TECHNICAL ELECTIVE COURSES

ME-423 RENEWABLE ENERGY RESOURCES
(3,0)

Specific Objectives:
- To understand exploration of various energy sources.
- To understand the concepts of energy conversion systems
- To implement the ways of energy conservation and management.

Course Outline:

Introduction to types of renewable energy, solar energy, tidal wave and geothermal energy, biomass energy, fuel cell and heat pump systems, energy efficiency issues and energy storage, potential of using renewable energy resources as supplement of conventional energy resources.
Renewable and non-renewable energies used as hybrid energy systems, modern renewable energy plants.
Wind energy, wind turbine design specifications, compatible electric generators and major operational, wind mills design usage for pumping water.
Biomass energy conversion methods, detailed description of synthetic gas, biodiesel, biomass and biogas, operational and maintenance problems and their remedies.

Recommended Books:
1. Renewable Energy, By Godfrey Boyle, Oxford University Press
3. Renewable Energy Conversion, Transmission and Storage, By Bent Sorensen
ME-412 TRIBOLOGY (3,0)

Specific Objectives:

- To understand the tribological systems:
- To design the interfaces between two or more bodies in relative motion.

Course Outline:

Fundamental topics include: geometric, chemical, and physical characterization of surfaces; friction and wear mechanisms for metals, polymers, and ceramics, including abrasive wear, delamination theory, tool wear, erosive wear, wear of polymers and composites; and boundary lubrication and solid-film lubrication. The course also considers the relationship between nano-tribology and macro-tribology, rolling contacts, tribological problems in magnetic recording and electrical contacts, and monitoring and diagnosis of friction and wear. Case studies are used to illustrate key points.

Recommended Books:

ME-413 MAINTENANCE ENGINEERING (3,0)

Specific Objectives:

- To understand the significance of maintenance engineering.
- To understand the concepts of maintenance engineering.
- To implement the ways of maintenance engineering.

Course Outline:

Introductory management aspects concerning engineering maintenance, Maintenance and control, Preventive maintenance (PM), Various aspects of corrective maintenance (CM) maintenance processes, Modern system life cycle. Reliability-centered maintenance, Quality maintenance.

Recommended Books:
ME-424 COMPUTATIONAL FLUID DYNAMICS (2,1)

Specific Objectives:

- Computational Fluid Dynamics Course provides an introduction to the methods and analysis techniques used in computational solutions of fluid mechanics and heat transfer problems.
- This course introduces the students to the finite difference and finite volume method as a means of solving different type of differential equations that arise in fluid dynamics.

Course Outline:


Recommended Books:

2. J. D. Anderson, Jr., Computational Fluid Dynamics: The Basic with Applications, McGraw-Hill.

ME-425 GAS DYNAMICS (3,0)

Specific Objectives:

- To understand the application of mechanics and thermodynamics to a variety of compressible fluid problems, both practical and theoretical.
- Emphasis is placed on understanding physical mechanisms and the use of computer simulations to understand unsteady compressible flows and pressure waves in fluids.

Course Outline:


Recommended Books:

2. The Dynamics and Thermodynamics of Compressible Fluid Flow (Volume 1), 1st
   Edition By A. H. Shapiro, Ronald Wiley
4. Compressible Flow By B. W. Imrie

**ME-426 AERODYNAMICS (3,0)**

**Specific Objectives:**
- To understand the concepts in incompressible airfoil theory, including
  symmetric and cambered airfoils using analytical and numerical approaches.
- To understand the incompressible wing theory, including down wash, lifting-line
  theory, elliptic wings, general twisted wings, application of fundamentals to the
  design of a wing to meet given performance criteria.

**Course Outline:**

Introduction, aerodynamics of incompressible flow, compressible and ideal fluid
flow, airfoils theory, finite wing aerodynamics, blade element theory and aircraft
propellers, Cascade aerodynamics, jet propulsion, intake and nozzle performance,
aircraft performance measurement.

**Recommended Books:**
1. Aerodynamics for Engineering Students, By El. Houghton & A. E. Brock St
   Mortin Cambridge University Press, 2003

**ME 426 HEAT VENTILATING AND AIR CONDITIONING SYSTEM (2,1)**

**Course Outline:**

Introduction, definitions and basic terminology, refrigeration cycle, vapor compression
cycle, COP, introduction to pressure- enthalpy chart, types of refrigerants, air cycle
refrigeration, vapor absorption refrigeration, Air conditioning, indoor and outdoor air
conditions, comfort air-conditions and comfort zone, indoors air quality, psychrometry,
psychrometric chart and psychrometric properties, central air-conditioning system,
essential components of central air-conditioning plant, water chiller and water heater, air
handling unit, chilled water and hot water re-circulating system, return air supply system,
fresh air supply system air mixture chamber, supply fan, air dust cleaning and bacteria
removal, air supply system and air return terminals, diffusers, dampers, grilles and
registers, CFM rating and tons of air-conditioning of central air-conditioning plant, cooling
and heating loads, calculation procedures, duct sizing and piping design, pumps and fans
selection, air ventilation, calculation of fresh air supply of multi story buildings, air handling
units for treatment of fresh and return, dust and bacteria removal methods, forced
convection based air ventilator design, cooling towers, hydronic terminal units.
ME-414 FRACTURE MECHANICS (3,0)

Course Outline:


ME-415 MECHANICAL ENGINEERING DESIGN ANALYSIS: (3,0)


ME-416 AUTOMATION AND ROBOTICS: (3,0)

Robotics: Basic concepts in robotics, classification and structure of robotic system, drive and control system, coordinate transformation, kinematics dynamic analysis and trajectory interpolation, interfacing with micro controllers and PLCs, applications of robots. Robotics and Automated Guided Vehicles. Basic robot motion, path control, robot drive system sensors, robot-computer interface, robot programming, Automated Guided Vehicles (AGV) types. Programmeable logic controller (PLC). Basics components and terminologies, ladder diagram elements, relay sequencing, processor input and output modules, programming unit and programming procedures with machines or assembly language. Microcontroller. Basic elements of microcontroller, types of microcontroller, micro processor and PLC, overview of architecture and principles of operations, assembly, machine and high level programming languages for microcontroller, input and output peripherals for specific application in mechanical engineering with interfacing techniques. Actuators, sensor, input signals, output signals, signal conditioning. Automations: Introduction to automations, automation strategies, economics of automations, partial automations, group technology and flexible manufacturing. Use of sensors and actuators in automations.

ME-417 Production Engineering (2,1)

Course Outline:


Lab Outline:
Experiments related to the course outline mentioned above will be covered in the Lab class.

Recommended Books:

2. Process and materials of manufacture By R.A Lindberg
4. Manufacturing Technology By Hazel Hurst.
5. Engineering Metallurgy By R.A Higgins
6. Manufacturing Science By Gosh and Malik

ME-418 MODELING AND SIMULATION (2,1)

Basic mathematical tools for kinematics and dynamics modeling of planar and spatial rigid multi body dynamic systems, Absolute and relative kinematic constraints and driving constraints, virtual work and the generalized force concepts, equations of motion for constrained rigid multi body systems, inverse dynamics of kinematically driven systems, equilibrium conditions, and constant reaction forces, Euler parameters for the orientation of rigid bodies in space, numerical considerations in solving spatial differential-algebraic equations of motion, Methods of coordinate transformations with the help of Euler angles, Direction cosines and Quaternion, Attitude dynamics (dynamics of angular motion), Failure mode analysis, Robustness analysis, Monte Carlo Simulations, ANSYS / COMSOL MULTIPHYSICS for analysis

ME-419 ENGINEERING OPTIMIZATION (2,1)

Optimization methods, nonlinear optimization under constraints, multi objective optimization, multidisciplinary design, incorporating different disciplines simultaneously, single and multi-objective optimization under constraints, Different approaches to Multidisciplinary Design

ME-428 Introduction to Nuclear Engineering (3,0)

Nuclear Physics Review
Nuclear structure; Nuclear stability; Binding energy and mass-energy equivalence; Radioactivity (natural and artificial); Decay rate; Mean-life and half-life; Radioactive equilibrium; Nuclear Reactions; Q value; Fission reaction; Elastic and inelastic scattering
Reactor Physics
Neutron reaction; Neutron flux; Cross section for scattering, absorption and fission; Neutron diffusion Neutron leakage; Solution of diffusion equation for a bare reactor; Albedo and reflector saving, Neutron slowing down; Continuous slowing down model' Lethargy; Slowing down power; Moderation ratio, Fermi age.

Reactor Theory
Nuclear chain reactors; Criticality; The four factor formula; One group critical equation; The critical size, Non-leakage probability; Neutron life cycle.

Reactor Kinetics
Excess reactivity and reactor-period; Xenon poisoning.

Types of Nuclear Reactors
Introduction, Pressurized Water Reactor (PWR), and Primary Loop, Pressurize, Chemical Shim Control A PWR Power plant, Boiling Water Reactor (BWR), and Load Following Control, Current BWR System High Temperature Gas-Cooled Reactor (HTGR), Advanced Gas Cooled Reactors (AGR).

Fast Breeder Reactor and Power plants
Introduction, Nuclear Reactions, Conversion and Breeding, Liquid Metal Fast Breeder Reactor (LMFBR) Plant arrangements, LMFBR, Gas Cooled Fast Breeder Reactor (GCFBR).

Reactor Materials
Choice of a moderator; the fuel; the coolant; Nuclear fuels.

Allied Topics
Nuclear power economics; Fuel reprocessing; Health hazard due to reactions; Shielding; Nuclear applications for peaceful purposes.

ME-431 Finite Element Methods (2,1)

Specific Objectives:
- To understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis
- To understand the importance of analysis and design, using the FEM, in the broader context of engineering practice

Course Outline:
Introduction to stress analysis by FEM, Basic concepts, Types of elements, linear static analysis, Review of the basic continuum theory, 1-D and 2-D FEM problems, Plane stress and plane strain problems, energy method, variational principles and Ritz’s methods; co-ordinate transformation; isoparametric formulation, solution of eigen value, boundary value, discretized time dependant problems, use of commercial finite element code, project based learning of FEM.

Recommended Books:

ME-432 CAD/CAM (2,1)

CAM: Conventional Numerical Control, NC part programming, Computer controls in NC

Recommended Books


ME-429 Power Plant (2,1)

Specific Objectives:
- To gain understanding of working principles of various types of power plants operating on conventional as well as renewable energies
- To learn the methods of trouble shooting, maintenance and optimization of various types of power plants

Course Outline:

Conventional power plants
Steam turbine, gas turbine, combined cycle, jet engine, diesel engine, nuclear, hydro-electric and combined heat and power plants (CHP).

Non-Conventional power plants
Solar, wind, geothermal, ocean waves and tidal power plants.

Recommended Books:
2. Power Plant, By F. T. Morse
3. Applied Thermodynamics for Engineering Technologist, By T. D. Eastop & J. McConkey
ME-433 Hydraulics & Pneumatics

Course Outline:

Fluid theory and applied physics which relates to hydraulics. Theory of operation, maintenance requirements, and adjustments of various hydraulics components and systems. Ability to test, inspect, troubleshoot, and service hydraulic systems and overhaul malfunctioning components. Pneumatics as used in aircraft operation. Fluid flow, identifies the various actuating units, types of seals, pumps and differences between hydraulics and pneumatics. The inspection, maintenance and repair of the various components.

ME-434 Introduction to composite Materials

Course Outline:

The concepts covered in this course include:


Recommended Books


S. Suresh and A. Mortensen, Fundamentals of Functionally Graded Materials
K.K. Chawla, Composite Materials
A. Kelly and N. H. MacMillan, Strong Solids
MANAGEMENT ELECTIVE COURSES

MS-401 INDUSTRIAL MANAGEMENT (3,0)

Specific Objectives:
- Optimization of organizational resources
- To understand the tools/techniques related to Project Management
- To develop efficient relations with supplier and customers

Course Outline:

Plant management
Management systems Role & functions of management. Productivity, basic concepts, classification, measurement and improvement. Role of work study, work measurement and work sampling.

Facilities planning and design
Plant location, material handling systems, types of production, MRP-II, group technology, make or buy decisions, demand forecasting, material requirement planning, inventory models and just in time (JIT) technique, production planning, scheduling problems & models, project management, techniques for PERT & CPM, network scheduling, activity crashing and resource leveling.

Human resource management
Recruitment process, job evaluation, performance appraisal, non-financial and financial incentives, training, labour relations, management theories.

Recommended Books:
2. Production Management By Kieth & Loekyer.
MS-402 PROJECT MANAGEMENT (3,0)

Specific Objectives:
- To understand modern project management techniques related government regulations.
- To implement modern project management techniques using software.

Course Outline:
Fundamental principles, project proposals and feasibilities, project life cycle; project organization and human resource management; PM planning; Work breakdown structure; Estimating time and cost; Precedence relationships; Project scheduling and control techniques; Project risk analysis; Time compression and resource leveling; Computerized project management; special software packages

Recommended Books:
1. Project Management: A Systems Approach to Planning, Scheduling, and Controlling by Harold Kerzner, John Wiley

MS-403 OPERATIONS RESEARCH (3,0)

Specific Objectives:
- To understand the Operations Research tools and techniques.
- To understand working and application of computer software packages.

Course Outline:
Operation Research Techniques and basics, Linear programming, graphical method, simplex method dynamic programming, sensitivity and post-optimal analysis, transportation models, Queuing theory (weighting live models). Replacement Models. Simulation. Basic principles, discrete models vs. continuous system simulation, Markov Chain.

Recommended Books:
MS-404 TOTAL QUALITY MANAGEMENT (3,0)

Specific Objectives:
- To understand the philosophy of total quality management
- To implement the tools and techniques in the organizations.

Course Outline:
Fundamental principles; Standards; Techniques for quality analysis and improvements; statistical methods and SPC. Acceptance sampling; QFD; Value engineering; Cross-functional management and benchmarking; ISO-9000 application, clauses, and implementation issues, Six Sigma.

Recommended Books:
1. Total Quality Management with text cases by John S. Oakland, Butterworth-Heinemann
2. Total Quality Management by Besterfields, Prentice Hall.

MS-405 OPERATIONS MANAGEMENT (3,0)

Specific Objectives:
- To understand the philosophy of Operations management
- To implement the tools and techniques in the organizations.

Course Outline:
Basics of managing manufacturing and service organizations; strategic decision making; facility location and layout; job design and work compensation; demand forecasting; capacity and material planning; scheduling in various environments; emerging trends in managing operations. Use of quantitative management tools after introducing fundamental concepts.

Recommended Books:
2. Operation Management by Jay Heizer and Barry Render.

MS-406 BUSINESS AND ENTREPRENEURSHIP (3,0)

Specific Objectives:
- To understand the philosophy of Business and Entrepreneurship
• To implement the tools and techniques in the organizations.

**Course Outline:**

Evolution of the concept of entrepreneur, Characteristics of an entrepreneur, Distinction between an entrepreneur and a Manager, in Economic Development, Factors affecting entrepreneurial growth (economic, Non-Economic and Government factors)


Creativity and sources of new business ideas, the difference the difference between ideas and opportunity and creativity. Assessing business opportunities in Pakistan. Screening and evaluating opportunities Product planning and development process. Creating parallel competition by developing a similar product or service, Product life cycle, Finding sponsorship. Acquiring a going concern, E-Commerce and business start-up and growth.

Marketing as a philosophy, marketing management: Creating a marketing plan, Analyzing the environmental situation and the market opportunity, Setting marketing objective, Formulating a marketing strategy.


Franchising, becoming a franchisees versus starting a stand-alone business, the franchisee contract, Non-contractual considerations of buying a franchise, Limitations of franchising.

**Recommended Books:**

2. S. S. Khanka, Entrepreneurial Development
3. Irving Burstiner, the small Businesses Handbook
4. Bruce A. Kirchhoff, Entrepreneurship and Dynamic Capitalism
CEFE, Germany, Development Manual

**ME-407 SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT (3,0)**

**Specific Objectives:**

• To understand the philosophy of Safety Health and Environment
• To implement the concepts in the organizations.
Course Outline:


Principles of accident prevention, hazard analysis. Legal, humanitarian and economic reason for action. Safety inspection procedures. Safety training, First aid and emergency procedures,


Atmospheric Pollution: Types of Atmospheric pollution, Their Causes and Effects on Human Health, Available Technologies for Controlling Pollution.

ISO Standards for Safety and Health and Environment

Recommended Books:


MS-408 PRODUCTION MANAGEMENT (3,0)

Course Outline:

Essentials of production management. Productivity Analysis, Forecasting Techniques, Regression and correlation analysis, Inventory models techniques and project management analysis. Computer solutions with excel spreadsheets.

Recommended Books:

1. Factory & Production Management By K. G. Lockyer, Pitman Publishing