Course Description

CH 101 - Applied Chemistry (2-0-2)

The emphasis in this course is on basic principles of atomic and molecular electronic structure, periodic trends and chemical thermodynamics. During the course relevant examples are also introduced, in order to develop a better understanding of the practical application of these concepts.

ME 100 - Introduction to Mechanical Engineering (1-0-1)

This course introduces students to the field of mechanical engineering, review of some basic principles from mathematics and physics that are applied in Mechanical Engineering. Ethical considerations and technical communication skills necessary for engineering work, computational and experimental tools available with engineers. Application of the concepts learned throughout the course to a small design project that employs mechanical engineering principles.

ME 121 - Engineering Statics (3-0-3)

Engineering statistics comprises of the following topics; Force systems: Force, Rectangular components (2D & 3D), Moment and couple (2D & 3D), Resultants (2D & 3D). Equilibrium: Mechanical system isolation and free body diagrams (2D & 3D), Equilibrium conditions. Structures: Plane trusses, Method of joints, Method of sections, Frames. Friction: Types of friction, Dry Friction, Applications of friction.

ME 131 - Thermodynamics I (3-0-3)

Thermodynamics and systems, Energy and 1st law of thermodynamics, Energy balance and analysis, Closed systems and cycles, Evaluating properties, Control volume analysis, Conservation of mass & energy for a control volume (CV), Second law of thermodynamics, Entropy balance for control volume and closed systems.

ME 140 - Workshop Practice I (0-1-1)

Introduction to workshop technology: Safety concept and practices. Engineering materials: Ferrous and non-ferrous alloys. Types of woods, Processing and preservation, Characteristics of a good timber, Plywood and its application, Common tools Types of wood joints. Welding, Soldering and brazing. Sheet metal working: Sheet metal operations. Pattern

development. Electrical wiring, Safety practices, Types and uses of cables, Electrical codes, Electric circuits.

ME 142 - Engineering Drawing and Graphics

Line types of Drawing, Lettering, Dimensioning, Use of drawing tools, Sheet planning, Orthographic projection (1^{st} angle and 3^{rd} angle) of points, straight lines, oblique, and auxiliary planes. Solids in simple and inclined positions. Traces of lines, section. Loci of points and generation of different types of curves, development of surface & ISO metric.

ME 143 - Workshop Practice II (0-1-1)

Machining, Cutting tools, Measurement instruments, Lathe, Milling and Shaper operations. Drilling Boring, Grinding, Gas welding, production of small machine components. Casting and forging, practice of production on milling, lathe, shaper and drill machine.

ME 145 - Engineering Drawing and Graphics/AutoCAD (1-1-2)

Introduction to Computer Aided Drafting. Introduction to software Auto-CAD 2010.Graphical user interface, Drawing and Modifying commands. Developing a sketch in Auto-CAD.Drawing orthographic projections, Dimensioning, Using drawing templates. Introduction to isometric drawings. Introduction and Demonstration of 3-D modeling in different software's.

ME 211 - Control Engineering (2-1-3)

System mathematical modeling and graphical representation in both time and frequency domain for translational, rotational, hydraulic, pneumatic and electrical systems, stability analysis, transient and steady-state analysis, root locus method and root locus based control system design

ME 222 - Engineering Dynamics (3-0-3)

Kinematics of particles: rectilinear and plane curvilinear motion of particles in rectangular, normal and tangential and polar coordinates, space curvilinear motion. Kinetics of particles: force, mass, acceleration and equation of motion, for rectilinear and curvilinear motion, Work and kinetic

energy, impulse momentum relations, conservation of energy and momentum. Plane kinematics of rigid bodies: rotation and absolute motion, relative velocity and acceleration. Plane kinetics of rigid bodies: equations of motion, fair translation, fixed axes rotation and general plane motions, with application, work and energy relations, impulse-momentum relations.

ME 223 - Mechanics of Materials I (3-0-3)

Stress and strain-Axial loading: Normal & Shearing stress, Stress on oblique plane. Stress-strain diagram, Hooke's law, Modulus of elasticity, Elastic/ plastic behavior, Deformation of members, SI problems & Problems with temp changes, Poisson's ratio, Shearing strain. Torsion: Stresses in a shaft, Deformations in a circular shaft, Stresses and angle of twist in the elastic range, shafts. Pure bending: Stresses and deformations. Beams: Shear and BM diagrams, Relations b/w load, shear and BM, Design of beams for bending, Shear stresses in beams &Thin Wall Section.

ME 224 - Mechanics of Materials II (3-0-3)

Transformation of stress and strain: Principal stresses, Max shear stress, Mohr circle 3D state of stress, Criterion for ductile & brittle materials, stresses in TW pressure vessels, transformation of plane strain. Principal stresses: Principal stresses in a beam, Design of transmission shafts, Stresses under CL. Beam deflections: Deformation of beam under T load, Equation of elastic curve, SI beams, Method of superposition, BM diagrams. Columns: Stability of structures, Energy methods: Strain energy, Impact loading.

ME 233 - Fluid Mechanics I (3-0-3)

The course covers evaluation & analysis of Basic properties of fluid (Gas and Liquid) at Rest and in Motion. Hydro static fluid analysis covers Fluid properties, Viscosity and compressibility, Vapor pressure, pressure fields, standard atmosphere, hydrostatic forces, buoyancy, floatation and stability. Fluids in dynamics analysis covers the Bernoulli equation, the velocity fields, control volume and system representation. The analysis techniques cover the Control Volumes and Differential methods techniques.

ME 234 - Thermodynamics II (3-0-3)

Vapor Power Systems: Modeling and analysis, Rankin cycle, Reheat and superheat Regenerative and other Vapor cycles. Gas power systems: Internal combustion engines, Gas turbine power plants. Refrigeration and heat pump systems: Vapor and absorption refrigeration, Heat pump systems, Gas refrigeration systems. Thermodynamic relations: Equation of state and property relations, Entropy and enthalpy changes, P-v-T relation of gas mixture. Ideal gas mixture and psychometric applications.

ME 235 - Fluid Mechanics II (3-0-3)

The course deals with the behavior of fluid when subjected to practical common models. It is designed to attain knowledge of fluid (liquid and gases) behavior in pipe/ducts, flow over bodies, open channel flows and compressible flows. The knowledge gained is also applied to compression, expansion and power devices.

ME 247 - Manufacturing Processes I (3-0-3)

Introduction to manufacturing engineering, Engineering properties of materials, Casting: processes and equipment, Bulk forming processes, Sheet metal forming, Joining and Assembly Processes, Powder metallurgy, Forming and shaping of plastics and composite materials.

ME 301 - Engineering Materials (3-0-3)

The course contents of this module include; chemical bonding, crystal structures and imperfections and how they dictate material properties, phase diagrams and their analysis, a review of Ferrous and non-Ferrous alloys and their properties, an introduction to structure and properties of polymeric & composite materials and degradation of materials.

ME 312 - Instrumentation and Measurement (2-0-2)

Significance of measurements, design of experiments, measurement systems, calibration, static and dynamic measurements, sensitivity, range, precision, repeatability, uncertainty and errors in the measurement of length, force, torque, frequency, pressure, flow and temperature, analogue and digital conversion

ME 325 - Mechanics of Machines (3-03)

Friction: bearings, screw threads, clutches, belts, brakes, rope drives; Chain and sprockets; Governors: effort, power, sensitivity, stability; Gyroscopic couple; Gears: simple and compound, gear-trains, epi-cyclic trains; Dynamometers; Linkage analysis; Balancing of rotating masses.

ME 327 - Machine Design I (3-0-3)

Design philosophy: static, dynamic, fatigue loading; Concept of: load, stress, deflection, stiffness; Design of non-permanent joints: screws, fasteners; Design of permanent joints: welding, bonding; Design of: springs, bearings, gears; Fatigue failure; Flexible machine elements; Design standards.

ME 328 - Machine Design II (2-0-2)

Kinematics, force analysis, failure theories, stress analysis and design of spur, helical, bevel and worm gears; Design of rolling contact bearings, journal bearings, springs, belts, ropes, chains, shafts; Hydrodynamic theory of lubrication; Introduction to: experimental stress analysis, FEA, CAD (3D modeling, 2D drawing).

ME 329 - Mechanical Vibrations (3-0-3)

Motion: oscillatory, periodic, harmonic; Natural frequency: Holzer, Rayleigh; SDOF system solution through Newton and energy methods; Un-damped, damped, free and forced systems; Two DOF systems: modes, coordinate coupling, vibration isolation and absorption, orthogonality; Critical speeds.

ME 336 - Heat and Mass Transfer (3-0-3)

Conduction: Heat equation, Fourier's Law, Steady / transient / multidimensional conduction, Boundary conditions, One-dimensional steady heat conduction in plane and composite walls, cylinders and spheres with and without heat generation, Critical thickness of insulation, Heat transfer through extended surfaces, etc**. Convection:** Newton's law of cooling, Boundary layers, Effects of flows on convection, Convection for flow over flat plates and through pipes and ducts, Fluid friction and heat transfer, Free and forced convections with its coefficients etc. **Radiation**:

Stefan's Boltzman Law, Blackbody radiation, Radiation shape factor & its application, Kirchoff's Law, Radiation shields etc. **Heat exchangers:** Classification, Heat exchanger effectiveness – LMTD & NTU methods, Design considerations etc. **Mass Transfer:** Fick's law and its application, Mass transfer Coefficient, Water vapor migration in buildings, analogy between momentum heat and mass transfer etc.

ME 345 - Manufacturing Processes II (2-1-3)

Conventional machining processes, Machining processes for producing various shapes, Abrasive machining and finishing operations, Non-conventional machining, Control of machine tools, Jigs and fixtures, Computer integrated manufacturing systems, Metrology and precision measurements, Process planning.

ME 348 - Computer Aided Engineering (CAE) (1-2-3)

Fundamentals of Finite Element Method, Computational Fluid Dynamics, Solid Modeling and Multi-body Dynamics, Implementation of engineering design concepts using codes and industry standard software packages.

ME 436 - Refrigeration and Air Conditioning (2-0-2)

The course aims at providing essential knowledge on various refrigeration cycles, system components, refrigerants and air conditioning systems, including basic analysis of common cycles including Vapor compression cycle, air cycle refrigeration and vapor absorption systems. The basic design aspects of Refrigeration & Air Conditioning Systems including HVAC essentials are also covered.

ME 451 - Engineering Management and Economics (3-0-3)

This course aims to focus on important concepts in relations to both engineering management and economics. Engineering management module comprises: Plant management, Management systems, Productivity, Role of work study and other plant management parameters. Inventory management and PERT-CPM. Engineering economics module comprises of: Types of costs,

Equivalence, Types of investments, Depreciation accounting, Inflation and economic considerations, Project management.

ME 492- Final Year Project I (0-1-1)

Final Year Project I requires independent, or group work, as prescribed by supervisor and projects committee of the concerned department.

ME 493 - Final Year Project II (0-2-2)

Final Year Project II requires independent, or group work, as prescribed by supervisor and projects committee of concerned department

ME 494 - Final Year Project III (0-3-3)

Final Year Project II requires independent, or group work, as prescribed by supervisor and projects committee of concerned department

ML XXX - Mechanical Engineering Labs

Mechanical Engineering lab consists of practical and experimental work related to following subjects: Statics, Dynamics, Thermodynamics, Fluid Mechanics, Mechanics of Materials, Manufacturing Process, Mechanics of Machines, Heat and Mass Transfer, Stress Analysis and Mechanical Vibrations

Course Description for Technical Electives

ME 426 - Machine Design II (3-0-3)

This course includes Techniques of mechanical design, Describing mechanical design problems and process, the human element in design, finite element method of stress analysis, application of method to plane strain and axisymmetric problems, techniques for non-linear analysis, study of loads, life and reliability relationship for various mechanical components. Techniques of the mechanical design process, computer aided design methods, and design for mass production and batch production.

ME 428 - Finite Element Methods (FEM) (3-0-3)

Introduction to FEM. Stress analysis by FEM, Energy, Variational principles and Ritz's methods, Coordinate Transformation. Isoperimetric formulation. Solution of Eigen value, Boundary value and Initial value problems.

ME 429 - Experimental Stress Analysis (3-0-3)

Stress strain transformation, Strain measurement methods, Grids, Electric resistance gauges: Rosettes and their principle of operation, Strain gauge bridges for measurements of forces, moments and structural members. Instrumentation for stress analysis work. Photo elasticity methods stress optics, Fringe patterns in polariscope. Calibration and compensation techniques for stress measurements on optical models, Brittle coating technique, Birefringent Coatings.

ME 438 - Computational Fluid Dynamics (CFD) (3-0-3)

Types of ordinary and partial differential equations, Solution of equation sets, Boundary value and initial value problems, Control volume approach, Time stepping, Accuracy, Stability, Consistency, Linearization, Diffusion, Dispersion, Vorticity stream function and primitive variable formulations. Turbulence modeling. Examples of external flow across various configurations, Internal flows through pipes, ducts and valves.

ME 448 - Fundamentals of Automated Manufacturing (3-0-3)

Introduction to manufacturing automation, numerically controlled machines, Integration of NC and robotics. Machine tool controls, CNC, Programming for CNC Lathe, CAM.

ME 449 - Automation and Robotics (3-0-3)

Robotics: Basic concepts in robotics, Classification, Drive and control system, Coordinate transformation, Kinematics dynamic analysis and trajectory interpolation, interfacing with micro controllers, Applications of robots. Basic robot motion, Robot programming, PLCs, Ladder diagram elements, Processor input and output modules. Microcontroller. Basic elements of microcontroller: Types of microcontroller, Micro processor and PLC, Assembly, machine and high level programming languages for microcontroller. Actuators, Sensor, Automation strategies, Partial automations, Use of sensors and actuators in automations.

ME 461 - I.C. Engines (3-0-3)

Basic: Engine classifications, Engine components, Basic terminology, Working principles of SI and CI engines etc. Testing and performance: Design, performance and testing parameters, knocking characteristics, engines emissions and their control etc. Thermo-Chemistry: Characterization of flames, Composition of air and fuels, Alternative fuels, Combustion stoichiometry, Enthalpies of combustion, Self-ignition and Octane Number, Unburned / burned mixture composition, Thermodynamics charts etc. Air Standard Cycles and Their Analysis: Otto, Diesel, Dual, and Brayton cycles etc. Combustion: Combustion phases in SI and CI engines, ignition advance and retard, Combustion chamber design etc. Carburetion: Factors affecting carburetion, Mixture requirements, Simple carburetor, Calculation of the air-fuel ratio etc.

ME 462 - Power Plant Engineering (3-0-3)

Economics of Power Generation: load curve, Incremental heat rate, Economic scheduling principle etc. Thermodynamics Review & Rankine Cycle: Ideal and externally / internally irreversible Rankine cycle, Superheat, Regeneration, Supercritical-pressure cycle etc. Fossil-Fuel Steam Generators: Classification, Water-Tube boiler, Water circulation, Super-heaters, Fans, Stack etc. Fuels and Combustion: Coal analysis, Coal firing, Fluidized bed combustion etc. Condensate-Feedwater System: Direct-contact / Surface condensers, Desertion, Heat transfer surface area, circulating water flow and pressure drop etc. Gas-Turbine and Combined Cycles: Turbine losses, Gas-turbine cycles, Ideal / non-ideal Brayton cycle and modifications, Combined cycles etc. Nuclear / Hydro Power Plants: Fusion and fission, Neutron energies, Reactor control, Water reactors, Hydro-electric power plants etc. Non-Conventional power plants: Solar, Wind, Geothermal, Ocean waves and tidal power plants.

ME 463 - Energy Resources and Utilization (3-0-3)

Introduction to types of renewable energy: Solar energy, Wind energy, geothermal energy, Ocean thermal 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 nonrenewable energies used as hybrid energy systems, Modern renewable energy plants. Wind energy, Wind turbine design specifications, Compatible electric generators and major operational issues of the wind mill for electric power generation. Wind mills design usage for pumping water. Biomass energy

conversion methods, detailed description of biomass energy conversion plant, Operational and maintenance problems and their remedies.

ME 464 - Heating Ventilation & Air Conditioning (HVAC) (3-0-3)

Refrigeration cycles: Vapor compression cycle, Pressure- enthalpy chart, Types of refrigerants, Air cycle refrigeration and vapor absorption system. Air conditioning: Indoor and outdoor air conditions, Comfort conditions and comfort zone, Indoor air quality. Psychometric, Central air-conditioning system, Essential components of central air-conditioning plant, Water chiller and water heater, Air handling unit, Chilled water and hot water recirculation system, CFM rating and tons of air-conditioning of a central air-conditioning plant. Cooling load and heating load calculation procedures, Duct sizing and piping design, Pumps and fans selection. Air ventilation: Calculation of fresh air supply of a multi-story building, Air handling unit for untreated fresh air, Dust and bacteria removal systems, Forced convection based air ventilator design.

ME 465 - Aerodynamics (3-0-3)

Introduction, Aerodynamics of incompressible flow, Ideal potential flows, Aerofoil theory, 3D lifting surfaces, Lift and Drag estimation, Effect of geometric features of wing. Introduction to high speed aerodynamics. Introduction to dynamics of flight including stability and control.

ME 466 - Tribology (3-0-3)

Friction, Wear mechanism, Wear debris classification, Surface roughness, Friction and wear measurement techniques, Lubrication of sliding and rolling parts. Types of lubricants, Grades and their properties, Theories of lubrication, Oil whirl, Hydrodynamic and elastohydrodynamics lubrication of journal bearing, Solid lubricants, Self-lubricating fuel. Tribology in manufacturing. Tribology in automobiles.

ME 467 - Nuclear Engineering (3-0-3)

Review of nuclear physics, Reactor physics, and Reactor heat transport. Types of enrichment and reprocessing; Handling of fuels. Safety aspects.

ME 468 - Gas Dynamics (3-0-3)

Basic governing laws of conservation of mass, Momentum and energy, Limitations. Sub-sonic and supersonic gas flow. Mach number and Mach angle. Isentropic Flow and Applications; Operation of nozzles under varying pressure ratios. Normal and oblique shocks, Prandtl- Meyer compression and expansion with applications. Rayleigh flow and Fanno flow, Busemann's shock polar diagram.

ME 482 - Introduction to Mechatronics (3-0-3)

Introduction to Mechatronics. Sensors and transducers: Transducer characteristics, Sensors for measuring displacement, Strain, Force, Pressure, Temperature and Motion. Encoders. Motors and their types. Stepper motors. Permanent magnet DC motors. Servo Systems. Interfacing. Ports, Input/output, Analog to Digital converter, Sampling theory, Digital to Analog converter. Sample and hold, Multiplexer. Interfacing switches, LEDs, Stepper motors and DC motors to micro-controllers.

ME 483 - Maintenance Engineering (3-0-3)

Introduction and types of maintenance: Preventive maintenance, Its objectives, Benefits and economics, Inspection and implementation. Routine maintenance and monitoring of fault indicators, Main concepts and implementation. Proper assembly/ disassembly, Alignment aspects, Machine handling. Record keeping and maintenance scheduling, Stocking spares and cost effectiveness, Safety in maintenance. Introduction to 1st, 2nd and depot level maintenance.

ME 484 - Mechanical Engineering Design Analysis (3-0-3)

Philosophy and concept of engineering design. Engineering creativity, Phases and procedure in design. Management of engineering project. Computer aided design. Modeling and simulation, Optimization and reliability. Application of industrial design codes. Design for service, Manufacturing, cost. Philosophy of design software and analysis.

ME 485 - Reliability in Engineering (3-0-3)

Quality control and reliability, Reliability prediction and calculations, Reliability enhancing techniques. Hazard function. Poisson process. Weibull distribution. Series and parallel systems, Non series-parallel systems, Time- dependent systems, Life-testing, Sequential probability ratio test.

AE601/ME732 - Theory of Elasticity (3-0-3)

This course aims to make a study on the following topics such as: Development of TOE equations; rectangular and polar coordinates; Airy's stress function; problem solving; plane stress and strain, through polynomials, rotationally symmetric stress distributions; super positioning; bending of bars, thermal stresses; disks; rotating, inside / outside pressure, diametric load.

AE 645 - Advanced Materials in Engineering (3-0-3)

This module gives understanding of both conventional and advanced materials in engineering applications and its applications in aerospace. Course include; internal atomic/ crystal structures and imperfections and dictation in material properties, phase diagrams, analysis & review of Ferrous and non-Ferrous alloys/properties. property modifications & treatments, TTT diagrams, introduction to structure and properties of polymeric materials, composite materials, ceramics and engineering ceramics, failure analysis and degradation of materials..

ME765 - Product and Process Design

This is an advanced course on design methodologies, Conceptualization, preliminary design, detail design, and manufacturing. Failure analysis, materials selection, methods of design optimization, and current approaches in computer-aided design, Application of computer methods to engineering design, Optimization and automated design methods, the use of linear and non-linear programming methods for engineering design and related problems, Unconstrained minimization, penalty functions and feasible directions.

ME 602/AE640 - Finite Element Methods (3-0-3)

The course covers theory of FEM as applied to 1 & 2D problems of solid mechanics. Displacement method approach is used to develop the stiffness matrices of various elements. Hands on Projects using PATRAN / NASTRAN are undertaken by students to enhance practical ability in using the

commercially available software. Students are also required to give a detailed presentation at the end of the course depicting their theoretical / software knowledge gained during the course.

ME742 - Advanced Theory of Vibrations

It begins with an introduction to some basic concepts, discussion about spring, mass and damper elements, and introduction to harmonic motion and its analysis. The course then covers Free and Forced vibration of single degree of freedom (SDOF) system, damped and un-damped system. After thoroughly covering SDOF system two and multi degrees of freedom system are covered. Special additional topics are covered at the end of the course.

AE723 - Advanced Mechanics of Composites

The objective of this course is to introduce composite materials to graduate students. It begins with an introduction to the composite material and their constituents. The course then covers unidirectional composites, in which various mechanical properties of unidirectional composite are discussed. The course also covers behavior of laminated composite plates under various loading conditions in detail. Special additional topics are covered at the end of the course.

ME 731 - Advanced Mechanics of Materials

Introduction, Theory of Stress and Strain, Linear Stress-Strain-Temperature Relations, Inelastic Material Behavior, Applications of Energy Methods, Torsion, Bending of Straight Beams, Shear Center for Thin-Wall Beam Cross Sections, Curved Beams, Beam on Elastic Foundations, The Thick-Wall Cylinder, Elastic and Inelastic Stability of Columns, Flat Plates, Stress Concentration, Fracture Mechanics, Fatigue: Progressive Fracture, Contact Stresses, Creep: Time-Dependent Deformation.

ME 733/AE747 - Theory of plasticity

Stresses and Strains, Foundations of Plasticity, Elastoplastic Bending and Torsion, Plastic Analysis of Beams and Frames, Further Solutions of Elastoplastic Problems, Theory of the Slip line Field, Steady Problems in Plane Strain, Non steady Problems in Plane Strains, Computational Methods.

ME734 - Computational Fatigue Mechanics

Fatigue phenomenon; constant and variable loads; stress concentration, stress intensity factors; residual stresses; fatigue crack; growth and analysis; fatigue testing, interpretation, corrosion due to fatigue, fretting, high and low temperature, fatigue of joints and structures; design for fatigue; fiber-metal laminates.

ME 735 - Computational Fracture Mechanics

Introduction, Linear Elastic Fracture Mechanics, The Elastic Stress Field Approach, Crack Tip Plasticity, The Energy Balance Approach, LEFM Testing, Elastic-Plastic Fracture Mechanics, Basic Aspects of Elastic-Plastic Fracture Mechanics, EPFM Testing, Failure Assessment Using EPFM, Fracture Mechanics Concepts for Crack Growth, Fatigue Crack Growth, Sustained Load Fracture, Dynamic Crack Growth and Arrest, Mechanism of Fracture in Actual Material, Mechanisms of Fracture in Metallic Materials, Influence of Material Behavior on Fracture Mechanics Property.

ME 736 - Computational Thermo-mechanics

Tensor Notation, Some Basic Equations of Continuum Mechanics, Creep Behavior of Isotropic and Anisotropic Material; Constitutive Equations, Creep Behavior of Thick-Walled Tubes, The Creep Potential Hypothesis in Comparison with the Tensor Function Theory, Damage Mechanics, Tensorial Generalization of Uniaxial Creep Laws to Multi-axial State of Stress, Viscous Fluids, Memory Fluids, Viscoelastic Materials, Visco-plastic Materials, Creep and Damage Experiments, Creep Curve.

ME 737 - Computational Weld Mechanics

Introduction, Computer Simulation of Welding Processes, Thermal Analysis of Welds, Evolution of Microstructure Depending On Temperature, Evolution of Microstructure Depending On Deformations, Carburized and Hydrogen Diffusion Analysis, Welded Structure and Applications

of Welding in Industrial Fields, Fracture Mechanics, Input Data for Computational Welding Mechanics.

AE 644 - Thin Walled Structures

Mechanics of Solids, Thin Plates and Shells, Non-Linear Static Analysis, Vibrations of Structures, Non-Linear Dynamics, Stability of Structures, Dynamic Stability.

AE646 – Aero-Elasticity

Introduction, Deformation of Airplane Structures under Static Loads, Deformation of Airplane Structures under Dynamic Loads, Approximate Methods for Computing Natural Mode Shapes and Frequencies, Aerodynamic Tools, Wings and Bodies in 3-D Unsteady Flow, Static Aeroelastic Phenomena, Flutter, Dynamic Response Phenomena, Aeroelastic Model Theory, Model Design and Construction, Testing Techniques.

AE 724 - Theory of Plates and Shells

Simple Elastic Shells, Geometric Boundary Layers, FEM and Time Stepping Procedures in Non-Linear Dynamics of Flexible Branched Shell Structures, Dynamic Stiffness Vibration Analysis for Higher Order Plate Models, Anisotropic Thermo-Creep-Damage in 3D Thick Plate vs. Reissner's Approach,

AE 705 - Advanced Aircraft Structural Analysis

Fundamentals of Structural Analysis, Elasticity, Virtual Work, Energy and Matrix Method, Thin Plate Theory, Structural Instability, Vibrations of Structures, Analysis of Aircraft Structures, Principles of Skinned Structures, Airworthiness and Airframe Loads, Bending, Shear and Torsion of Thin-Walled Beams, Stress Analysis of Aircraft Components, Structural and Loading Discontinuities.

AE 857 - Hydrodynamic Stability

Introduction, Thermal Instability, Centrifugal Instability, Parallel Shear Flows, Uniform Asymptotic Approximations, Additional Topics in Linear Stability Theory, Non-Linear Stability.

AE 610 - Advanced Incompressible Fluid Dynamics

The main focus of this course is on incompressible flow. Incompressible flows form a major part of aerodynamics and their analysis is broadly classified under “inviscid” and “viscous” flows. In viscous incompressible flows, further subdivisions are made on the basis of flow Reynolds number (Re), i.e. Laminar boundary layer (High Re), Stokes flow (low Re) and turbulent flow (Very high Re). The basic governing equations of fluid/aerodynamics i.e. Navier Stokes equations are introduced and their various analytical solution techniques are explained in detail. Two dimensional incompressible and inviscid flows are solved using complex analysis treatment.

AE 611 - Advanced Compressible Fluid Dynamics

The main focus of this course is on compressible flow. Compressible flows form a major part of aerodynamics and their analysis is broadly classified under “inviscid” and “viscous” flows. Inviscid compressible flows include analysis of properties across shocks/expansion waves, variable area flows, linearized 2 D flow, part of hypersonic flow and unsteady wave motion. Viscous compressible flows involve solution of the complete system of governing equations including Navier Stokes equations. Various examples of viscous compressible flow are illustrated.

ME 601/AE630 - Computational Fluid Dynamics I

This course introduces CFD to postgraduate students. The major topics include classification, implicit & explicit methods, iterative & time/space marching schemes, grids, boundary conditions, aerospace applications. Various techniques like Finite difference; finite volume methods for solutions of Navier Strokes & Euler equations are introduced.

AE753 - Advanced Heat Transfer

This graduate level course in heat transfer is designed to cover material beyond the undergraduate level. Different modes of heat transfer, i.e. conduction, Convection and Radiation are broadly discussed. The main focus of this course is on Conduction and Connection with some introductory material on Radiation towards the end of the course. In Conduction, 2 D steady and 1 D unsteady problems are introduced and their solution methods discussed. In Convection, the equations of motion, energy and mass conservation are reviewed and problems involving forced and free convection are discussed with reference to various flow regimes.

ME 712 - Computational Heat Transfer

Introduction to Heat Transfer, Mathematical Background, Governing Equations, Finite Difference Review, Finite Element, Simulation of Transport Processes, Numerical Method for Conduction Heat Transfer, Numerical Method for Convection Heat Transfer, Numerical Method for Radiation Heat transfer, Combined Modes and Process Application.

ME 711/AE730 - Computational Fluid Dynamics II

Review of Finite Difference Solution of Partial Differential Equations, Transformations of the Fluid equations of Fluid Motion from Physical space to Computational Space, Euler Equations, Parabolized Navier Stokes Equations, Navier Stokes Equations, Boundary Conditions, Introduction to High Temperature Gases, Grid Generation: Unstructured Grids, Finite Volume Method, Finite Element Method.

ME 713 - Engineering Tribology

Concept of Lubrication and Wear, Hydrodynamic Lubrication, Hydrodynamic Lubrication in Non-Newtonian Fluids, Computational Hydrodynamics, Elasto-hydrodynamic Lubrication, Micro-Elasto-hydrodynamic Lubrication, Deposition methods of solid Lubricants, Applications, Tribology of Polymers, Tribology of Polymers Composites, Wear and Friction of Ceramics, Nano-Tribology, Bio-Tribology.

ME 714 - Combustion

Fundamentals, Experimental Investigation, Mathematical Description of Premixed Laminar Flat Flames, Thermodynamics of Combustion Processes, Ignition Process, Engine Knock, Navier-Stokes-Equations for Three-Dimensional Reacting Flow, Turbulent Reacting Flows, Turbulent Non-premixed Flames, Turbulent Premixed Flames, Combustion of Liquid and Solid Fuels, Effects of Combustion Processes on the Atmosphere.

ME 715 - Flow Induced Vibrations

Introduction, General Overview, Modeling Approaches, Fundamental Mechanism of FIV, Vibration Induced by Cross-Flow, Single circular cylinder, Two circular cylinder in cross-flow,

Multiple Circular Cylinder, Bodies of rectangular and other cross-section shapes, Acoustic Resonance in tube bundles, Prevention of FIV, Vibration Induced by External Axial Flow, Single cylinder/multiple cylinders, Vibration of elastic plates and shells, ,Vibration induced by leakage flow, Vibrations Induced by Internal Fluid Flow, Vibration of Straight and Curved pipes conveying fluid, Vibration related to bellows, Collapsible Tubes.

AE 711 - Computational Gas Dynamics

Gas Dynamics Review, Governing Equations of Gas Dynamics, Waves, Scalar Conservation Laws, Computational Review, Numerical Error. Numerical Calculus, Basic Principles of Computational Gas Dynamics, Conservation and other Basic Principles, CFL Condition, Upwind and Adaptive Stencils, Artificial Viscosity, Linear Stability. Basic Numerical Methods for the Euler Equations, Boundary Treatments, Advanced Methods of Computational Gas Dynamics, Flux-Limited Methods, Flux-Corrected Methods, Self-Adjusting Hybrid Methods,

AE 629 -Advanced Aircraft Dynamics and Controls

Airframe and Atmospheric Modeling, Control and Guidance System Modeling, Root Locus, s-Plane, z-Plane, Transient Response, Flight-Path calculation, Covariance Propagation, Utility Sub-Routines.

AE 735 - Advanced Aircraft Propulsion

Fundamentals, Fundamental Equations, Isentropic Equations, Polytropic Process, Rockets, Performance of Ideal Rocket, Solid Rocket Motors, Liquid Rocket Motors, Hybrid Rockets, Construction of Rockets, Multi-staging, Design Methodology, Piston Aerodynamic Engines, Engine Type, Thrust, Combustion, Propeller Design, Propeller Performance, Gas Turbine Engines, Ideal Gas Dynamics, Engine Cycle , Performance, Component Performance, Engine Performance Analysis, Design Point Optimization, Component Design, Engine Controls, Ramjet and Scramjet Engines.

AE 615 - Aircraft Engine Design

Engine Cycle Design, The Design Process, Constraint Analysis, Mission Analysis, Engine Selection, Parametric Cycle Analysis, Engine Selection: Performance Cycle Analysis, Sizing the

Engine, Engine Component Design, Global and Interface Quantities, Rotating Turbo-Machinery, Combustion Systems, Inlets and Exhaust Nozzles.

AE 716 - Waves and Compressible Flow

Equations of inviscid compressible flow including flow relative to rotating axes, Models for linear wave propagation including Stokes' waves, Inertial waves, Rossby waves and simples solutions, Fourier Series, Fourier integrals, Method of stationary phase, Dispersion and group velocity, Flow past thin wings, Simple wave flows applied to one-dimensional unsteady gas flow and shallow water theory, Shock waves, Weak solutions, Rankine-Hugniot relations, Oblique shocks, Bores, Hydraulic pump.

AE 633 - Potential Flow and Panel Method

Introduction, Different forms of fluid dynamics equations, Fundamentals of inviscid, incompressible flows, General Solution of the incompressible, Potential flow equations, Exact solution with complex variables, Numerical (Panel) Methods, Singularity elements and Influence coefficients, Two-dimensional numerical solutions, Three dimensional numerical solutions, Enhancement of Potential Flow Models.

ME 773/AE650 - Turbo-machinery

Overview of Basic Concepts, Hydraulic Pumps, Hydraulic Turbine, Centrifugal Compressors and fans, Axial Flow Compressors and Fans, Steam Turbine, Axial Flow and Radial Flow Gas Turbine, Cavitation in Hydraulic Machinery.

AE 859 - Turbulent Fluid Flow

Classical Picture of Turbulence, Ubiquitous Nature of turbulence, Equations of Fluid Mechanics, Origin and Nature of Turbulence, Turbulence Shear Flows and Simple Closure Models, Phenomenology of Taylor, Richardson and Kalmogorov, Freely Decaying, Homogeneous Turbulence, Isotropic Turbulence, Role of Numerical Simulation, Isotropic Turbulence, Role of Rotation, Stratification and Magnetic Field on Turbulence, Two Dimensional Turbulence.

ME 79X – MS Thesis

ME 89X – PhD Thesis

ME 9XX – PhD Thesis