Courses Description

MILS 100: Military Sciences (3 Cr. Hrs.)

History of the Jordanian Arab Army. United Nations Peace Keeping Forces. Preparation of the nation for defense and liberation. History of the Hashemite Kingdom of Jordan and its development.

ARB 100: Arabic (3 Cr. Hrs.)

Grammar and structure. Rectifying weakness in linguistic application; training in sound reading. Dictation; use of language in a manner free from grammatical and linguistic errors; accurate expression of intended meaning. Study and analysis of literary texts through the discussion of linguistic, grammatical and writing skills therein.

ENGL 098: English I (Elementary English) (0 Cr. Hrs.)

Students will focus on English at an elementary level concentrating on the receptive skills of reading and listening, and the productive skills of writing and speaking. These will include such things as independent clauses, verb tenses, model verbs, adverbs, short dialogues, reading simple material and answering short questions, writing short meaningful sentences, listening to short conversations.

ENGL 099: English II (Pre-Intermediate English) (0 Cr. Hrs.)

Students will focus on English at a pre-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. These will include such things as comparatives and superlatives, quantifiers, possessive adjectives and pronouns, vocabulary building, role play activities for speaking, reading comprehension and writing short descriptive paragraphs.

ENGL 101: English III (Intermediate English) (1 Cr. Hr.)

Students will focus on English at an intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. These will include collocations, tense review, affirmative, negative statements, synonyms and antonyms, time clauses, conditionals, active and passive forms, reported speech, phrasal verbs, reading comprehension with detailed questions, vocabulary and writing developed descriptive and opinion essays.

ENGL 102: English IV (Upper-Intermediate English) (1 Cr. Hr.)

Students will focus on English at an upper-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. Model verb review, silent letters and proper pronunciation, jobs and careers, requests and offers, more phrasal verbs with vocabulary

building, relative clauses and relative pronouns, narrative tenses for writing exercises, wishes and regrets, reading and comprehending longer passages with direct and inference questions of medium difficulty, hypothesizing, and writing fully developed descriptive, argumentative and analytical essays of 350 words.

ENGL 201: English V (Advanced English I) (2 Cr. Hrs.)

Students will focus on English at an Advanced level. Students will analyze and produce 2 – 3 page essays with an emphasis on argumentation and persuasion working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Class activities include interactive lectures, small group and class discussions, informal debates, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using basic literary terms and concepts.

ENGL 202: English VI (Advanced English II) (2 Cr. Hrs.)

Students will continue to focus on English at an Advanced level. Students will analyze and produce 4 – 5 page essays emphasizing argumentative, persuasive and discursive styles of writing, working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Students will integrate the practice of critical thinking and reading into the writing process. Class activities include interactive lectures, small group and class discussions, informal debates, mini-conferences, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using stronger and more intensive literary terms and concepts than in 201.

GER 101: German I (2 Cr. Hrs.)

Can understand and use familiar, everyday expressions and very simple sentences, which aim at the satisfaction of specific needs. Can introduce oneself, and others, and ask others questions to themselves - e.g. where they live, which people they know or what kind of things they have - and can give answers on questions of this kind. Can communicate on a basic level if those involved with him/ her in a conversation speak slowly and clearly and are willing to help.

GER 102: German II (2 Cr. Hrs.)

Can understand sentences and frequently used expressions if those are connected with things of immediate meaning (e.g. information to the person and to the family, buying, work, closer environment). Can communicate in simple, routine situations, with the purpose of a simple and direct exchange of information about familiar and common things. Can describe with simple means their own origin and training, direct environment and things that are in connection with direct needs.

GER 201: German III (2 Cr. Hrs.)

Can understand the main points if no dialect is used and if it concerns familiar things about work, school, spare time etc. Can master most situations which one encounters on journeys in a German speaking area. Can express oneself simply and coherently about familiar topics and areas of personal interest. Can report experiences and events, describe dreams, hopes and goals and give short reasons or explanations about plans and opinions.

GER 202: German IV (2 Cr. Hrs.)

Can understand the main contents of complex texts, as well as concrete and abstract topics; even discussions between specialists in his/ her own special field. Can communicate spontaneously and fluidly a normal discussion with native speakers, without larger effort on both sides. Can express oneself clearly and in detail in a broad spectrum of topics, describe a point of view to a current question and indicate the pro and cons of different possibilities.

GER 301: German V (2 Cr. Hrs.)

Can understand and also seize implicit meanings of a broad spectrum of demanding, longer texts. Can express oneself spontaneously and fluidly, recognizing words without having to search for words frequently. Can use the language effectively and flexibly in social and vocational life or in training and study. Can express oneself clearly, structured and detailed, to complex subjects and use appropriate different means for linkage of texts.

GER 302: German VI (2 Cr. Hrs.)

Can understand and assimilate appropriately written and spoken texts, which are relevant in a university-referred context. Can implement appropriately writings and actions of speech, which are relevant in a university-referred context.

ENE211: Electrical Circuits I (3 Cr. Hrs)

Overview: SI units , voltage and current; Ohm's and Kirchhoff"s Laws, circuits with dependent sources; simple resistive circuits: series, parallel and delta to wye; Techniques of circuit analysis: nodal and mesh analyses, source transformation, Thevenin and Norton equivalents; Amplifiers; Inductance, capacitance and mutual inductance; Natural and step responses of RL and RC circuits; Natural and step response of series and parallel RLC circuits; Sinusoidal steady state analysis.

Prerequisite: PHYS102

ENE2110: Electrical Circuits Lab (1 Cr. Hrs)

Resistive circuits, Potentiometers, Superposition, Thevenin's theorem and maximum power transfer, RLC current and voltage characteristics, Frequency response of RL, RC and RLC circuits, Series and parallel resonant circuits, Amplifiers.

Prerequisite: ENE211

ENE212: Electrical Circuits II (3 Cr. Hrs)

Calculating average and reactive power, power in parallel loads, maximum power transfer. Analysis of 3-phase circuits: calculating wattmeter readings in 3-phase circuits. Introduction to Laplace Transform: poles and zeros, initial- and final value theorems. The Laplace Transform in circuit analysis. Active filter circuits. Fourier series. The Fourier Transform. Two-port circuits.
Prerequisite: ENE211

ENE213: Electronics (3 Cr. Hrs)

Introduction to (semiconductor) electronic devices. Semiconductor p-n junction, the transistor. Analysis and synthesis of linear and nonlinear electronic circuits containing diodes and transistors. Elementary analog circuit analysis. Fundamentals of transistors and voltage amplification. Characterization of MOS transistors for circuit simulation. Common-source amplifiers, MOSFET source-follower buffer stage, differential amplifier stage, and MOSFET current sources. Operational amplifiers. Development of a Basic CMOS Operational amplifier.

Prerequisite: ENE211

ENE 221: Thermodynamics (3 Cr. Hrs)

Properties and behavior of a pure substance, work and heat, first law and second law analysis of closed and open systems. Availability and Irreversibility. Vapor and air-standard power and refrigeration cycles. Thermodynamicrelations. Ideal and real mixtures and solutions. Chemical reactions, phase and chemical equilibrium.Prerequisite:

MATH202

ENE231: Introduction to Environmental and Energy Engineering (3 Cr. Hrs)

Application of scientific and engineering principles to an understanding of environmental issues associated with human activity. Mass and energy transfer, environmental chemistry, water and air pollution, pollutant transport modeling, pollution management, and risk assessment, and global atmospheric change. Introduction to the physical, chemical, and biological systems relating to the quality of water, land and air environments. Topics relating energy to environmental engineering will be addressed, these topics include carbon production, heat and energy transfer and thermal pollution. Prerequisite: CHEM101

ENE311: Electric Machines (3 Cr. Hrs)

Magnetic circuit. Transformers: construction and performance characteristics, three-phase connection, autotransformer. DC machines: construction, performance equations, characteristics, starting and speed control of motors. Three-phase induction motor: construction, operation, performance calculations, starting and speed control. Synchronous machines: construction, generator and motor operation and characteristics. Single-phase induction motors. Universal motors. Prerequisite: ENE211

ENE313: Electric Machines Lab (1 Cr. Hrs)

Transformers: characteristics, single-phase and three-phase. DC motors: speed and torque characteristics. Three-phase and single phase induction motors. Synchronous motors and generators. Universal motors.

Prerequisite: ENE311

ENE312: Power Electronics (3 Cr. Hrs)

Power semiconductor devices: types, drive circuits, protection circuits and power loss calculations. AC-DC converters: uncontrolled and fully controlled single-phase and three-phase rectifiers and half-controlled rectifiers. AC-AC converters: cycloconverters, ac voltage controllers. DC-AC inverters: single-phase and three-phase. DC-DC converters: step-down, step-up, and step-down/up converters.

Prerequisite: ENE213

ENE314 : Power Electronics Lab (1 Cr. Hrs)

Single-phase fully-controlled bridge rectifier with static and rotating loads. Single-phase half-controlled bridge rectifier. Three-phase controlled bridge rectifier. Single-phase ac voltage controller. Frequency converter. Single-phase bridge inverter with static and rotating loads. Three-phase bridge inverter. Step-down and step-up converter.

Prerequisite: ENE312

ENE315: Electrical Power Generation, Transmission & Distribution (3 Cr. Hrs)

Power generation, transformers, transmission and distribution line structures and equipment; transmission system planning; parameters and equivalent circuits in symmetrical components for overhead and underground lines; DC-Transmission lines; construction of substations, transmission and distribution power lines, sag and tension Analysis.

Prerequisite: ENE311

ENE321: Heat Transfer (3 Cr. Hrs)

Introductory course for Conduction, Convection and Radiation. In conduction, the course covers: steady state (1D and 2-D), Transient state. In convection, the course covers: Forced (external and internal), natural convection and heat exchangers. In radiation, the course covers: black body radiation, radiative properties, shape factors and gray surfaces radiation.

Prerequisite: ENE221

ENE3210: Thermal Science Lab (1 Cr. Hrs)

Experiments on thermo-fluid systems including: pipe flows, flow meters, hydrostatic forces, pump performance, jet forces, thermal conductivity, heat transfer coefficients, heat exchanger performance, air-conditioning processes, refrigeration cycles, boiling and condensation, and steam devices.

Prerequisite: ENE221, ENE321

ENE331: Fundamentals of Renewable Energy Systems (3 Cr. Hrs)

The module lays the foundation for theuse of renewable energy sources and provides anoverview of the potential of the environmentally friendlyuseof regenerativeenergysources.In particular,application-specific knowledge about solarradiation is provided. In particular theprimarycomponents for the conversionofnaturalenergy in form of solarradiationinto usefulforms of energy,such asheat,and electricalenergy are discussed. The content comprises the natural energyforms, the systematizationof energy conversionprinciples, solar radiation, solar energy, solar thermal and photovoltaic systems as well as theimportance of windand water power. The participants acquire the skillsand the basics to construct renewable energy systems.

Prerequisite: ENE221 , GER301

ENE341: Modern Control Systems (3 Cr. Hrs)

Basic definitions and concepts: Linear time –invariant systems, Open-loop and closed loop systems, feedback system. Transfer function and Laplace-Transform. Modeling and analysis of feedback system: Transient and steady state response impulse response, state – variable model. Discrete - Time system: Difference equations, z - transform, pulse transfer function, sampling interval, practical examples of control systems.

Prerequisite: ENE211, MATH202

ENE342: Instrumentation and Measurements (3 Cr. Hrs, 3 Lab)

Introduction to instrumentation in energy systems; Units, Dimensions and standards; Error measurements; Statistical analysis of experimental data; Op-Amp circuits in instrumentation; Basic electrical measurement and sensing devices: physics of electric, magnetic, chemical sensors displacements, area, pressure, flow, temperature, thermal and transport properties, force, torque and strain measurements. Smart sensors and networking of sensor systems. Data acquisition and processing.

Prerequisite: ENE211

ENE411: Electric Drives (2 Cr. Hrs)

DC motor drives using controlled AC-DC converters. DC motor drives using DC-DC converters. Frequency controlled Induction motor drives. Slip energy recovery. Synchronous motor drives using inverters and cycloconverters. Variable reluctance drives: switched reluctance and stepper motor drive.

Prerequisite: ENE311

ENE412: Electromagnetic Fields and Waves: (3 Cr. Hrs)

Review of Vector analysis and calculus, static electric and magnetic fields, capacitance and inductance. Maxwell's equations solutions, reflection and refraction of plane waves in dielectric and conducting media, transmission lines; transients and frequency domain solutions in loss and lossless lines, Smith chart and its applications, parallel plate and rectangular waveguides.

Prerequisite: ENE212

ENE414: Digital Electronics (3 Cr. Hrs)

Digital electronic topics include determining the logic voltage levels, speed and power of Bipolar Junction Transistor, BJT and Field Effect Transistor, FET logic circuits and latching circuits. Also covered will be analysis of BJT and FET ROM and RAM cells. Analog topics include input resistance, output resistance and voltage and current gain of single transistor amplifiers. Cascading and coupling of multiple transistors producing differential circuits, constant current sources and high gain amplifiers will also be discussed. The course will conclude with a discussion of feedback and stability of feedback amplifiers. Prerequisite: ENE213

ENE415: Power Systems (3 Cr. Hrs)

Over all introduction of power systems, load flow of power systems, Gauss Siedel and Newton Raphson methods to solve nonlinear algebraic power flow equations, symmetrical and unsymmetrical fault analysis, transient and dynamics power system stability, power control systems, Automatic Voltage Regulator (AVR) and Load Frequency Control (LFC).

Prerequisite: ENE315

ENE416: Communications Systems and Networking (3 Cr. Hrs)

The goal will be to study approaches that will enable secure, real-time, two-way communications across the numerous entities within the grid so that it can 1) heal itself; 2) operate efficiently; and 3) engage customers in its improved operation. Course discussion will focus on several types of networks: home networks, smart meters and Automated Meter Reading Infrastructure (AMRI), wireless mesh networks, sensor networks, metropolitan and wide area networks. The course will also cover related topics in the design and implementation of the Supervisory Control and Data Acquisition (SCADA) system and the IntelliGrid architecture, an open-standards and requirements-based approach for integrating data networks and equipment in smart grids. The course will address relevant overlaps with telecommunications technologies (e.g., Ethernet, G.hn, WiMAX, Wi-Fi, Zigbee, TCP/IP, etc.) and how these approaches may be used to enhance grid functionality and response.

Prerequisite: ENE415

ENE431: Energy Conversion (3 Cr. Hrs)

This course covers three aspects of energy: Energy resources, Energy Conversion and Development and environment. Energy Sources: Fossil fuels including, petroleum, coal, oil shale and tar sand, natural gas and hydrogen power. Renewable energy sources including: solar, wind, biomass, hydroelectric and geothermal. Energy Conversion: Conversion of thermal energy into electrical power including thermoelectric converters and fuel cells, thermoelectric systems, electric generators and alternators. Development and environment: implications for sustainable development: Technical, economic, ethical and philosophical aspects of sustainable development, Environment and sustainable development at urban, national and international levels.

Prerequisite: ENE221, ENE321

ENE432: Power Plants Engineering (3 Cr. Hrs)

This course will be divided in two parts: Power cycle review, thermal power plant and power market. Power cycle review covers: Vapor-cycles, gas turbine-cycles, and combined-cycles. Thermal power plant covers: components, selection and economics for Steam and gas turbine power plants which include: steam generators, condenser and condensate, feed-water heating systems which covers Fuel management and boiler automatic control systems, turbine plant, generator plant, turbine and generator control and protection systems, cooling water systems, steam and water cycle, power plant thermal performance and efficiency losses.power market covers: Alternative power generation technologies, electricity and gas networks and markets, climate change and energy markets.

Prerequisite: ENE431

ENE433: Solar Energy I (3 Cr. Hrs)

The course comprises principles and technologies of solar thermal energy. Students will acquire an overview of solar radiation, calculation of incident power on stationary and sun-tracking solar thermal collectors, and an overview of solar thermal technologies. The course will comprehend modeling the performance and the efficiency of solar thermal collectors including a synopsis of quality test methods of solar thermal collectors. Knowledge on design and sizing of solar thermal systems, especially solar water heating systems, will be obtained by students attending the course. Finally, the course will describe relevant engineering applications of solar thermal technologies such as solar space heating and cooling.

Prerequisite: ENE331, ENE431

ENE434: PV Technology (3 Cr. Hrs)

The characteristics of sunlight. Semiconductor and P-N junctions. The behavior of solar cells. Cell properties and design. PV cell interconnection and module fabrication. Stand-alone photovoltaic system components. Designing stand-alone photovoltaic systems. Specific purpose photovoltaic applications. Remote area supply systems. Grid-connected photovoltaic systems. Photovoltaic water pumping system components. PV water pumping system design.

Prerequisite: ENE331, ENE431

ENE435: Wind Energy Technology (3 Cr. Hrs)

Basic characteristics of wind. Site characterization. Statistical methods of wind analysis. wind resources assessment. Fundamental principles of wind turbines; horizontal axis (HAWT) and vertical axis (VAWT). Aerodynamics, mechanical and electrical design aspects of HAWT and VAWT. Performance analysis of wind turbines. Wind machine technologies.

Prerequisite: ENE331, ENE431

ENE4360: Renewable Energy Lab (3 Cr. Hrs)

Hands-on laboratory experiments in the area of sustainable energy. The fundamental principles required will be provided prior to laboratory experimentation. Topics covered include but are not limited to,

solar-thermal energy and photovoltaics, energy storage in batteries and ultra-capacitors, wind energy, ethanol production from corn and sugar and bio-diesel extraction from algae.

Prerequisite: ENE331, ENE431

ENE462: Applied Refrigeration (3 Cr. Hrs)

The vapor compression cycle. Alternative cycles: The absorption cycle, multiple effect cycles, ejector cycles, expansion cycles, electric and magnetic cycles. Refrigerants: the properties, refrigerant mixtures. Refrigeration system components.

Prerequisite: ENE321

ENE511: Special Electrical Machines (3 Cr. Hrs)

Linear electric machines: comparison with rotating machines. Linear induction motor: simplified electromagnetic field theory, force equation, characteristics. Superconducting ac generators and motors. Variable reluctance motors: performance and characteristics. Printed circuit motors.

Prerequisite: ENE311

ENE513: Power Systems Operation and Control (3 Cr. Hrs)

General characteristics of modern power systems, evolution of power systems, power system control. Equipment characteristics and modeling, excitation systems, DC-excitation system, AC excitation system, control of protective functions, modeling of excitation system. Prime mover and energy supply systems. Hydraulic turbine and governor systems. Steam turbine and governor systems. Wind turbine control. Control of active and reactive power; modern stability of power systems; linear and nonlinear systems.

Prerequisite: ENE415

ENE516: Smart-Grid Power Systems (3 Cr. Hrs)

This course presents a new concept in power systems, by integrating three areas of electrical engineering, (Power systems, Power electronics, and electric energy conversion systems). It addresses the fundamental design of renewable energy, such as wind and solar energies, and the integration to

electrical power grid via smart switching elements (DC-DC converter, DC-AC inverter, and AC-DC rectifier). In addition, the concept of involving intelligent control SCADA system in smart power grid will be presented.

Prerequisite: ENE416

ENE517: Power Systems Protection (3 Cr. Hrs)

Introduction and Review (Power system modeling, Symmetrical components, Three phase faults, Asymmetric faults, Fault transients, Transformer in-rush currents, Motor starting transients, Effects of grounding, High impedance faults), Relaying Instrumentation (Instrument transformers VTs and CTs, Characteristic of VTs and CTs), Protection Fundamentals (Overcurrent protection, Overvoltage / under voltage protection, Under frequency / over frequency protection, Zone distance protection, Differential protection, Pilot relaying, Computer relaying), Protective Relaying Applications (Generator protection, Motor protection, Transformer protection, Bus protection, Line production - network, radial Reactor and shunt capacitor protection).

Prerequisite: ENE415

ENE518: High Voltage Engineering: (3 Cr. Hrs)

Topics include introduction to high-voltage engineering; calculation methods of electric field strength, Discharge phenomena in gaseous, fluid and solid insulation materials, evaluation of onset and breakdown voltage of technical device, generation of high voltages (AC, DC, impulse, pulse); measurements of high voltages; destructive and nondestructive insulation test techniques; shielding and grounding; electric shock and safety.

Prerequisite: ENE315

ENE524: Geothermal and Hydropower Systems (3 Cr. Hrs)

Geothermal Systems: Geothermal Exploration Techniques, Drilling Techniques and Logging Methods, Reservoir Physics, Well Test Analysis, Monitoring & Forecasting, Direct and Indirect Use of Geothermal Resources, Visualization and Modeling Techniques, design, sizing, analysis and environmental impacts of geothermal systems (Geothermal Power Plants and its types and Heat pump systems. Hydropower systems: hydropower systems including pico, mini, small and large scale plants. General overview of types of hydropower plants, planning, assessment of hydropower resources, dam design, mechanical and electrical equipment, economic analysis of hydropower plant and the environmental impacts.

Prerequisite: ENE431

ENE 525: Fuel Cells and Hydrogen Production (3Cr. Hrs)

Overview of the various types of fuel cells followed by a detailed discussion of the proton-exchange membrane (PEM) fuel cell fundamentals: thermodynamic relations, kinetics, and overall design and performance characteristics of PEM fuel cells. Hydrogen production technology, hydrogen systems modeling, hydrogen applications, life-Cycle analysis methods, hydrogen production from hydrocarbons, hydrogen delivery and storage systems and safety.

Prerequisites: ENE431

ENE526: Bio-Energy Technology (3 Cr. Hrs)

Chemistry & Biochemistry of biomass, Biodiesel, Bio-Methane, Bio-Ethanol & Bio-Hydrogen, Bio-Energy Systems, Direct Biomass Combustion & Co-firing Technologies, Gasification & pyrolysis Technologies, Analysis and evaluation of the Biotechnologies and policies and future of Bio-fuels and Bio-Energy.

Prerequisite: ENE431

ENE527: Techno-economics of Energy Systems (3 Cr. Hrs)

This course will provide students with sufficient knowledge on technical and economic features of renewable energy systems. Furthermore, the feasibility of renewable energy systems will be introduced in depth. The economic competitiveness of renewable energy systems compared to conventional systems will be highlighted in the course mainly for utility scale electric generation systems. Moreover, students are required in this course to conduct term work to enhance their learning by using practical methods to define the systems' technological and economic feasibilities. Prerequisites: Economy, RE

ENE528: Energy Storage(3 Cr. Hrs)

Thermal and electric storage is crucial for the implementation of renewable energy technologies because of the fluctuating nature of the renewable energy resources. Energy storage allows better management for energy use from renewable energy systems, in which the available energy will be used only when required. The energy storage course will introduce renewable energy engineering students to the different energy storing technologies with emphasis on electrical and thermal energies storage. Furthermore, energy storage strategies for system optimization will be covered in this course.

Prerequisites:

ENE532: Low Carbon Buildings (3 Cr. Hrs)

The fundamentals of conventional energy sources used in buildings; renewable technology; policies and drivers that are leading to the more widespread uptake of low carbon building technologies; low carbon building codes, global policies and planning from the past, present and future. Integrated design: urban micro-climate design, passive architectural interventions, active interventions. Low carbon buildings design and operation.

Prerequisites: None

ENE5320: Energy lab (1 Cr. Hrs)

Experiments on energy production including: Gas Turbine Power System, Steam Turbine Lab, Ram Jet Engine, Internal Combustion Engine, Combustion Laboratory, Sterling Engine.

Prerequisite: ENE431

ENE533: Solar Energy II (3 Cr. Hrs)

The course will cover an introduction to solar radiation; solar incident power on sun-tracking collectors; Review of the basics of thermodynamics and heat transfer, Power plant Technologies; Types of CSP systems including CSP parabolic trough systems, CSP dish technology, CSP Fresnel technology and Solar tower; Heat storage systems; Hybridization; Secondary use of CSP systems; Operation and maintenance of CSP systems; Power quality control and grid integration; CSP plant project planning: economic, social and environmental considerations and site assessment.

ENE536: Energy Engineering Economics (3 Cr. Hrs)

The course covers the basics of economics and investment decisions. Topics such as time value of money, depreciation models, capital recovery and tax implications, rate of return, cash-flow development, project evaluation methods, risk analysis and break-even concepts are covered. Micro-economic topics such as demand and supply elasticity, utility functions, types of markets, and game models are also covered. Furthermore, the course shall discuss energy related environmental and regulatory issues.

Prerequisite: ENE331

ENE537: Energy Efficiency, Management and Law (3 Cr. Hrs)

Energy management principles; energy conservation; energy auditing; analysis; formulation of energy management options; economic evaluation, implementation & control; energy conservation techniques

– conservation in energy intensive industries; integrated resource planning; demand-side management; cogeneration; total energy schemes; thermal insulation; energy storage; economic evaluation of conservation technologies; analysis of typical applications. Energy law and regulation in Jordan and worldwide.

Prerequisite: ENE431

ENE541: Real Time Computer Control Systems (3 CH)

Introduction to digital control. Discrete system analysis. Difference equations. Discrete transfer functions, z-transform, discrete signal analysis. Controllers implemented in real-Time system ; PID control in discrete systems. Implementation of Direct Digital Control algorithms. Examples from industry. Implementation of the basic PID algorithm in real -time, Synchronization of the control loop, Timing Considerations in implementation of Control Loops. Hard and soft real-time systems, Real-time scheduling theory. Interfacing processes to real time computer (ADC and DAC), program controllers in real–time high level language Examples and Applications from Industry.

Prerequisite: ENE341

ENE542: Programmable Logic Controllers (3 Cr. Hrs)

PLC Control system components: the computer, the Microprocessor and the Microcontroller. Relay logic Diagrams. PLC Programming (Ladder diagram , high level Language) . Programming Logic Gate. Functions in PLC. PLC Timer Functions, Counter Functions, Math Functions, and Logic Functions. PLC Programming : Compare , Jump, Interrupt ,…..etc. Process Control. PLC Networks. PLC Applications and Case Studies.

Prerequisite: ENE414

ENE571: Modeling and Simulation of Energy Systems. (3Cr. Hrs)

Basic principles underlying piping, pumping and heat exchangers. Modeling techniques of system's Components. Simulation techniques of Systems.

This course introduces the basic deterministic optimization techniques which includes LaGrange multiplies, search method, linear and dynamic programming. These techniques are applied to energy-related problems. Moreover, Simulation techniques related to thermal and electrical systems are introduced. Design tools such as such as TRANSYS, EES, MathCad (Mathematics) are used in this course.

Prerequisite: CS111, MATH202

IE331: Operations Research (3 Cr. Hrs)

An introduction to operations research. Linear programming formulation, optimization using Simplex. Duality and sensitivity analysis, transportation models, networks, work scheduling, and introduction to integer programming.

Prerequisite: MATH 201

IE231 Numerical Methods for Engineers (3 Cr.Hrs)

Errors in computations. Roots of equation. System of linear algebraic equations including eigen values problems. Interpolations and curve fitting. Numerical integration and differentiation. Ordinary differential equations including boundary and initial value problems. Introduction to numerical solution of partial differential equation.

Prerequisite: MATH 201.

TME212: Statics (3 Cr. Hrs)

Vector mechanics of forces and moments, free-body diagrams, couples, resultants, equilibrium of particles and rigid bodies in two and three dimensions, forces in trusses, frames, and machines, centroids, centers of mass, distributed forces, internal shear forces and bending moments in beams, shear force and bending moment diagrams, friction, area of moments of inertia.

Prerequisites: MATH102, PHYS101

TME213: Mechanics of Materials (3 Cr. Hrs)

Normal and shear stress and strain, deflection of axially loaded members, thermal stress, torsion of bars with circular sections, shear stress, angle of twist, power transmission, bending of beams, bending and shear stress, combined loadings, beam deflection, column buckling.

Prerequisites: TME212 or ME211

TME215: Dynamics (3 Cr. Hrs)

Dynamics of particles, two- and three-dimensional dynamics of rigid bodies, moment of inertia, work and energy, impulse and momentum for rigid bodies.

Prerequisites: TME212

TME222: Fluid Mechanics (3 Cr. Hrs)

Physical properties of fluids and fundamental concepts in fluid mechanics, hydrostatics, conservation laws for mass, momentum and energy, flow similarity and dimensional analysis as applied to engineering problems in fluid mechanics, laminar and turbulent flow, engineering applications such as flow measurement flow in pipes and fluid forces on moving bodies.

Prerequisites: MATH102, PHY 106

TME323: Thermofluids Lab (1 Cr. Hrs)

Measurement of thermal conductivity, forced convection heat transfer, measurement of specific heat ratio, flow through nozzles, losses in pipes and fittings, hydrostatic pressure, impact of water jet, flow visualizations, performance of hydraulic positive displacement pumps.

Prerequisites: ENE321

TME522: HVAC (3 Cr. Hrs)

Psychrometric principles, thermal comfort, air conditioning processes, inside and outside design conditions, heating load calculations, infiltration, cooling load calculations, solar gain, design of heating and air conditioning systems, HVAC equipment and components.

Prerequisites: ENE321

TME527: Turbomachinery (3 Cr. Hrs)

Impulse and reaction turbines, velocity diagrams, energy equations and degree of reaction, total pressure correlation, turbine design, three dimensional analysis, free vortex design, estimation of stage and design point performance.

Prerequisites: TME222

MATH101: Calculus I (3 Cr. Hrs)

Review of functions: notation, operations,Limits and continuity, including trigonometric functions, Derivatives: rates of change and techniques of differentiation, including trig functions, Function composition, chain rule, and implicit differentiation, Applications of derivatives: related rates and optimization problems, Exponential and logarithmic functions — graphs, derivatives, and applications, Inverse trigonometric and hyperbolic functions — graphs, derivatives, and applications, L'Hôpital's rule, improper integrals, Techniques of integration — integration by parts, integration by partial fractions.

Prerequisites: MATH 099 (or Pass replacements test)

MATH102: Calculus II (3 Cr. Hrs)

Sequences and series, power series, convergence theorems: integral, ratio, and alternating-series tests, Polar coordinates and functions, integration and differentiation of polar functions, Vectors in three-dimensional space, spherical and cylindrical coordinates, Vector valued functions, Partial derivatives, Multiple integrals, Topics in vector calculus.

Prerequisites: MATH101

MATH201: Applied Mathematics for Engineers (3 Cr. Hrs)

Infinite Series; Infinite series of constant terms, Convergence tests, Power series and radius of convergence, Taylor and Laurent series. Linear Algebra; Vector analysis in Cartesian coordinates; Curvilinear coordinates and transformations to Cartesian, Spherical, and Cylindrical coordinates; Matrices and linear equations; Matrices and Linear Operators; Determinants, Eigenvalues and eigenvectors.

Complex Numbers and Complex Variable; Representation of complex numbers, DeMoivre's formula, Powers and roots of complex numbers, Functions of complex variable.
Prerequisites: MATH102

MATH202: Differential Equations(3 Cr. Hrs)

Ordinary differential equations' Sturm-Liouville theory, properties of Special Functions, Solution methods including Laplace transforms, Fourier series: eigenvalue problems and expansions in orthogonal functions. Partial differential equation: classification, separation of variables, solution by series and transform methods. Models in Applied Mathematics; Applications to illustrate typical problems and methods of applied mathematics in solid and fluid mechanics, fields of physics, deformation and vibration, wave phenomena, diffusion phenomena, heat conduction, chemical and nuclear reactors, and biological processes.Prerequisites: MATH102

MATH231: Probability and Statistics for Engineers(3 Cr. Hrs)

Probability, Discrete Distributions and their applications, Continuous Distributions and their applications, Estimation of parameters, Hypothesis testing, Regression, Quality control for engineers.

Prerequisites: MATH102

PHYS101: Physics I (3 Cr. Hrs)

Physics and measurement, Motion in one dimension, Vectors, Motion in two dimensions, Force and motion, Kinetic energy and work, Potential energy and conservation of energy, Linear momentum and collisions, Rotation, Rolling and angular momentum.

Prerequisites: None

PHYS102: Physics II(3 Cr. Hrs)

Electric Fields, Gauss's Law, Electric Potential, Capacitance and Dielectrics, Current and Resistance, Direct Current Circuits, Magnetic Fields, Sources of the Magnetic Field, and Faraday's Law.

Prerequisites: PHYS101

PHYS104: General Physics Lab (3 Cr. Hrs)

Developing a good understanding of a few important concepts in Mechanical physics, Learning to apply these concepts to familiar and unfamiliar situations and Gaining the ability to reason qualitatively and quantitatively about Mechanics.

Prerequisites: PHYS102

CS111: Computing Fundamentals (3 Cr. Hrs)

Basic computer skill; Programming concepts; algorithms: data types, arithmetic, logical, relational, Boolean, and assignment operators, simple input and output statements; programming control structures; data structures: single and multidimensional arrays; character strings; functions; pointers;

file structures and representation; 3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered in the course using Gnu C compiler on a Solaris/Sun environment.

Prerequisites: None

ME 111 Engineering Drawing (3 Cr. Hrs)

The Use of computer aided software in drawing such as AutoCAD. Geometric constructions. Orthographic and Isometric projections; Sketching, sectioning, dimensioning and layering. Model layout (wire-frame, surface, and solid modeling), plotting to scale, blocks and attributes, Introduction to descriptive geometry, perspective drawing. Engineering applications.

Prerequisites: CS111

IE 121 Engineering Workshop (1 Cr. Hrs)

General safety, materials and their classifications, measuring devices and their accuracy, basic household plumbing and electricity, fits and tolerances, theoretical background for the practical exercises including fitting, forging, carpentry, casting, welding, mechanical saws, shearers, drills, lathes, milling machines, shapers and grinders.

Prerequisites: ME111

CHEM 101. General Chemistry (3Cr. Hrs)

Stoichiometry of formulas and equations. Gases and the kinetic-molecular theory. Quantum theory and atomic structure. The components of matter. The major classes of chemical reactions (precipitation, acid-base, oxidation-reduction, and reversible reactions). Thermodynamics: energy flow and chemical change. Quantum theory and atomic structure. Electron configurations and chemical periodicity. Kinetics: rates and mechanisms of chemical reactions. Equilibrium: The extent of chemical reactions. Acid-base equilibria.

Prerequisites: None.

ENE544.Thermal and Hydrodynamic equipment's (3Cr. Hrs)

This course introduce all Thermal and Hydrodynamic equipment'sthat includes but not limited to the design and selection of the flowing items: boilers, heat exchangers, piping system and fitting, burners, pumps,…etc. that includes the operation and maintenance for these equipment …etc.

Prerequisites: ENE322.

TME 215: Dynamics (3 Cr. Hrs)

Dynamics of particles, two- and three-dimensional dynamics of rigid bodies, moment of inertia, work and energy, impulse and momentum for rigid bodies.

Prerequisites: TME212.

TME 216: Vibrations. (3 Cr. Hrs)

Properties of oscillatory motion. Derivation of governing differential equations. Free and damped vibrations. Harmonically excited motion, rotating and reciprocating unbalance, support motion. Vibration measurements. Vibration isolation. Transient vibrations. Free and forced vibrations in multi-degrees-of-freedom systems. Vibration absorbers. Continuous systems.

Prerequisites: TME 215.