University of Derna

Master's Program – Faculty of Engineering

CATEGORY A - GENERAL COURSES

GME 600 Advanced Numerical Methods

Review of error and approximation theory, interpolation and polynomial approximation, iterative methods for solving linear systems: Jacobi and Gauss-Seidel methods, and multiple regression. Advanced numerical methods for solving parabolic, elliptic, and hyperbolic partial differential equations; convergence and stability criteria; grid generation; special mesh systems and orthogonal coordinate systems; computer applications.

GME 601 Research Methodology

Writing a proposal, the purposes of literature review, using library resources, working with others, Errors and uncertainty, collection and presentation of data, experimental design, communication of research findings, protecting and exploiting research.

GME 602 Instrumentation and Measurement Techniques

General measurement systems: specifications of instruments, their static and dynamic characteristics, Transducers: sensing elements and measurements: Resistance type - potentiometer, strain gauge; Temperature sensing elements – RTD, thermistor, thermocouple, semiconductor IC sensors; Pressure sensing elements – manometers, elastic elements, Bourdon tube, diaphragm, bellows, electrical type, McLeod gauge, Pirani gauge; Flow sensing type – head meters (orifice, venturi), area meters, rotameters, electromagnetic flowmeter, Coriolis flow meter, Ultrasonic flowmeter.

GME 603 Advanced Engineering Mathematics

An introduction to the use of mathematical analysis techniques for the solution of engineering analysis problems and the simulation of engineering systems. Both continuous and discrete methods are covered. Initial and boundary value problems for ordinary and partial differential equations are treated.

GME 604 Advanced Engineering Statistics

Topics cover advanced statistical tools for engineering that analyze multivariate statistical data. Those include Factor and Component Analysis, Stepwise Regression models and diagnosis, Discriminant and Logistic Regression, MANOVA, Canonical and Conjoint Analysis, Cluster Analysis, Time-series and Non-parametric Statistics. Imminent use of computer packages with applications

CATEGORY B – CORE COURSES

MEP 605 Advanced Thermodynamics

Availability Analysis of Cycle, Mixtures and Solutions, Equilibrium of Multiphase-Multicomponent Systems, Chemical Availability, An Introduction to Thermo-Economic Optimization, Kinetic Theory of Gases and Transport Phenomena, Statistical Thermodynamics, Applications of Statistical Thermodynamics.

MEP 606 Convective Mass and Heat Transfer

Principles of convection. Analysis of heat transfer for internal and external flows; laminar and turbulent boundary layer theories; forced and natural convection. Analysis using similarity transformations, integral solutions and numerical methods.

MEP 607 Advanced Fluid Dynamics

Boundary layer phenomena, Fundamentals of incompressible flow, Kinematic and dynamic equations for compressible viscous flow, Incompressible flow cricriteria, viscous flow patterns and solution methods. Fundamentals of turbulence, including scaling, transport, and kinetic energy of turbulence; wakes, jets; wall-bounded flows; spectrum of turbulence. Dynamics of vorticity, inviscid flow; boundary layer theory and computational techniques. Dynamical equations, structure of time-averaged flows, two-equation and Reynolds stress closure models, Flow computation. Classical solution techniques for compressible laminar and turbulent boundary layers, computational methods for inviscid and viscous flows.

CATEGORY C - ELECTIVE COURSES

MEP 608 Internal Combustion Engineering

Engine performance characteristics, performance indices; idealised thermodynamic cycles and the limits to ideal behaviour; thermo-fluid implications of maximising power output using high engine speeds. Maximising air/fuel charge, intake and exhaust system design, supercharging and turbocharging; fuel systems, combustion control and engine management systems.

MEP 609 Conduction Heat Transfer

Principles of conduction. Analysis of one-dimensional and multidimensional steady and transient, phase change and moving heat source problems are examined. A comprehensive treatment of numerical and analytical methods for solving heat conduction problems is presented.

MEP 610 Control Volume Method

Formulation and implementation of control volume based on finite difference method for the solution of convection-diffusion problems. Discussion of different interpolating schemes such as Upwind Scheme; Exponential Scheme; Hybrid Scheme and Power-Law Scheme. Generalized formulation and flow field calculation.

MEP 611 Radiation Heat Transfer

Introduction to thermal radiation; the electromagnetic spectrum; the black body; wave phenomena versus geometric optics; polarization; diffraction and refraction effects; emission; reflection; absorption, and transmission of thermal radiation by surfaces; radiant interchange among surfaces; radiation through a participating medium; the Monte Carlo ray trace method.

MEP 612 – Advanced Gas Dynamics

Control volume analysis, conservation of mass, conservation of energy, pressure energy equation, sonic velocity, equations for perfect gas in terms of Mach number, varying area adiabatic flow, perfect gas with losses, nozzle operation, diffusers operation, normal shock waves, shocks in nozzles, oblique shock waves, oblique tables and charts, Prandtl Meyer flow, analysis of Prandtl Meyer flow, Fanno flow, reference state and fanno tables applications, friction shocking, Rayliegh flow applications, correlation with shocks, propulsion engines, thrust, power and efficiency.

MEP 613 Applied Finite Elements

Formulation and computer implementation of finite elements models of typical equations of fluid flow, heat transfer, and solid mechanics, the problems considered include heat conduction and convection, torsion, ground water flow, electrostatic and magnetism, plane elasticity, flow of viscous incompressible fluid, and plane bending. Both theoretical development and computer program development are studied.

MEP 614 Refrigeration and HVAC System Design

Analysis, design, performance prediction of vapor-compression and absorption refrigeration components and systems; applications to heat pumps and cryogenic. Computer analysis and design of air conditioning systems for commercial and industrial buildings, including component and equipment selection. Energy – efficient concepts and controls are emphasized.

MEP 615 Renewable Energy Systems

Solar radiation intensity and location; basic concepts of solar thermal process; collectors; applications for water heating; active and passive building heating and cooling; industrial processes. Wind energy fundamentals. Aerodynamic theory of propellers and windmills. Optimal blade design and economics.

MEP 616 Principles of Desalination

Theory and methods of separation, topics include conventional and non-conventional desalination techniques. Detailed analysis and description of basic distillation and freezing processes, major components and systems, plant installation and factors in plant economics.

MEP 617 Advanced Gas Turbine Cycles

Brief review of power generation thermodynamics, reversibility and availability, basic gas turbine cycles, cycle efficiency with turbine cooling, full calculation of plant efficiency, wet gas turbine plants, the combined cycle gas turbine (CCGT), Novell gas turbine cycles, the gas turbine as a cogeneration (combined heat and power) plant.

MEP 618 Advanced Air Conditioning

General consideration in air conditioning design; Comfort indices; Effective temperature; Comfort chart; Control of indoor air quality; Central air conditioning; Unitary and door systems; Automobile and train car air conditioning; Heat pumps; Different types of heat pumps; Comparison of various heating systems; The year round air conditioning; Air and water systems; All water systems; Heating and cooling load calculations;

Pumps and piping design; Room air distribution; Noise control; fan selection and installation; Duct design, Vanes and dampers; Passive conditioning.

MEP 619 Principles of Hydraulic Machines and System Design

Principle of operation of hydraulic machines, Radial and axial flow pumps, Cavitation in radial flow pump, Radial flow pump operational issues, Pump Design: Degrees of reaction, Pump characteristics and system design, Numerical problems of pumps (Radial and Axial flow), Positive displacement pump, Hydraulic Turbine: Impulse Turbine, Hydraulic Turbine: Reaction Turbine, Cavitation in hydraulic reaction turbines, Numerical problems of Turbines (Impulse and Reaction).

MEP 620 Solar Thermal Processes

Solar Ray Geometry: Solar-earth geometric relations, Apparent solar path diagram, Shadow determination. Solar Radiation: Solar extraterrestrial & terrestrial irradiation, Insolation on tilted surfaces. Solar Energy Collectors: Flat-plate solar energy collectors, Thermal analysis of flat-plate collectors, Concentrating collectors, Thermal analysis of concentrating collectors, Central receiver-heliostat systems. Heating Processes: Service water heating, Space heating, Performance and design of heating systems using f-chart and utilizability methods, Cooling Processes: Vapour-compression and absorption refrigeration systems, Solar operated absorption systems, Performance of solar absorption air-conditioning systems.

MEP 621 Photovoltaic Solar Cells

The course focuses on the physical principles, technology, and design of efficient semiconductor photovoltaic. Course goals equip students with the concepts and analytical skills to understand efficiency limitations, to assess the viability of various solar and thermo-photovoltaic technologies, and to introduce the physics required for understanding photovoltaic energy conversion. The course will focus on three primary aspects of photovoltaic energy conversion, (i) the transfer and conversion of solar (i.e. thermal) radiation to electronic energy, (ii) the theory and design of the semiconductor photovoltaic cell and (iii) photovoltaic systems and applications

MEP 622 Wind Energy

Wind Speed and Energy Distributions: Speed and power relations, Power extracted from the wind, Rotor swept area, Air density, Wind speed distribution, Wind speed prediction, Wind resource maps. Propeller-Type Converters: Theory of non-interacting stream-tubes, Model behaviour of power output and matching to load, Non-uniform wind velocity, Restoration of wind profile in wake, and implications for turbine arrays. Wind Power System: System components, Turbine rating, Electrical load matching, Variable-speed operation, System design features, Maximum power operation, System control requirements, Environmental aspects, Wind farm sizing.

MEP 623 Passive Solar Heating and Cooling

Passive Solar Systems: Direct gain, Indirect gain. Design Patterns: Building location, Building shape and orientation, Location of indoor spaces, Protected entrance, Window location, Overhang shading, Choosing the system, Appropriate materials. Direct Gain: Solar windows, Collectors and skylights, Performance and design of direct gain systems, Masonry heat storage, Interior water wall. Thermal Storage Wall Systems: Performance and design of absorber storage (Trombe) wall systems, Wall details, Convection loops. Attached Greenhouse Systems: Sizing the greenhouse, Greenhouse connection. Roof Pond Systems: Sizing the roof pond, Roof pond details.

MEP 624 Seawater Thermal Desalination

Fundamentals: Heat transfer surface and performance ratio, Boiling point elevation, Pressure drop losses, Hydrostatic head effects, Flash range. Multi-stage Flash Distillation: The submerged coil evaporator, Multi-stage flash principles, Stage number effect, Flash plant layout and components. Multiple Effect Distillation: VTE multiple effect distillation, Analysis of multiple effect distillation, Fluted tubes, Horizontal tube evaporator, Multiple-effect plant layout and operation. Other Methods of Distillation: Vapour compression distillation, Vapour reheat distillation, Freezing methods. Combined Power and Water Production: Combination plants, Cost allocation

MEP 625 Heat Exchangers Analysis and Design

Heat Exchangers Classification, Heat exchanger design methodology, Double Pipe Heat Exchangers, Shell and tube type heat exchanger, Condensers and evaporators, Compact heat exchangers, Mechanical Design, Testing, Maintenance, Simulation and Optimization.

WDE 626 Corrosion and Materials Selection

Fundamental properties of materials, functional properties of materials, structural properties of materials, surfaces and interfaces, steels, light metals, structural properties of polymers, processibility of polymers, composites, corrosion, material selection.

ME 627 Energy Management and Efficiency

Introduction, energy auditing, economic analysis, waste heat recovery, building envelop, HVAC systems, energy management control systems, energy system maintenance, insulations, use of alternative energy, indoor air quality, thermal energy storage, codes, standards and legislation, energy security and reliability, financing energy management projects, measurement and verification of energy savings, sustainability and high performance green buildings.

MEP 628 Exergy Analysis of Thermal Systems

Introduction to thermodynamics: Basic concepts of energy analysis of thermal systems. Basic exergy concepts: Classification of forms of exergy, concepts of exergy, exergy concepts for control volume, physical exergy, exergy concepts for closed systems analysis, non flow analysis

Elements of Plant Analysis: Control volume analysis, criterion for performance, pictorial representation of exergy balance, exergy based property diagram. Exergy Analysis in Process: Expansion process, compression process, heat transfer process, mixing process, separation process, and combustion processes. Energy and Exergy Analysis of gas turbine, steam power plant, captive power plant, combined cycle power plant, refrigeration plant, heat exchanger.

MEP 629 Advanced Automatic Control

Review of linear control systems; Compensation techniques; Nonlinear control systems; Phase-plane analysis of nonlinear control systems; Stability analysis of nonlinear systems; Optimal and adaptive control of control systems.

MEP 630 Theory of Mechanical Vibrations

Vibration of two and multi-degree of freedom systems; Energy and numerical methods in mechanical vibration analysis; Vibration of continuous systems.

MEP 631 Special Topics

Study selected subjects related to renewable energy and/or water desalination with emphasis placed on power plant developments in the field: permission of department is required.

MEP 632 M. Sc. Project

After completing all course work (or at least the core courses), each student commences with a thesis project on which he/she typically works over a maximum period of 12 months (maybe longer depending on the student's activity). Provided that a thesis project deals with a clearly defined topic from the domain of mechanical engineering/renewable energy engineering/water desalination, and under the condition that competent guidance/supervision is available to the student throughout the thesis project period, the project may be carried out either in Derna University or in a Research Center or in an industrial environment. However, if the Thesis project is to be carried out outside Derna University, special agreement and written permission from the department and the School of Engineering and Applied Sciences must be obtained.