3(3-1-0)**

NC machines, basic principles; Numerical control and industrial robotics; Group technology and flexible manufacturing systems; Production lines; Machining centers; High speed machining; Manufacturing engineering: Process planning; Problem solving and continuous improvement; Concurrent engineering design for manufacturability; Production planning and control; Quality control.

Pre-requisite: *AME 2110, AME 4920.*

**AME 4150 : CNC machines**

**3(3-1-0)**

Introduction to Computer Numerical Control Machining; Coordinates, Axes, and Motion, CNC Systems, CNC Controls, Operating a CNC Machine, Program Planning, Level-One Programming, Level-Two Programming, Setting Up a CNC Machine, Computer-Assisted Machining (CAM) Programming, Statistical Process Control (SPC), Computer Coordinate Measuring.

Pre-requisite: *AME 2110, AME 4920.*

**AME 4420 : Principles of Refrigeration**

**3(2-0-2)**

Vapor - compression refrigeration systems: standard cycle and its modification, compressors, condensers, evaporators, expansion devices, system analysis, multi-pressure systems; Absorption refrigeration systems: Lithium-Bromide system, cycle and improvements, combined systems; Aqua-Ammonia systems.

Pre-requisite: *AME 2710, AME 4920.*

**AME 4430 : Air Conditioning**

**3(3-1-0)**

Air conditioning systems; HVAC applications; Basic air conditioning processes; Indoor air quality; Heat transmission in buildings; Solar radiation; Load calculations; Pipes and ducts design; Air distribution; Equipment selection; HVAC control.

Pre-requisite: *AME 3720, AME 4920.*

**AME 4440 : Internal Combustion Engines**

**3(2-0-2)**

Air standard cycle approximation; Fuel air cycle analysis; Actual engine cycles; Engine friction; Detonation; Air capacity performance and supercharging; Performance tests for SI and CI engines.

Pre-requisite: *AME 2710, AME 4920.*

**AME 4520 : Introduction to Composite Materials**

**3(3-1-0)**

Stress and strain analysis of continuous fiber composite materials. Orthotropic elasticity, lamination theory, failure criterion, and design philosophies, as applied to structural polymeric composites.

Pre-requisite: *AME 3010, AME3720, AME 4920.*

**AME 4530 : Mechanical Behavior of Materials**

**3(3-1-0)**

Fundamentals of elastic, viscoelastic and plastic deformation of materials; the elementary theory of static and dynamic dislocations; fracture, fatigue, creep; strengthening mechanisms.

Pre-requisite: *AME 3010, AME 4920.*

**AME 4620 : Introduction to Mechatronics**

**3(2-1-2)**

Introduction to mechatronics systems; modeling of mixed mechatronics systems; microcontroller programming and interfacing; theory, selection and implementation of actuators commonly used in mechatronic systems (electrical motors, pneumatic and hydraulic actuators, solenoids, etc.); modeling, interfacing and signal conditioning of motion sensors (potentiometers, proximity probes, capacitive sensors, piezoelectric transducers, fiber optic sensors, photoelectric sensors, ultrasonic sensors, linear variable differential transformers (LVDT), digital sensors (optical encoders, magnetic encoders, tachometer); etc.; programmable logic controller (PLC); control architectures and case studies in mechatronics systems. Lab, students *are required to* have the low cost Mechatronics Student Kit to keep. Hands on practice on microcontrollers, data acquisition, pneumatic and hydraulic systems, PLC programming, mechatronics systems.

Pre-requisite: *AME 3330, AME 3610, AME 4920.*

**AME 4630 : Introduction to Robotics**

**3(3-1-0)**

Definitions, popular robots, history of technology, and future robots. Planar and spatial rigid body motion. Robot configurations, links, joints, geometry, and coordinates. Forward kinematics and inverse kinematics of planar, 3-R wrist, and 3D robots. Robot Jacobian, trajectory planning, statics and gripping, and dynamics and control.

Pre-requisite: *AME 3330, AME 3610, AME 4920.*



**AME 4750 : Renewable Energy****3(3-1-0)**

Solar radiation spectrum; Global distribution; Seasonal variation; Effect of tilt angle; Resource estimation; Flat plate collectors; Solar Concentrators Introduction to Photovoltaics; PV Cell Characteristics, Modules, Arrays and system types, Wind energy distribution, Wind power, Wind turbines, Wind farms and energy generation, Hydrogen: Energy generation, Hydrogen energy transfer; Fuel cells, Types of fuel cells, Hydropower, Ocean thermal energy conversion; Biomass; Geothermal energy, Tidal energy, Wave energy.

Pre-requisite: *AME 3720, AME 3810, AME 4920.*

**AME 4760 : Energy Conversion and Storage Systems****3(3-1-0)**

Analysis of thermo-mechanical, thermo-chemical, electrochemical, and photoelectric processes and technologies of renewable energy conversion and storage systems; on-shore and off-shore energy conversion; innovative energy storage devices; energy carriers, synthesized fuels, and fuel reforming. Emphasis is on advanced energy technologies, energy efficiency, systems performance, innovative grid connections, and minimizing environmental impacts

Pre-requisite: *AME 3720, AME 4920.*

**AME 4770 : Water Desalination****3(3-1-0)**

Fundamentals of water desalination; thermal methods of desalination: MSF, MED, Freezing, Vapor compression, humidification-dehumidification, solar still; Reverse Osmosis, Electro dialysis, Membrane evaporation desalination, Nanotechnology and desalination.

Pre-requisite: *AME 3720, AME 4920.*

**AME 4820 : Propulsion****3(2-0-2)**

Basic one-dimensional flow isentropic flow with area change, Construction details, working and performance characteristics of propellers, ramjets, turbojets, turbofans, turboprop jets. Performance analysis of inlets, exhaust nozzles, compressors, burners, and turbines. The thrust equation - Factors affecting thrust - Effect of pressure, velocity and temperature changes of air entering compressor - Methods of thrust augmentation. Performance characteristics of rockets engine. Liquid and solid propellant rocket motors. Performance of rocket flight, Single and multi-stage chemical rockets.

Pre-requisite: *AME 3810, AME 4920.*

**AME 4830 : Power Plants**

**3(3-1-0)**

Steam cycles; Reheat and Regenerations; Condensers; Cooling Towers; Steam Turbines and Turbine Governing; Steam Generators; Simple Gas Turbine Cycles; Combined and Cogeneration cycles; Power Plant Load Curves.

Pre-requisite: *AME 2710, AME 4920.*

**AME 4840 : Fluid Machinery**

**3(3-1-0)**

Fundamental equations of fluid flow; Euler equation of turbomachinery; Efficiency definitions of Turbomachines and their components; Axial-flow turbomachinery; Radial-flow turbomachinery; Hydraulic Turbines; Wind Turbines.

Pre-requisite: *AME 3810, AME 4920.*

**AME 4940 : Selected Topics in Mechanical Engineering I**

**3(2-1-2)**

These courses will be offered upon the request of some industrial needs and requirements and tailored to answer some of these practical industrial issues and could be offered jointly by the assistance from the industry experts. The applied and practical contents of these courses are highly encouraged.

Pre-requisites: *AME 4920 & Instructor and Program Approval.*

**AME 4950: Selected Topics in Mechanical Engineering II**

**3(2-1-2)**

These courses will be offered upon the request of some industrial needs and requirements and tailored to answer some of these practical industrial issues and could be offered jointly by the assistance from the industry experts. The applied and practical contents of these courses are highly encouraged.

Pre-requisites: *AME 4920 & Instructor and Program Approval.*