COURSE OUTLINES

ME 501	**RESEARCH METHODOLOGY**	3 (3 + 0)
Pre-Requisite	Nil	
Course Objective	At the end of this course, the students should be able to: understand some basic concepts of research and its methodologies identify appropriate research topics select and define appropriate research problem and parameters prepare a project proposal (to undertake a project) organize and conduct research (advanced project) in a more appropriate manner write a research report and thesis write a research proposal (grants)	
Course Outline	The meaning of research, Research and academics, Research problems, Types of research, Research process and design, Characteristics of good research and choice of research topic, Components of research proposal, Literature review, Research strategies, Sampling analysis, Data collection, Research ethics, Research access, Data analysis and Report writing	
Recommended Books	1. Research Methodology by Rajendar Kumar 2. Research Methodology by P . Sam Daniel, Aroma G. Sam	
ME 502	**STATISTICAL ANALYSIS**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• To introduces the field of statistics and hypothesis testing. • To analyze data – or the information collected when for empirical research	
Course Outline	(1) completely describe a data set (a set of scores) using appropriate descriptive statistics, (2) understand the logic and application of hypothesis testing, (3) interpret a set of descriptive statistics and understand the limitations of each measure, (4) apply the appropriate inferential statistical technique to situations, (5) interpret the results of an inferential test and understand the limitations of each procedure, and (6) compute descriptive and inferential statistics.	
Recommended Books	1. Statistical Data Analysis (Oxford Science Publications) by Glen Cowan 1998. **2. An Introduction to Multivariate Statistical Analysis , 2003 by T. W. Anderson**	
ME 503	**ADVANCED NUMERICAL ANALYSIS**	**3 (3+ 0)**
Pre-Requisite	Nil	
Course Objective	**1.** To integrate a discussion of the properties of engineering and physical problems with the discussion of methods by which such problems may be solved numerically	

	2. To provide understanding of main sources of numerical errors and the power of numerical methods that minimize these errors
Course Outline	Introduction: basic ideas, concepts, terminology, elements of a numerical method: differential formulation, solution domain and mesh, discretization, set of algebraic equations, solution algorithm. Preview: choice of numerical mesh, Cartesian, polar-cylindrical, general orthogonal, regular non-orthogonal, arbitrary triangular meshes, discretization, truncation and discretization errors, Newton's method of solving algebraic equation of single variable, Crammer's rule for solving set of equations, round off errors and their estimation. Polynomials and Finite differences: collocation-type polynomials, finite-difference-operator algebra, forms of polynomials, relationship to Taylor series. Finite differences: differences and Differential operators, basic operator relations, relations of first, second and higher order derivatives to difference series, solutions errors. Solution of equation sets: Ill-conditioning, iterative solution methods, Decomposition, Eigen-value problem, system stability, characteristic polynomial, roots, Eigen-values, convergence of solution scheme. Ordinary differential equations: order, methods of solving first order ordinary differential equations, higher order differential equations and their conversion into set of first order ordinary equations. Partial differential equations: variants of partial differential equation, choice of finite-difference formulation and solution algorithm, elliptic, parabolic and hyperbolic equations. Discretization and solution of second order 2-D steady diffusion equation, first order 1-D transient diffusion equation, first order 1-D convection equation, Finite volume approach
Recommended Books	1. Numerical Analysis by Richard L. Burden, John Douglas Faires, 9th Edition, Cengage Learning, 2010, ISBN: 0538733519, 9780538733519. 2. Applied Numerical Analysis by Curtis F. Gerald, Patrick O. Wheatley, 7th Edition (August 10, 2003), Pearson, ISBN-10: 0321133048, ISBN-13: 978-0321133045
ME 511	**ADVANCED ENGINEERING MATERIALS** | 3 (3 + 0)
Pre-Requisite	NIL
Course Objectives	• To be able to perform design using advanced materials and carry out research on mechanical properties of these materials. • To provide students with the latest developments in material technology and applications of new advanced materials.
Course Outline	Polymeric Material: High performance fiber, high performance elastomers, high performance coatings, special polymers, moderately high polymers, engineering polymers. Materials development and modification, multilayer and adhesive technology will also be part of this course. Physical and chemical testing of polymers. Fundamentals of polymers: Molecular structure, polymerization processes,

	morphology of polymer molecules, plasticizers and fillers. Composition and characteristics of principal types of polymers, convention constant rate of elongation test, creep tests, isochronous curves and other forms of data presentation, strain recovery and stress relaxation, anisotropy of properties time-dependence of strength and creep rupture, durability under cyclic loading BS impact tests. Fracture of polymers: Fundamentals of fracture mechanics, application of fracture mechanics to polymers, Kc determinations Kc crack speed curves instability, environmental effects impact testing, application to practical problems. Composites: Composite materials compared with conventional materials, fiber and matrices, composite mechanics, elastic properties, failure processes, failure at notches, notch sensitivity and fracture energy. Fatigue and failure of composite materials. Deterioration of properties owing to environmental conditions, hybrid composite materials, manufacturing the by hand lay-up, preparing specimen for mechanical testing, burn off tests to determine fibre volume fracture.	
Recommended Books	1. Polymeric Materials: Structure, Properties, Applications by G. W. Ehrenstein, HanserVerlag, 2001, ISBN: 1569903107, 9781569903100. 2. Composite Materials: Fatigue and Fracture, edited by Ronald B. Bucinell, 7th Volume, ASTM International, 1998, ISBN: 0803126093, 9780803126091. 3. Composite Materials: Science and Engineering by Krishan Kumar Chawla, Springer, 1987, ISBN: 0387984097, 9780387984094.	
ME 512	**FINITE ELEMENT ANALYSIS**	3 (3 + 0)
Pre-Requisite	NIL	
Course Objectives	• To develop comprehensive knowledge in the fundamental mathematical and physical basis of finite element method (FEM). • To develop complete FEM solution strategy for analysis of mechanical/thermo-mechanical systems.	
Course Outline	The stiffness method and the plane truss, Integral formulations and variational methods, week boundary value problem, Rayleigh – Ritz method, numerical error and accuracy analysis, Eigen value problem, Two and three Dimensional problems, Plane Elasticity, Bending of plates, beams, nonlinearity sources (material and geometric), techniques for nonlinear analysis, Basic Equations of Thermal Analysis, FEs for thermal analysis, Thermal transients, use of commercial FEA codes. Applications of FEA in the relevant fields of study.	
Recommended Books	1. Introduction to Finite Element Method by Frank Stasa, CBS. 2. Finite Element Procedures by Bathe, Prentice Hall. 3. ANSYS Manuals, ANSYS Publication.	
ME 513	**Mechanics of Composite Materials**	3 (3 + 0)
Pre-Requisite	NIL	
Course Objectives	• To develop comprehensive knowledge in mechanics of composites • To develop skills for design of composites.	

Course Outline	Introduction to composite materials, classification and characteristics of composite materials, mechanical behavior of composite materials, macro-mechanical behavior of a lamina, Stress Strain relation for anisotropic materials, Engineering constants for orthotropic materials, Stress strain relations for plane stress in orthotropic materials. Invariant properties of an orthotropic lamina, Strength of orthotropic laminas Biaxial strength theories for an orthotropic lamina, Biaxial strength theories for an orthotropic lamina. Micromechanical behavior of a lamina, Micromechanical behavior of a laminate. Classical lamination theory, special cases of laminate stiffness, strength of laminates. Entertainer stresses. Design of laminates. Bending, buckling and vibration of laminate plate.	
Recommended Books	Analysis and Performance of Fibre Composites, by Agarwal and Broutman, 2ndEd, John Wiley, NY, 1980	
ME 611	**THEORY OF ELASTICITY**	3 (3 + 0)
Pre-Requisite	NIL	
Course Objectives	• To develop concepts related to theory of elasticity and methods of solving the problems. • To apply the methods of theory of elasticity in technical calculations on the basis of illustrative examples.	
Course Outline	Cartesian Tensor Analysis, 3D state of stress and stress transformation, Principal stresses and planes. Mohr's Representation, Stress small deformation theory, Strain displacement relations, Strain compatibility equations. Stress-Strain relation, Lame's and engineering constants. Formulating of problem in elasticity, Bi-harmonic equation, Stress function. Plane stress and plane strain problem in Cartesian and polar coordinates. Principle of superposition, Uniqueness of elasticity solution, Axisymmertic plane problems. Semi inverse method. General solution of torsion problem. Solution derived from equations of boundaries. Approximate solution of torsion of cell sections, Review of the equations of the theory of elasticity.	
Recommended Books	1. Theory of Elasticity by S. P. Timoshenko and Goodier, McGraw- Hill. 2. Elasticity, Tensor and Dyadic Approach by Pe-Chi-Chou, John Wiley. 3. Advance Mechanics of Material by Hugh Ford, McGraw-Hill.	
ME 612	**EXPERIMENTAL STRESS ANALYSIS**	3 (3 + 0)
Pre-Requisite	NIL	
Course Objectives	• To learn the basics of commonly used Experimental Stress analysis techniques. • To train students in the modern methods of measuring strains (stresses), displacements, etc.	
Course Outline	Revision of Fundamental concepts of stress and strain in two and three dimensional. Mechanical and electrical gauges. Electrical resistance strain gage material, Foil and wire gages, Two and three elements rosette, Cross sensitivity	

	factor, Potentiometer and Wheatstone bridge circuit, Full-half and quarter bridge circuit, Strain indicators, Data acquisition systems, Transducers. Optics description of light as an electromagnetic wave. Maxwell's equations. Design of optical elements. Wave plates. Theory of diffraction of light, Stress optic law, Photo-elasticity. Caustics. Stress Freezing, Scattered ray and brittle coating techniques. Grid methods. Brittle coatings. Laser interferometry. Moire interferometry. Normal and transverse displacement interferometers. Mechanical testing of ductile and brittle materials. Quasi-static loading, Dynamic loading.	
Recommended Books	1. Experimental Stress Analysis by J. W. Dally and W. F. Riley. 2. Handbook on Experimental Mechanics. Edited by Albert S. Kobayashi.	
ME 613	**ENGINEERING DESIGN OPTIMIZATION**	3 (3 + 0)
Pre-Requisite:	NIL	
Course Objectives	• To provide knowledge about traditional optimization techniques and newer techniques for multidisciplinary optimization. • To develop ability for proper engineering optimization problem statement and select which method is appropriate for a given application.	
Course Outline:	Modeling. Mathematical modal. Nature of design process. Analysis and design models. Optimal design. Formal optimization model. Bounded ness, Feasibility and constraint activity. Topography of the design space. Mathematical review. Notation. Multi-variable functions. Continuity gradient and definite matrices. Convergence of algorithms. Conditions of optimality: necessary and sufficient conditions for unconstrained and constrained optima. Meeting of LaGrange multipliers. Methods of unconstrained optima. One dimensional minimization. Bisection and golden section initial bracketing, Polynomial interpolation. Multi-dimensional minimization. Steepest descent. Conjugate direction & conjugate gradient methods. Newton's method and its modifications. Quasi-Newton methods. Scaling. Stopping criteria. Methods for constrained optima. Interior and exterior penalty method. Augmented lagrangian method. Direct methods.	
Recommended Books	1. Principles of Optimal Design by Papalambros& Press, USA. Wilde, McGraw-Hill 2. Introduction To Optimum Design by J. Arora,	
ME 711	**FRACTURE MECHANICS**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• To calculate the stress-strain and load-displacement fields around a crack tip. • Identify and formulate stress intensity factor, strain energy release rate, and the stress and strain fields around a crack tip for linear and non linear materials. • To define and predict fracture toughness of materials and be familiar with the experimental methods to determine the fracture	

	toughness, and • To design materials and structures using fracture mechanics approaches.	
Course Outline	Introduction to fracture mechanics. Types of cracks. Fracture toughness, stress intensity factors. Crack opening modes. Singular stress fields, Crack tip stress fields. Ductile to brittle transition. Linear elastic and elastic-plastic fracture mechanics, J-integral, Post yield fracture mechanics, Failure theories. Fracture mechanics in design, experimental and analytical procedure in fracture mechanics. Case studies: ships, aerospace, and nuclear reactors	
ME 712	Fatigue Analysis	3 (3 + 0
Pre-Requisite	NIL	
Course Objectives	• To develop comprehensive knowledge of the fatigue failure • To develop skills for design against fatigue	
Course Outline	Nature of fatigue failure, crack nucleation and crack propagation. Fatigue testing machines. High cycle fatigue. The SNP curves and factors affecting SNP curves. The influence of non-zero mean stresses. Multiaxial fatigue stresses and fatigue failuretheories. Commutative fat/gue damage and life prediction. Low cycle fatigue. The strain-life curve and low cycle fatigue relationships. Commutative damage in low cycle fatigue. Fatigue stress concentration factors for elastic and plastic ranges.	
Recommended Books	*Metal fatigue: what it is and why it matters, vol 145 of solid mechanics and its applications, LP Pook, Springer, 2007* *Fatigue of metals and structures, HJ Grover, SA Gordon and LR Jackson, Thames and* *Hudson, 1956*	
ME 713	**Tribology**	3 (3 + 0)
Pre-Requisite	NIL	
Course Objectives	• To understand mechanisms of wear, erosion and corrosion • To develop skills for the design selection of lubrication	
Course Outline	Theories of friction. Mechanism of wear, adhesive, abrasive, corrosive and other types of wear & measurement, lubricants, properties, hydrostatic & hydrodynamic lubrication, Elasto-hydro-dynamic lubrication, solid film lubrication, and boundary lubrication, Bearing types and selection, Design procedure and performance evaluation.	
Recommended Books	*Tribology: friction and wear of engineering materials, Ian M Hutchings, Edward* *Arnold, 1992* *Tribology: principles and design applications, RD Arnell, Macmillam, 1991*	
ME 813	**SPECIAL TOPICS IN DESIGN ENGINEERING**	**3(3+0)**
Pre-Requisite		

Course Objectives		
Course Outline		
Recommended Books		
ME 521	**Behavior of Materials under Impact Loading**	**3 (3 + 0)**
Pre-Requisite	Nil	
Course Objectives	To understand impact phenomenon To design against impact loading	
Course Outline	Stress waves: Propagation of elastic waves in continuum. Wave Reflections and interaction. Solution of wave equation by method of characteristics. Experimental techniques, diagnostic tools: Laser interferometry, rotating cameras. Experimental techniques for impact loading hopkinsion bar, kolsky bar, fracture Bar, gas gun. Material behavior under high strain rates: Steel, Aluminum alloys, MMCs, Plastics. Dynamic Fracture: Fracture Mechanics, Limiting Crack Speed. Crack Branching. Stress wave loading of cracks. Spalling. Fragmentation. Dynamic fracture of steels, Aluminum alloys, Plastics. Applications: introduction. Shaped charges and projectiles. Penetration. Armor. Dynamic Effects in Geological Materials. Dynamic Events in Space.	
Recommended Books	*Impact loading and dynamic behaviour of materials, CY Chiem, HD Kunze and LW* *Meyer, Ir Publications Ltd., 1968*	
ME 621	**Mechanism Design**	**3 (3 + 0)**
Pre-Requisite	Nil	
Course Objectives	To understand kinematics an dydmanimics of mechanisms To analyze mechanisms	
Course Outline	Kinematics and dynamic characteristics of planar and spatial mechanisms, Vector and graphical methods for kinematics analysis, Introduction to graphical and computer methods for kinematics synthesis of mechanisms, Methods for dynamic analysis of mechanisms, Applications from industrial machine systems and robotics	

	manipulators.	
Recommended Books	*Mechanism design: enumeration of kinematic structures according to function, Lung-Wen Tsai, CRC press 2001*	
ME622	**Condition Monitoring of Rotating Machinery**	**3 (3 + 0)**
Pre-Requisite	Nil	
Course Objectives	To understand the the basics of rotator machinray vibrations To develop skills for the monitoring and manatanance of rotating machinery	
Course Outline	Introduction to basic concepts of machine condition monitoring, conditions based maintenance techniques in industry, predictive analysis, diagnostic analysis, Major benefits of a conditions monitoring program. Practical machine condition monitoring systems in industry, vibration monitoring wear debris monitoring, temperature monitoring, noise monitoring, performance monitoring, data accusation methods, Data analysis techniques, Data interpretations and diagl1liStics, Instrumentation required. Computer aided machine condition monitoring, Use of rotor dynamic simulation as an aid to fault diagnostics, Intelligent knowledge based expert systems for continuous machine surveillance in advanced condition monitoring. Selection and installation of a Machine condition monitoring system, Analysis of the problem measurable parameters, System requirement, Economic considerations in the selection and installation of a machine condition monitoring system, case studies.	
Recommended Books	*Rotating machinery vibration: from analysis to trouble shooting, ML Adams, CRC* *press, 2001* *Vibratory condition monitoring of machines, JS Rao, CRC press, 2000* ME **Mechanics of Micro Structure** 3 Credits	
ME 721	**ADVANCED MECHANICAL VIBRATIONS**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• To learn application of analytical and computational methods for machine design and vibration control problems. • To enable students in conducting basic vibration analysis of systems with a large number of degrees of freedom.	
Course Outline	Properties of vibrating system, Lagrange's equation. Continuous systems: Transverse vibration of string of cable, longitudinal. Use of computers for solution of vibration problems. Orthogonality of Eigen vectors, modal matrix, normal mode summation, computational methods, Gauss elimination, matrix iteration to the Finite Element Method, mode summation procedures for continuous systems, random vibrations, non-linear vibrations, perturbation method, phase plan, modal analysis.	
Recommended Books	1. Mechanical Vibrations, S. S. Rao, Prentice Hall, 5th edition. 2. Theory of Vibration with Applications, W. T. Thomson, Prentice Hall, 5th edition. 3. Fundamentals of Mechanical Vibrations, S. G. Kelly, McGraw-Hill, 2nd	

	edition.

ME 722	**ROBOTICS**	3 (3 + 0)
Pre-Requisite:	NIL	
Course Objectives	• To familiarize the students with the concepts and techniques in robot manipulator control, to incorporate robots in engineering systems. • To impart fundamentals of manipulators, sensors, actuators, end effectors and product design for automation.	
Course Outline:	An overview of Robotics, Drive methods, Sensors for robots. Spatial description and transformation, Forward kinematics Inverse Kinematics Jacobean, Denavit-Hartenherg coordinate transformations, Force/Torque relations, Trajectory planning, Dynamics, Lagrange equations, Position control, PID control, Inverse dynamics feed forward control, Nonlinear and two parts control. open-Loop Manipulators, Closed Loop Linkages, Epicyclical Gear Drives, Wrist Mechanisms, Tendon Driven Robotics Hands. Robot Sensors including contact sensors and proximity sensors, Machine vision systems Robotics application growth and cost.	
Recommended Books	1. Robotics: Modelling, Planning and Control *Advanced Textbooks in Control and Signal Processing*, by Lorenzo Sciavicco, Springer, 2009, ISSN 1439-2232, ISBN: 1846286417, 9781846286414. 2. Springer Handbook of Robotics *Gale virtual reference library, edited by* Bruno Siciliano, OussamaKhatib, Springer, 2008, ISBN: 354023957X, 9783540239574. 3. Introduction to Robotics: Mechanics and Control By John J. Craig, Prentice Hall; 3rd Edition (August 6, 2004), ISBN-10: 0201543613, ISBN-13: 978-0201543612.	

ME 821	**ENGINEERING ACOUSTICS**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	1. Calculate the displacement and velocity of a second-order mechanical system assuming simple harmonic motion with loss and with forced harmonic excitation. 2. Derive the one-dimensional wave equation for transverse waves on a string. 3. Use the appropriate general solution of the one-dimensional wave equation of the string and solve for the transverse wave function given boundary conditions. 4. Calculate the input mechanical impedance and average input power to a string under forced harmonic excitation. 5. Derive the one-dimensional lossless wave equation for an acoustic wave in a fluid. 6. Calculate the propagation speed in a fluid from the fluid's equation of state and from the fluid's adiabatic bulk modulus and equilibrium	

	density. 7. Derive and solve by separation of variables the three-dimensional acoustic wave equation in a fluid. 8. Calculate energy density and acoustic intensity for both a plane progressive wave and spherical progressive wave in a fluid from any of the first-order propagation quanitities (particle displacement, particle velocity, particle acceleration, excess density, acoustic pressure, condensation, sound pressure level, temperature fluctuation). 9. Derive the pressure reflection coefficient and pressure transmission coefficient using a locally-reacting boundary condition between two fluid media when the incident acoustic wave is normally incident on the boundary. 10. Calculate the pressure reflection coefficient and pressure transmission coefficient between two fluid media when the incident acoustic wave is normally incident on the boundary. 11. Calculate the locations of nodes and antinodes in a standing acoustic wave. 12. Calculate the standing wave ratio (SWR) in a standing acoustic wave. 13. Derive and apply Snell's Law using phase matching conditions. 14. Calculate the pressure reflection coefficient and pressure transmission coefficient between two fluid media when the incident acoustic wave is both normally and obliquely incident on the boundary. 15. Identify the condition for which a critical angle and an angle of intromission exist, and calculate these angles from the fluid properties. 16. Calculate the pressure reflection coefficient and pressure transmission coefficient when an interposed layer of known thickness exists between two media when the incident acoustic wave is normally incident on the boundary. 17. Derive the surface displacement boundary conditions for a radially oscillating sphere in a fluid and derive the propagated acoustic field from this source. 18. Derive the far field acoustic pressure distribution for in-phase continuous line source by applying the field sources from the monopole solution. 19. Calculate the beam width and locations of the sidelobes and nulls from the in-phase continuous line source. 20. Derive the near field (Fresnel) and far field (Fraunhoffer) acoustic pressure distribution for the baffled circular piston source. 21. Calculate the on-axis and off-axis acoustic pressure and sidelobes

	and nulls from the baffled circular piston source. 22. Derive the far field acoustic pressure distribution for the linear array by applying the field sources from the monopole solution. 23. Calculate the on-axis and off-axis acoustic pressure and sidelobes, nulls and grating lobes from the linear array source. 24. Calculate the resonant frequency in a pipe which has either a rigid or open end, and calculate the total acoustic power radiated under the open-pipe condition. 25. Calculate the intensity reflection coefficient and intensity transmission coefficient in a pipe that has a side branch. This solution models many wind instruments. 26. Derive the acoustic radiation impedance function of a Helmholtz resonator.
Course Outline	Vibration & Waves • How are time and space related? What about the relation between frequency and wavelength? • Does the characteristic impedance of medium determine reflection and transmission? • Do we well see the waves of a string in terms of driving point impedance? Acoustics Wave Equation and Its Basic Physical Measures (1D acoustic wave equation, Acoustic Intensity and Energy, Units of Sound) • What are the relations of acoustic pressure, density, and particle velocity? • How do they make acoustic wave equation? • Is acoustic wave well analogous with one dimension string wave? Acoustics Wave Equation and Its Basic Physical Measures (Acoustic Intensity and Energy, Solutions of the Wave equation, Demonstration: hearing system) • What about the relation between acoustic intensity and energy? • How does human hearing system measure sound and its characteristics? • Let us experience the change of sound in level and frequency! Waves on a Flat Surface of Discontinuity

	(Normal incidence on a Flat Surface, The Mass Law) • How mathematically express the boundary conditions at discontinuity? • How does impedance at discontinuity determine reflection and transmission? • When can we use mass law? Waves on a Flat Surface of Discontinuity (Transmission Loss, Snell's Law, Transmission and Reflection of an Infinite Plate/Finite Structure) • How different is the transmission loss of a flexible partition compared to the mass law? • Does the obliqueness of wave play a critical role to determine transmitted and reflected wave? • What are the roles of partition and fluid loading impedance to transmission loss?
Recommended Books	1. Sound Propagation: An Impedance Based Approach by, Yang-Hann Kim (Wiley & Sons, 2010).
ME 822	**MODAL ANALYSIS** **3 (3 + 0)**
Pre-Requisite	NIL
Course Objectives	• To give an understanding of Modal Testing, its possibilities, limitations and to perform proper mobility measurements as the basis for modal analysis • To explain and demonstrate how to plan and execute a complete modal test and to perform modal analysis on real structures
Course Outline	Introduction, Application and philosophy of modal testing, Summary of theory, Measurement methods, Analysis and test procedures, Introduction to mobility measurement techniques, Basis measurement system structure preparation, Excitation of structure, Transducer and amplifiers, Analyzers, Digital signal processing, Use of different excitation types, Calibration, Mass cancellation, Rotational mobility measurement, Measurement on non-linear structure, Multi excitation methods, Introduction to model parameters extraction methods, Preliminary checks of PRF data, SDOF modal analysis, I peak amplitude, SDOF modal analysis-II, Circle fit method, SDOF Modal analysis-III inverse method, MDOF curve-fitting procedures, MDOF curve –fitting in the same domain, Global or multi curve-fitting, Non-linear systems. Introduction to derivation mathematical models, modal models, Display of modal model, Response models, Spatial models, Mobility skeletons and system models. Applications, comparison of experiment and prediction, correction of adjustment of models, Structure modifications; Coupled structure analysis, Response prediction modifications, Coupled structure analysis, Response prediction and force determination.

Recommended Books	1. Modal Analysis By D. J. Ewins, Wiley. 2. Modal Testing, Theory and Practice By D. J. Ewins, Wiley.	
ME 823	**ADVANCED AUTOMATIC CONTROL SYSTEMS**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• *To develop an understanding of the principles of control and optimisation in industry;* • *To analyse the system response and stability in terms of root locus and frequency response techniques;* *To apply these principles to technological and commercial systems including the selection and application of hardware and software for a variety of process plants.*	
Course Outline	*Mechanical Systems, representation of Control Systems, z-Transform, State-Space response, Digital Control System, Frequency Response Methods, Controllability and absorbability, Design of observers, Stochastic Analysis of Control System, error Analysis, stability, Lyapunov's stability criterion, Modeling of Control using MATLIB*	
Recommended Books	1. Adaptive control systems: techniques and applications, Vol 39 of electrical engineering and electronics, electrical and computer engineering, VV Chalam, CRC Press 1987	
ME 824	**SPECIAL TOPICS IN DYNAMICS AND CONTROL**	**3 (3 + 0)**
Pre-Requisite		
Course Objectives		
Course Outline		
Recommended Books		
ME531	**Computational Fluid Dynamics**	**3 (3 + 0)**
Pre-Requisite	**nil**	
Course Objectives	To understand numerical methods to model fluid flow behaviour	
Course Outline	Introduction; partial differential equation; Basics of finite-difference methods; Concepts of error, consistency and stability; Momentum and energy equations; Diffusion equations; Turbulence modeling; Boundary layer computational methods;	
Recommended Books	*Computational Fluid Mechanics and Heat Transfer by Anderson, Tanehill, & Fletcher, Hemisphere Pub, NY 1984*	
ME532	**Propulsion Engineering**	3(3+0)
Pre-Requisite	*nil*	
Course Objectives	The objectives of this course are to develop an understanding of how air-breathing engines and chemical rockets produce thrust; an ability to do overall engine performance analysis calculations; an ability to carry out performance	

	calculations for individual engine components; an ability to carry out performance analysis for chemical rockets; an understanding of elementary overall engine design considerations.
Course Outline	Dynamics and thermodynamics of perfect gases, Quasi-one-dimensional flow, thrust and efficiencies, Aircraft jet engines, propellers, ramjets, Subsonic inlets, supersonic inlets, Turbojets, turbofans, turboprops, Engine performance, engine and aircraft matching, Engine performance, engine and aircraft matching, Chemical rockets, thrust chambers, nozzles, Liquid and solid propellant engines
Recommended Books	P.G. Hill and C. R. Peterson, *Mechanics and Thermodynamics of Propulsion*, Addison Wesley, 2nd Edition, 1992.
ME533	**Nuclear Engineering 3(3+0)**
	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, 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. 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
Recommended Books	Nuclear Power Plants by MM Elwakil
ME 631	**SOLAR ENERGY UTILIZATION** **3 (3 + 0)**
Pre-Requisite	NIL
Course Objectives	• The common conventional and alternative resources and technologies for producing electrical power work and describe the role and the resource it plays in the current energy economy • Define key characteristics of solar power resources, and bioenergy resources and prepare a preliminary commercial assessment for a solar power project • Compare economic and environmental factors associated with the production, distribution, and use of solar energy sources to conventional approaches for generating electric power; and, describe key public policies affecting solar power generation and identify the role played by these policies in shaping the electric power industry.

Course Outline	Advanced topics including passive, active and hybrid heating techniques, thermal storage and solar ponds, equipment in solar systems, solar distillation and evaporation, solar cooling and refrigeration, solar pumping and irrigation, high temperature applications, photovoltaic, utilization of other renewable energy resources, biomass, wind energy etc.	
Recommended Books	*1. Solar energy engineering, AAM Sayigh and CE Backus, Academic press, 1977* *2. Solar energy utilization, ed H Yuncu, E Paykoc and YamanYener, Springer 1987*	
ME 632	**COMBUSTION ENGINEERING**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• Understanding of fundamental relationships between mass, moles, energy forms, and temperature • Application of combustion engineering analysis principles to waste, boilers, burners, etc. • Understanding and use of mass and energy balances to size units, fans, ducts, air pollution control systems, prepare permit calculations, etc. • Understanding of the different kinds of property analyses that are used to characterize fuels and wastes • Understanding of how fuel/waste characteristics affect important system behavior and operational parameters • Understanding of alternative approaches to estimate fuel/waste heat content • Understanding of how to develop estimates of the enthalpy of gas mixtures • Understanding of the basics of equilibrium processes that impact on combustion • Application of equilibrium theory in the analysis of combustion systems • Understanding of the basics of combustion kinetics and mechanisms • Application of kinetic principles in the analysis of combustion systems	
Course Outline	Combustion thermodynamics, introduction to chemical kinetics of	

	combustion, combustion properties of fuels, flammability of combustible mixtures. Flame propagation mechanisms, pre-mixed and diffusional; stability of flames; introduction to combustion aerodynamics, jet flames; atomization; droplet and spray combustion. Elementary ignition concepts and theory. Basic detonation theory.	
Recommended Books	*1. Combustion: physical and chemical fundamentals, modeling and simulation, experiements, pollutant formation, J Warnatz, Ulrich Maas and Robert W Dibble, fourth ed., Springer, 2006* *2. Combustion, Irvin Glassman and Richard A Yetter, fourth ed., Academic press, 2008*	
ME 731	**EXPERIMENTAL METHODS IN FLUID**	3 (3 + 0)
Pre-Requisite	NIL	
Course Objectives	• To introduce students to a selection of currently used experimental methods for measuring fluid flows. • To expose the student to the limitations of experimental measurement systems and the validity of the produced data. • To introduce the importance of estimating and reporting uncertainty levels in experimental data	
Course Outline	Instruments for measurement in fluid flow: monitoring and controlling processes, engineering analysis, categories of flow, instrumentation in thermo-fluids, planning, designing and carrying out experiments, stages of an experimental investigation. Pressure differential devices: incompressible and compressible flow cases, idealized analysis of flow meters, practical flowmeters, Rota meter, idealized analysis, use with gases, calibration. Turbulence and Reynolds number: 2-D nozzle jet flow, time-dependent flow, coordinates and notation of the actual, mean and fluctuating components of flow velocity, time-averaged quantities, case studies. Pressure measurements: measurement at wall, manometers and instruments, pressure transducers, Pitot tubes (probes) performance, error sources, Pitot-static tubes performance. Flow system: open and closed circuit wind tunnels, high-pressure and /high-temperature closed circuit wind tunnels, working section, use of screens, meshes, gauzes, course meshes, honeycombs, nozzles, diffusers, contractions, bell-mouth contractions, refracting meshes, splitter plates, guide vans, blowing (Coanda effect), boundary layer suction, corners, corner vanes. Hot wire anemometry (HWA): measurement of mean and fluctuating components of velocity, HW response, King's law, Constant current (CCA) and constant temperature anemometers (CTA), calibration procedures, directional characteristics, normal yawed and crossed wires, processing the hotwire signals. Hot film anemometry, HWA versus HFA. Laser Doppler Anemometry (LDA): basic Doppler effect, laser light properties, components of LDA system, general schematic of an LDA system, 2-beam LDA system, signal processing, counters and trackers, Bragg cell, forward and backward LDA, choice between LDA, HWA and HFA.	

	Transducers: strain gauge, Piezo-electric, diaphragm pressure transducers, measurement of mechanical displacement, velocity, acceleration, rotational speed. Combustion flow measurements: measurement of temperature, pressure, velocity, density, pollutants, NO x , SO x ,HO x ,HC, and fuel concentrations, Particle sizing: mean droplet size, size distribution of droplets, droplet velocities, and trajectories, mean droplet diameters, non-intrusive techniques, spark photography, light scattering- laser diffraction, single particle counting, soot particles. High-speed cine film photography, holography, use of digital camera for experimentation and flow visualization in thermo-fluids.	
Recommended Books	1. Springer Handbook of Experimental Fluid Mechanics, Volume 1, edited by Cameron Tropea, Alexander L. Yarin, John F. Foss, Springer, 2007, ISBN: 3540251413, 9783540251415. 2. Hot Wire Anemometry: Principles and Signal Analysis *Oxford science publications, by* H. H. Bruun, edition: illustrated, reprint, Oxford University Press, 1995, ISBN: 0198563426, 9780198563426. 3. Fluid Mechanics Measurements, by R. Goldstein, Publisher: CRC Press; 2nd edition (March 1, 1996), ISBN-10: 156032306X, ISBN-13: 978-1560323068.	
ME 732	**ENERGY MANAGEMENT**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• *Knowledge of how economic analysis can help understand problems related to energy;* • *To analyse alternative energy policy options in terms of benefits and costs;* • *To have a good understanding of world energy markets;* • *To analyse the risks associated with energy options.* • *Skills needed to structure, analyse and evaluate energy-related problems*	
Course Outline	*Energy scene, Thermodynamics and energy, heat and mass transfer, waste heat recovery, vapor diffusion and condensation. Energy surveys and energy audits; laws of energy and materials flows, checklists for energy managers, case study generation, evaluation and optimization of options for energy conservation*	
Recommended Books	1. Energy management: theory and practice, vol 8 of energy, power and environment, HW Henry, M. Dekker, 1980 2. Guide to energy management, BL Capehart, WC Turner and WJ Kennedy, fourth ed., Fairmont press inc. 2002	
ME 831	**ADVANCED THERMODYNAMICS**	3 (3 + 0)
Pre-Requisite:	NIL	
Course Objectives	• Development of equations of state and thermodynamic property relations. • Enabling students to perform multi-component and multiphase system analysis.	

Course Outline:	Equilibrium of thermodynamics systems: concept of equilibrium, spontaneous change, criterion of stability, equilibrium of system, Van der Waals' equation. Systems of constant chemical composition: thermodynamic properties, equation of state, law of corresponding states, relations for pure substance, applications, specific heats, Clausius–Clapeyron equation, liquefaction of gases. Ideal gases and ideal gas mixtures of constant composition: state of all ideal gases, internal energy and enthalpy of an ideal gas, entropy of an ideal gas-the third law of thermodynamics, Gibbs free energy equation, heats of reaction or calorific values, adiabatic combustion, heats of formation and Hess's law, entropy of ideal gas mixtures. Gas mixtures of variable composition: chemical potential, stoichiometry and dissociation, chemical equilibrium, equilibrium constant and heat of reaction, Van't Hoff's equation, calculations, temperature rise due combustion reaction, Lighthill ideal dissociating gas, ionization of monatomic gases, non-equilibrium processes, equilibrium and frozen flows. Special systems: application of thermodynamics to elastic systems, systems with surface tension, reversible cell, fuel cell, magnetic systems, steady state or irreversible thermodynamics, thermo-electricity.
Recommended Books	1. Advanced Thermodynamics *Mercury Learning Series, by* Scott Post, Mercury Learning & Information, 2013, ISBN: 1936420279, 9781936420278. 2. Advanced thermodynamics for engineers, by D. E. Winterbone, Arnold, 1997, ISBN: 047023718X, 9780470237182. 3. Advanced Engineering Thermodynamics, 3rd Edition, Adrian Bejan, August 2006, ISBN: 978-0-471-67763-5.
ME 832	**ADVANCED FLUID MECHANICS** | 3 (3 + 0)
Pre-Requisite:	NIL
Course Objectives	• To train students to identify, formulate and solve engineering problems concerning internal and external flows. • To formulate the boundary layer problems and momentum integral equation and to obtain the exact solutions or the approximate solutions of the momentum equation.
Course Outline:	Fluid Dynamics: Laminar and turbulent boundary layer flow with and without heat transfer, boundary layer separation stability transition and control. Kinematics and dynamics of flow of continuous media, Navier-Stokes equation, simplification, exact and approximate solution. Irrational of hydrodynamics stability, turbulence, free shear flows, chemical reactions, and shock expansion. Rotating Fluid Machinery: Aero dynamics of compressors & turbines, subsonic, transonic and supersonic flow characteristics, secondary flow and stall stability, components matching of total non-dimensional representation of performance.
Recommended Books	1. Advanced Fluid Mechanics, by William Graebel, Academic Press; 1st edition (July 5, 2007), ISBN-10: 0123708850, ISBN-13: 978-0123708854. 2. Advanced Engineering Fluid Mechanics by K. Muralidhar, Gautam Biswas,

	2nd edition, reprint, Alpha Science International, 2005, ISBN:184265134X, 9781842651346. 3. Advanced Fluid Mechanics: An Introduction by ArvedJaanRaudkivi, Robert A. Callander, John Wiley & Sons, Incorporated, ISBN: 0470709405, 9780470709405.	
ME 833	**ADVANCED HEAT TRANSFER**	3 (3 + 0)
Pre-Requisite	NIL	
Course Objectives	• To demonstrate and in-depth understanding of fundamental heat transfer principles • To develop analytic solutions of simplified heat transfer problems	
Course Outline	**Conduction:** Review of analytical methods in heat conduction, melting and freezing, sources and sinks, anisotropic and composites media, numerical methods for steady and unsteady state problems. Numerical methods for solution of steady and unsteady state conduction problems. **Convection:** Analysis of isothermal and non-isothermal boundary layers. Exact and approximate solution of laminar and turbulent flow, variable property and high speed effect, the dimensional analysis. Navier-Stokes equations numerical solutions by velocity and temperature fields in boundary layers of simple and complex shapes. **Radiation** Heat Transfer: Radiation properties; black body radiation, shape factor of radiations, network analogy, and solar radiation.	
Recommended Books	1. Heat Transfer: Textbook by John H. Lienhard. **2.** Heat and Mass Transfer, by Frank P. Incropera.	
ME 834	**SPECIAL TOPICS IN MECHANICAL POWER ENGINEERING**	**3 (3 + 0)**
Pre-Requisite		
Course Objectives		
Course Outline		
Recommended Books		
ME 541	**ADVANCED METAL FORMING**	3 (3 + 0)
Pre-Requisite	NIL	
Course Objectives	• To provide student with the understanding of mechanics & various materials widely used in metal forming processes. • To develop ability evaluating the basic design methodologies for metal forming contents.	
Course Outline	Macroscopic Plasticity & Yield Criteria: Tresca, & Von Mises criterion; Plastic work, Effective stress; Effective strain; Flow rules for plastic stress – strain relations; Principle of normality. Work hardening & Plastic instability: Tensile test; Mechanical properties; Nominal and true stress-strain curves; work hardening expression; Behavior after necking; Direct compression; Bulge test; Plane-strain compression test.	

	General approach to instability; Balanced biaxial tensin; Thin-walled sphere internal pressure; significance of instability. Strain Rae and Temperature: Strain rate; Super plasticity; combined stress and strain-rate effects; Strain rate dependence; Temperature dependence of flow stress; Hot working; temperature rise during deformation. Ideal Work: Ideal Work or uniform energy; Extrusion & rod drawing; Friction; Redundant work, and mechanical efficiency; Maximum drawing reduction. Slab analysis: Sheet drawing; Comparison of slab method & ideal work method; wire drawing; Direct compression in plane strain; Average pressure during plane-strain compression; Sticking friction; Axisymmetric compression; Flat rolling. Bending: Spring back in sheet bending; Bending with superimposed tension; Sheet bend ability; Bending of sheets & tubes; Forming limits in shape bending. Cupping, Redrawing, and Ironing Cup drawing; Effects of work hardening; Deformation efficiency; Effects of tooling; Redrawing; Ironing. Complex Stamping: Localized necking in biaxial stretching; Formability; Formain limit diagrams; Cupping test; Edge cracking; Bulk forming tests.	
Recommended Books	1. Metal Forming Mechanics and Metallurgy by William F. Hosford and Robert M. Caddell. 2. Theory of Plasticity by J. Lubli 3. Mechanical Metallurgy by Dieter	
Recommended Books	1. CAD/CAM by McMohen& Brownie. 2. Product Design & Development by Ulrich Eppinger 3. Total Design by Pugh.	
ME 542	**LEAN AND AGILE MANUFACTURING**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• To design a globally competitive manufacturing organisation using lean and agile manufacturing principles; • To develop the skills to implement lean manufacturing in industry and manage the change process to achieve continuous improvement of efficiency and productivity. • Identify and understand the key requirements and concepts in lean and agile manufacturing and to initiate a continuous improvement change program in a manufacturing organisation; • Apply the tools in lean and agile manufacturing to analyse a manufacturing system and plan for its improvements; • Manage the manufacturing system to achieve six sigma quality and sustainability.	
Course Outline	Holistic understanding of manufacturing (systems approach, manufacturing strategy, quality sytems, design for manufacture). Problem solving and decision making (analysis and synthesis, analytical and system thinking, intuition, judgement, result interpretation) Working	

	in teams and professional networks (project management, conflict resolution, negotiation, professional networking, persuasion, organization, communication, interpersonal skills) Leadership (initiate and facilitate technological change and innovation, cross-discipline collaboration, cross-cultural communication) International and cultural awareness (ability to work in global teams and settings, ability to adapt to different work contexts). This course introduce to key concepts in lean and agile manufacturing such as continuous improvement, just-in-time production, "pull" philosophy, TQM. The course focuses on the methods and tools commonly used to analyse the existing state of a manufacturing environment, including value stream mapping, Kaizen cycle, single minute exchange of dies (SMED), six sigma and capability index. Illustrated with case studies and worked examples, the course will examine the socio-technical interactions within a modern manufacturing organisation and develop skills and processes for implementing changes for achieving agile manufacturing and global competitiveness
Recommended Books	**1.** Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities by V. Sivakumar, S.R. Devadasan, 2010.
ME 641	**MANUFACTURING PLANNING AND CONTROL** **3 (3 + 0)**
Pre-Requisite	NIL
Course Objectives	• A systematic exposition of the design, planning and control problems that arise in the context of the aforementioned facilities. • A systematic introduction to inventory control theory and its application in the contemporary production and distribution networks. • A formal analysis of the dynamics of production processes, based on queueing theoretic concepts and models. • The integration of the results developed to the prevailing production planning and control framework(s).
Course Outline	• Contemporary organizations and the role of Operations Management (OM) • The basic organizational structure and the scope of the OM issues addressed in this course • Corporate strategy and its connection to operations • The basic course structure Inventory Control Theory • The basic EOQ model and some of its variants • Replenishment coordinating approaches • Dynamic Lot Sizing • Statistical Inventory Control Models o The News Vendor Model o The Base Stock Model o The (Q,r) Model • An introduction to multi-echelon models (time permitting) Factory Physics: A queueing-theoretic analysis of serial production systems

	• Flow lines as the preferred layout for discrete-part, repetitive manufacturing
	• Flow line classification: Push vs. Pull, Synchronous vs. Asynchronous production lines, KANBAN and CONWIP-based production systems
	• Characterizing a flow line as a queueing system
	• Understanding the fundamental relationships between the line attributes and its performance indices
	• Analyzing the impact of the various operational detractors and the resulting operational variability
	Integrating the Factory Physics insights to the OM practice
	• Process Design, Capacity Planning and Line Balancing
	• Hierarchical Production Planning
	  • The classical Hierarchical Planning framework
	  • Forecasting
	  • Aggregate Planning
	  • Master Production Scheduling (MPS) and Material Requirement Planning (MRP), and their limitations
	  • Shop floor scheduling
	• Just-in-Time (JIT) and Lean Manufacturing
	  • The JIT philosophy
	  • JIT practices and the KANBAN production authorization system
	  • Shop-floor control based on the CONWIP production authorization model
	  • Production Planning and Scheduling for CONWIP-controlled production systems
	• The JIT limitations

Recommended Books	1. Bill Scott, *Manufacturing Planning Systems*, McGraw Hill: A more practical but nicely structured perspective on MRP-based production planning and control. 2. A.C. Hax and D. Candea, *Production and Inventory Management*, Prentice Hall: A classical reference for the Hierarchical Production Planning and Control framework. 3. R. G. Askins and Jeffrey B. Goldberg, *Design and Analysis of Lean Production Systems*, John Wiley & Sons: Another formal treatment of the production planning and control problem, with considerable emphasis on modern trends. 4. G. Cachon and C. Terwiesch, *Matching Supply with Demand*, McGraw Hill: A business-school version of the prevailing theory on (production) process design and analysis. 5. J. Buzacott and G. Shantikumar, *Stochastic Models of Manufacturing Systems*, Prentice Hall: A rigorous treatement of the queueing-theoretic modeling and analysis of many manufacturing systems layouts encountered in contemporary practice. 6. S. Gershwin, *Manufacturing System Engineering*, Prentice Hall: The production planning and control problem addressed as a stochastic

	optimal control problem. **7.** E. Silver, D. Pyke and R. Peterson, *Inventory Management and Production Planning and Scheduling*,Wiley: Maybe the most standard textbook on Inventory Control theory.	
ME 642	**WORK DESIGN AND MEASUREMENT**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	▪ Calculate the time that a task or set of tasks should take to be performed. ▪ Apply predetermined time values to activities from memory or from a data card according to the rules of BasicMOST work measurement system. ▪ Observe operator activities and write accurate method descriptions using the work measurement system. ▪ Analyze work on the basis of moving objects using the BasicMOST work measurement system. ▪ Identify work measurement activities in terms of the basic sequence models for manual work: General Move, Controlled Move, Tool Use and Equipment Use.	
Course Outline	Understand the foundation of work measurement ▪ Learn why work measurement is important to an organization. ▪ Learn about the traditional work measurement techniques of time study and predetermined motion time systems. ▪ Application courses designed to teach and provide practice in completing sequence models. ▪ Video courses designed to guide the participant through the complete process of identifying objects and measuring work with MOST. Learn the four basic sequence models used in the BasicMOST work measurement system ▪ General Move – work measurement sequence model for the movement of an object freely through the air. ▪ Controlled Move – work measurement sequence model for the movement of an object while it remains in contact with a surface or is attached to another object during movement. ▪ Tool Use – work measurement sequence model for the use of common hand tools. ▪ Equipment Use - sequence model for various administrative activities.	
Recommended Books	**1. Motion and Time Study: Design and Measurement, by Ralph M. Barnes** **2. Work Measurement and Methods Improvement, by Lawrence S. Aft**	
ME 741	**ADVANCED STATISTICS AND DATA MINING**	**3 (3 + 0)**

Pre-Requisite	NIL
Course Objectives	This course complements the background of many students with the theoretical and practical fundamentals of those modern techniques employed in the analysis and modelling of large data sets. This makes it very interesting since there are no specific studies on this kind of techniques. To get the student acquainted with a set of computational tools in which the learned techniques can be applied. This may involve tackling practical problems from the students own work environment, i.e., working with a student's own data set.
Course Outline	1. Searching by similarity*: Searching by content (texts, images, genes, ...); attributes, representations and definitions of similarity and distance; choice of representation; multi-dimensional scaling; classifications; image search and invariants; user feedback; evaluating searches* 2. Information*: information and uncertainty; classes and attributes; interactions among attributes* 3. Clustering*: supervised and unsupervised learning; categorization; unsupervised category-learning, a.k.a. clustering;* k*-means clustering; hierarchical clustering; geometry of clusters; what makes a good cluster?* 4. Data-reduction and feature-enhancement*: Standardizing data; using principal components to eliminate attributes; using factor analysis to eliminate attributes; limits and pitfalls of PCA and factor analysis; nonlinear dimensionality reduction: local linear embedding, diffusion maps* 5. Regression *Review of linear regression; transformations to linearity; the truth about linear regression; local linear regression; polynomial regression; kernel regression; additive models; other non-parametric methods* 6. Prediction*: Evaluating predictive models; over-fitting and capacity control; regression trees; classification trees; combining predictive models; forests; how to gamble if you must* 7. Classification*: Supervised categorization; linear classifiers; logistic regression; the kernel trick; base rates, Neyman-Pearson classifiers, ROC curves* 8. Distributions*: Histograms and the fundamental theorem of statistics; kernel density estimation; conditional density estimation; relative distributions; mixture models, probabilistic clustering, the EM algorithm; clustering with confidence; large numbers of rare events* 9. Modeling interventions*: Estimating causal impacts without experiments; matching; graphical causal models and Tetrad.* 10. Waste and Abuse*: when data mining will fail: bad data, wrong data, insufficient data, overwhelming false positives, impossible problems, attacking the wrong problem; when data mining is evil; some failures*
Recommended Books	1. Principles of Data Mining by Hand, Mannila and Smyth. 2. Berk'sStatistical Learning from a Regression Perspective (Powell's;

	publisher)	
ME 742	**PRODUCT DESIGN AND DEVELOPMENT**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• To learn methods of reducing development costs and time necessary for commercialization. • To enable students to co-ordinate and schedule the activities involved in the design and development of products within the entire set of activities, taking into account time, tasks, resources and manufacturing.	
Course Outline	Design process, advanced technology for design process, idea generation and creative problem solving, Project-centered subject addressing transformation of new ideas into technology based products, attaining a proper match between product and marketplace. Product design specification, Product design issues: evaluation, market perception, aesthetics and human interfacing, Design for manufacturability, reliability, and repair ability, pricing and legal implications.	
ME 743	**ENGINEERING OPTIMIZATION TECHNIQUES**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	To provide engineering students interested in CAE/CAD an engineering view of optimization as a tool for design. The course will concentrate on the mathematical and numerical techniques of optimization as applied to engineering problems Introduction to optimization techniques for engineering students. Minimization of unconstrained functions of several variables: steepest descent, Newton/Raphson, conjugate gradient, and quasi-Newton methods. Rates of convergence. Methods for constrained minimization: Introduction to linear programming and gradient projection methods. Lagrangian methods	
Course Outline	1. Introduction to the formulation of optimization problems. Unconstrained optimization. Zero order search. Random walk. 2.Adaptive creep. Powell's method. First order search. 3.Gradient, Conjugate gradient methods. 4. Second order search. Newton-Raphson, Davidon-Fletcher-Powell. 5. Constrained optimization. Penalty methods. Direct methods of constrained optimization. 6.Linear programming. 7. Sensitivity analysis. Multi-objective - pareto - optimization. Equality constraints, Cumulative constraints. 8. Law of diminishing returns and function approximation concepts. Sensitivity of objective function and Lagrange Multipliers. 9. Goal Programming. Primal Dual Methods. 10. Generalized Reduced Gradients. Dynamic Programming. Integer Programming. Sensitivity of optimum to problem parameters. 11. Multi-level optimization. Optimization of complex engineering problems. 12. Non-traditional tools of optimization - Genetic algorithms, Simulated annealing.	
Recommended Books	1. Belegundu A. and T. Chandrupatla Optimization Concepts and Applications in Engineering, Prentice Hall, 1999. 2. Gen, M. and R. Cheng, Genetic Algorithms and Engineering	

	Optimization, Wiley, 2000. 3. Edgar, T.F., Himmelblau, D.M., and L.S. Lasdon, Optimization of Chemical Processes, McGraw Hill, 2001. Download PDF 4. Fletcher R., Practical Methods of Optimization Volumes 1,2, John Wiley 1980, 1981. 5. Luenberger and Ye, Linear and Nonlinear Programming Third Edition, Springer, 2008	
ME 744	**RESEARCH METHODOLOGY AND DESIGN OF EXPERIMENTS**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• Describe how to design experiments, carry them out, and analyze the data they yield. • Understand the process of designing an experiment including factorial and fractional factorial designs. • Examine how a factorial design allows cost reduction, increases efficiency of experimentation, and reveals the essential nature of a process; and discuss its advantages to those who conduct the experiments as well as those to whom the results are reported. • Investigate the logic of hypothesis testing, including analysis of variance and the detailed analysis of experimental data. • Formulate understanding of the subject using real examples, including experimentation in the social and economic sciences. • Introduce Taguchi methods, and compare and contrast them with more traditional techniques. • Learn the technique of regression analysis, and how it compares and contrasts with other techniques studied in the course. • Understand the role of response surface methodology and its basic underpinnings. • Gain an understanding of how the analysis of experimental design data is carried out using the most common software packages.	
Course Outline	• The logic of complete two-level factorial designs • Detailed discussion of interaction among studied factors • Large versus small experiments • Simultaneous study of several factors versus study of one factor at a	

	time • Fractional experimental designs; construction and examples • The application of hypothesis testing to analyzing experiments • The important role of orthogonality in modern experimental design • Single degree-of-freedom analysis; pinpointing sources of variability • The trade-off between interaction and replication • Response surface experimentation • Yates' forward algorithm • The reliability of estimates in factorial designs • The usage of software in design and analysis of experiments • Latin and Graeco-Latin squares as fractional designs; examples • Designs with all studied factors at three levels • The role of fractional designs in response surface experimentation • Taguchi designs • Incomplete study of many factors versus intensive study of a few factors • Multivariate linear regression models
Recommended Books	1. Research Design and Statistical Analysis Third Edition by Jerome L. Myers, Arnold D. Well, Robert F. Lorch Jr 2. How to Design and Report Experiments by Andy Field and Graham Hole
ME 745	**DESIGN OF ADVANCED MANUFACTURING SYSTEMS** | **3 (3 + 0)**
Pre-Requisite	NIL
Course Objectives	The students will learn to: • Identify the components and characteristics of manufacturing systems. • Identify appropriate performance metrics of different manufacturing systems. • Develop mathematical models to describe manufacturing systems. • Develop computer-based models to simulate manufacturing systems. • Analyze performance of manufacturing systems. • Apply the modeling techniques on decision making regarding manufacturing systems. • Continue with self-directed study to pursuit more advanced knowledge. • Students will understand the principles of advanced manufacturing systems that provide increasingly efficient products and systems for the manufacturing enterprise. • Emphasis will be on Flexible Manufacturing Systems, • Lean Manufacturing, Just-in-Time Manufacturing, • Cellular Manufacturing, • Agile manufacturing, and • Supply Chain Management.
Course Outline	• Fundamentals of manufacturing systems • Production planning and control • Just in Time Manufacturing

	• Theory of constraints • Constant Work in Process • MRP-I , MRP-II • System variability analysis and role of quality measurements • Shop floor control analysis • Push pull interface analysis • System modeling and simulation (using Rockwelll Arena/SIMIO simulation package) • System performance and influencing factors analysis • Contemporary control policies and decision making	
Recommended Books	1. Design of Advanced Manufacturing Systems, Models for Capacity Planning in Advanced Manufacturing Systems by Matta, Andrea, Semeraro, Quirico (Eds.) **2. Manufacturing Systems Modeling and Analysis by Curry, Guy L., Feldman, Richard M.**	
ME 841	**ADVANCED CAD/CAM**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• To develop understanding of the principles underlying computer aided tools used in engineering • To develop students' awareness in the application of CAD and CAM systems in the context of developing engineering products	
Course Outline	Overview of existing CAE systems. Fundamental of CAD: Introduction, Design Process, Creating manufacturing database. CAD/CAM System Hardware Structure, Configuration, Mini, Micro, Interactive display devices, Peripherals, Storage, Display and operating system. Geometric Modal and Technique, Solid Modeling, Graphics in CAD. Conventional numerical control, NC part programming, computer numerical control, NC programming with interactive graphics, The role of group technology in CAD/CAM, The role of process planning in CAD/CAM, Process planning system.	
Recommended Books	1. V. B. Anand: Computer Graphics and Geometric Modeling for Engineers, John Wiley and Sons, 1993. 2. H. B. Kief and T. F. Waters: "Computer Numerical Control", A CNC Reference Guide, GLECOE, discovery. McGraw-Hill, 1992.	
ME 842	**COMPUTER INTEGRATED MANUFACTURING**	3 (3 + 0)
Pre-Requisite	NIL	
Course Objectives	• To develop the concepts of Computer Integrated Manufacturing, Flexible Manufacturing System and automated flow • To develop understanding of classical and state-of-the-art production systems, control systems, management technology, cost systems, and evaluation techniques	
Course Outline	Fundamental of operations and automation strategies, High volume production systems, computer aided manufacturing, numerical Control of Production	

	Systems, Industrial Robots, Material Handling and Storage, Group Technology, Flexible Manufacturing Systems, Quality Control and Automated Inspection, Expert Systems. **Manufacturing Systems**: Introduction, Overview of manufacturing processes, Machine tool and manufacturing equipment, process planning, design of manufacturing system, operation of manufacturing systems.
Recommended Books	Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice Hall, 2007.
Pre-Requisite	NIL
Course Objectives	The primary objective of this course is to provide an insight into how simulation modeling can aid in effective decision-making. The bulk of the time in the course is spent on discrete event simulation modeling. Simulation model building aspects of discrete systems (such as manufacturing and logistics facilities, supply-chains) are covered in detail. It is also demonstrated how computer simulation can be used to successfully model, analyze and improve systems under study. A simulation software (Arena) is used to demonstrate building and executing the models. Systems dynamics and continuous simulation are also covered in earlier part of the course. The course also covers the topic of simulation life cycle analysis, and goes over issues like model verification and validation. It also looks into the statistical analysis of simulation model output. The course can be sub-divided into two modules: Essentials of systems dynamics provides a continuous simulation perspective coupled with a broad treatment of strategic systems thinking issues as related to Global manufacturing problems. The second main module is discrete event simulation that ventures further into detailed event driven model building analysis and demonstrates how Global manufacturing facilities can be successfully planned, implemented and managed. Supporting topics include the use of the simulation for modeling the supply-chains with the objective to optimize, fine tune and control them. The course will cover both analytical methods (Markov Models and Queuing Networks) and simulation techniques (Monte Carlo Techniques and Event Driven Simulation) applied in performance modeling of communication systems and networks. Present concepts of computer-based modeling and simulation applicable to various domains of engineering and science. Provide theoretical concepts, methods, and hands-on experience with object oriented modeling and simulation.
Course Outline	System - ways to analyze the system - Model - types of models - Simulation - Definition - Types of simulation models - steps involved in simulation - Advantages & Disadvantages. Parameter estimation - estimator - properties - estimate - point estimate - confidence interval estimates - independent - dependent -hypothesis - types of hypothesis- step - types l& 2 errors - Framing - string law of large numbers. Building of Simulation model validation - verification - credibility - their timing - principles of valid simulation Modeling - Techniques for verification - statistical procedures for

	developing credible model. Modeling of stochastic input elements - importance - various procedures - theoretical distribution - continuous – discrete their suitability in modeling. Generation of random variables - factors for selection methods - inverse transform - composition - convolution - acceptance - rejection - generation of random variables - exponential - uniform - weibull - normal Bernoullie - Binomial uniform - poisson - Simulation languages - comparison of simulation languages with general purpose languages Simulation languages vs Simulators - software features - statistical capabilities - G P S S - S1MAN- SIMSCRIPT - Simulation of WMJI queue - comparison of simulation languages. Output data analysis - Types of Simulation w. r. t output data analysis – warm up period- Welch algorithm - Approaches for Steady - State Analysis - replication - Batch means methods - corn pan Sons.Applications of Simulation - flow shop system - job shop system - M/MI1 queues with infinite and finite capacities - Simple fixed period inventory system – News boy paper problem.Introduction to Simulation, Basics of Queueing Theory, Queueing Theory vs. Simulation, Kinds of Simulation, First Simio Models, Intermediate Modeling With Simio, Input Analysis, Working With Model Data, Animation and Entity Movement, Advanced Modeling With Simio, Customizing and Extending Simio, Case Studies Using Simio
Recommended Books	1. Simulation Modelling and Analysis / Law, A.M.& Kelton / Mc Graw Hill, Edition/ New York, 1991. 2. Discrete Event System Simulation *I* Banks J. & Carson J.S., PH *I* Englewood Cliffs N/ 1984. 3. Simulation of Manufacturing Systems / Carrie A. / Wiley, NY, 1990. 4. A Course in Simulation / Ross, S.M., McMillan, NY, 1990. 5. Simulation Modelling and S1MNET/ Taha HA. / PH, Englewood Cliffs, NJ, 1987 6. Simulation Modelling and Analysis / Law, A.M.& Kelton / Mc Graw Hill, Edition/ New York, 1991. 7. Simio and Simulation: Modeling, Analysis, Applications - Third Edition by W. David Kelton, Jeffrey S. Smith and David T. Sturrock *8. Simulation Modeling with SIMIO: A Workbook by* Authors Jeffrey A. Joines and Stephen D. Roberts 3rd Edition 9. Kelton, W.D., Sadowski, R.P. and Swets, N.B. *Simulation with Arena*, 4th ed., McGraw Hill, 2009, ISBN:0073376280 / 9780073376288.
ME 844	**STATISTICAL QUALITY CONTROL AND ASSURANCE** | **3 (3 + 0)**
Pre-Requisite	NIL
Course Objectives	This course is at the interface between statistics and quality improvement. Getting the most out of the course requires an understanding of the basic terminology of both fields. Quality Assurance from the viewpoint of Producer and Consumer. Much of this philosophy is credited to Taguchi. Quality systems, philosophy, history and practice. To provide a working framework within modern quality techniques.
Course Outline	• Statistical Process Control • Acceptance Sampling

	• Design of Experiments Process average and process variation • Attributes and variables data • Graphical methods • Control charts • Experimental design • Acceptance sampling	
Recommended Books	1. Quality Assurance and Quality Control in the Analytical Chemical Laboratory: A Practical Approach, Piotr Konieczka, Jacek Namiesnik. 2. Statistical Methods of Quality Assurance by Hans-Joachim. Mittag, Horst Rinne	
ME 845	**COMPUTER AIDED PROCESS PLANNING**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	Computer-aided process planning is a link between design and manufacturing in a computer-integrated manufacturing (CIM) environment. Commonly used by manufacturing engineers, CAPP can be used to develop a product manufacturing pla n based on projected variables such as cost, lead times, equipment availability, production volumes, potential material substitution routings and testing requirements.	
Course Outline	• The process-planning problem as a rigid hierarchical structure of tasks • Determination of machine and cutting parameters, • Control, coordinate and manage the entire system. • Coordination coupled with decision-making situation. • The complexity of CIM systems with hierarchical structures • Assimilating a large array of knowledge sources to plan the activities • . Computer Aided Process Planning • The variant CAPP method • The generative CAPP method	
Recommended Books	1.Computer aided process planning by Joseph TulkoffS 2. Computer aided process planning by Architecture Technology Corporation	
ME 846	**SPECIAL TOPICS IN MANUFACTURING ENGINEERING**	**3 (3 + 0)**
Pre-Requisite		
Course Objectives		
Course Outline		
Recommended Books		
ME 551	**HUMAN RESOURCES MANAGEMENT AND ORGANIZATIONAL BEHAVIOR**	**3 (3 + 0)**
Pre-Requisite	NIL	

Course Objectives	The HRM & OB focuses on preparing students to impact the study of people, process and outcomes within the fields of organizational behavior and human resources management. Through research, collaboration and dissemination of knowledge, students understand how to impact organizational effectiveness in a variety of different environments, industries and across multiple levels of analyses.	
Course Outline	HRM, equal opportunity, job analysis, personnel planning and recruitment, testing, performance management, careers, employees relations, An Overview of the Field of Organizational Behavior, Individual behaviour and learning in organizations, Theories of Employee Motivation and Rewards Systems, Communications in Organizations, Group Dynamics, Teambuilding and Decision Making, Organizational Conflict & Resolution Strategies, Organizational Change and Development, Organizational Culture,Organizationl Structure and Design	
Recommended Books	1. Human Resource Management (10th Edition) by Gary Dessler. 2. Human Resources Management by Wendell L. Frencch. 3. Organizational Behavior and Management by John M. Ivancevich, Robert, Micheal, Matteson. 4. Designing the Purposeful Organization: How to Inspire Business Performance Beyond Boundaries by Clive Wilson.	
ME 651	**INDUSTRIAL COST MANAGEMENT**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	1. Describe a cost management system, its objectives, and its major systems. 2. Identify the current factors affecting cost management. 3. Describe how management accountants function within an organization 4. Understand the importance of ethical behavior for management accountants. 5. Identify the three forms of certification available to internal accountants	
Course Outline	Introduction to Cost Management , Basic Cost Management Concepts, Cost Behavior, Activity-Based Costing, Product and Service Costing: Job-Order System, Product and Service Costing:A Process Systems Approach, Strategic Cost Management, The Balanced Scorecard: Strategic-Based Control, Cost-Volume-Profit Analysis	
Recommended Books	1. Cost Management, Accounting & Control by Hansen- Mowen Guan	
ME 652	**FACILITY PLANNING AND LAYOUT**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	A model facility layout should be able to provide an ideal relationship between raw material, equipment, manpower and final product at minimal cost under safe and comfortable environment. An efficient and effective facility layout can cover following objectives: ▪ To provide optimum space to organize equipment and facilitate movement of goods and to create safe and comfortable work	

	environment. ▪ To promote order in production towards a single objective ▪ To reduce movement of workers, raw material and equipment ▪ To promote safety of plant as well as its workers ▪ To facilitate extension or change in the layout to accommodate new product line or technology upgradation ▪ To increase production capacity of the organization
Course Outline	Analysis, design and evaluation of manufacturing facilities and material handling systems. The topics covered include definition of facilities planning, role of product process and schedule design, flow analysis and activity relationship, capacity and space requirements planning, computer aided layout planning, material handling systems and equipment, storage and warehousing, mathematical approaches to location problems, and performance evaluation and selection among alternatives. Layout Strategies, Warehouse Management, Facility Planning & Layout, Multiple Facilities, Inventory Management, JIT and Lean Operations
Recommended Books	1. Production and Operation Management, 8Th Edition by Norman Gaither and Greg Fazier, South-Western College Publishing 2.Principles of Operations Management, by Heizer/Render 3.Manufacturing Facilities, Location, Planning and Design by D.R. Sule
ME 653	**PROJECT MANAGEMNT** **3 (3 + 0)**
Pre-Requisite	NIL
Course Objectives	• To understand the concepts of project definition, life cycle, and systems approach; • To develop competency in project scooping, work definition, and work breakdown structure (WBS); • To handle the complex tasks of time estimation and project scheduling, including PERT and CPM • To develop competencies in project costing, budgeting, and financial appraisal; • To gain exposure to project control and management, using standard tools of cost and schedule variance analysis; • To appreciate the elements of risk and quality in hi-tech projects; • To learn project management by “practice”, through the medium of “study projects”; and • To appreciate and understand the use of computers in project management, especially a tool like MS Project..
Course Outline	Project management growth: concepts and, definitions, organizational structures, organizing and staffing the project office and team, management functions, planning, network scheduling techniques, project graphics, pricing and estimating, cost control, trade-off analysis in a project environment, risk management
Recommended	1. Project Management Institute (PMI). A Guide to the Project

Books	Management of Knowledge (PMBoK). Newton Square, PA. 1996. (Reference) 2. J.R. Meredith and S.J. Mantel. Project Management: A Managerial Approach. John Wiley and Sons. New York. 1995. (Reference). 3. Project Management, A system approach, planning, scheduling and control by Harold Kerzner, Latest Edition	
ME 751	**TOTAL QUALITY MANAGEMENT**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• The course aims to impart knowledge on the quality management process and key quality management activities • Demonstrate how to design quality into product and services, describe the importance of developing a strategic plan for Total Quality Management.	
Course Outline	Introduction to TQM, ISO-9000 Quality Model, Quality in manufacturing and service, Principles of total quality management, Leadership and Strategic planning, A focus on the customer, Quality measurement, Method for continuous improvement, Participation and teamwork, Implementation issue and strategies, inspection & quality control. Control Charts and their applications. Economics & quality control, Life testing, reliability, reliability prediction and calculations, reliability enhancing techniques.	
Recommended Books	1. Total Quality Management by James R. Evans, American Management Assoc. 2. Total Quality Management by Johns OrnlandAmriu S. Soha, Pacific Rim.	
ME 752	**LEADERSHIP AND ENTREPRENEURSHIP**	**3 (3 + 0)**
Pre-Requisite		
Course Objectives	• To expertise the students on leadership and entrepreneurship. It will examine the entrepreneur from a personal, organizational, and multidimensional point of view. In addition, successful entrepreneurs from profit and not-for-profit firms, and from manufacturing and service firms joined with assistance providers, to bring a firmer understanding of the qualities that contribute to successful leadership in growth-oriented firms. It emphasizes what entrepreneurs actually do, how they do it, and what can be learned by examining the common themes or concepts that exist in the practice of entrepreneurship	
Course Outline	This course will cover the following: - Definition and nature of Leadership and Management - Comparison between management and leadership - Theories of leadership styles - Stages of growth of leadership and management - Courage and moral leadership - Developing leadership diversity skills - Strategic and diverse leadership in a small business - Decision making and leadership - Profiles of successful business entrepreneurs - Management skills (plan, organize, measure, control, and	

	provide leadership)	
Recommended Books	1. The New Entrepreneurial Leader: Developing Leaders Who Shape Social and Economic Opportunity by Danna Greenberg, Kate McKone-Sweet, 2011. ISBN-13: 978-1605093444 2. Leadership and Entrepreneurship: Personal and Organizational Development in Entrepreneurial Ventures (Entrepreneurship, Principles and Practices) Hardcover – March 20, 1996 by Jana Matthews ISBN-13: 978-1567200430	
ME 753	**OPERATIONS MANAGEMENT**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	To provide students with a state-of-the-art overview of operations management. The goal is to teach the fundamental principles of operations and how they relate to making a firm more competitive. Operations Strategy for Competitive Advantage, designing operations, managing operations, and quantitative modules.	
Course Outline	This course covers topics related to operations management such the difference between manufacturing and services organisations, characteristics of operations managers, and the relationship between operations, productivity and competitiveness. This is extremely useful for anyone interested in a career in operations management. Introduction to Operations and Supply Management, Forecasting, Process Design, product/service, process, facility, waiting lines, work, systems and location, Quality Management, Capacity Planning and Inventory Control, - lean manufacturing,, inventory management, material, requirements planning, just-in-time, enterprise resource, planning, scheduling and control, Supply Chain Management	
Recommended Books	1. Operations Management by Barron 2. Operations Management by Jay Heizer, Barry Render-, 10th Edition (2011).	
ME 851	**SUPPLY CHAIN MANAGEMENT**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• To introduce the major building blocks, major functions, major business processes, performance metrics, and major decisions (strategic, tactical, and operational) in supply chain networks • To provide an insight into the role of Internet Technologies and Electronic Commerce in supply chain operations and to discuss technical aspects of key ITEC components in supply chain management. • To bring out the role of stochastic models (Markov chains, queueing networks); optimization models (LP, ILP, MILP, GA, Constraint Programming); and simulation in supply chain planning and decision-making. This will provide the foundation for design and analysis of supply chains.	

Course Outline	The course will cover: Operations Management & Strategy, Forecasting, Capacity Management, Capacity Management, Process Design, Lean Thinking, Performance Measurement, Quality & Product Design, Quality & Product Design, Inventory & Resource Planning, Inventory & Resource Planning, Collaborative Supply Chains, Collaborative Supply Chains.	
Recommended Books	**1.** Logistics and Supply Chain Management (4th Edition) by Martin Christopher. 2**.** Essentials of Supply Chain Management, Third Edition by Michael H. Hugos.	
ME 852	**COGNITIVE ERGONOMICS**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• It covers the breadth of cognitive ergonomics in human computer interaction (HCI). Covering models for design, learning procedures, and planning and understanding • It is specifically concerned with the cognitive ergonomics of human computer interaction--from analogical thinking to spreadsheet calculation, office organization to process control. It provides an overview of HCI issues from the cognitive perspective.	
Course Outline	Cognitive Approaches in HCI Design.- Towards Cognitive-Aware Multimodal Presentation: The Modality Effects in High-Load HCI.- Supporting Situation Awareness in Demanding Operating Environments through Wearable User Interfaces.- Development of a Technique for Predicting the Human Response to an Emergency Situation.- A Dynamic Task Representation Method for a Virtual Reality Application.- An Investigation of Function Based Design Considering Affordances in Conceptual Design of Mechanical Movement.- CWE: Assistance Environment for the Evaluation Operating a Set of Variations of the Cognitive Walkthrough Ergonomic Inspection Method.- The Use of Multimodal Representation in Icon Interpretation.- Beyond Emoticons: Combining Affect and Cognition in Icon Design.- Agency Attribution in Human-Computer Interaction.- Human-UAV Co-operation Based on Artificial Cognition.- Development of an Evaluation Method for Office Work Productivity	
Recommended Books	1. Cognitive Ergonomics: Understanding, Learning, and Designing Human-Computer Interaction (Computers and People), by Pierre Falzon, Brian R. Gaines, 1990. ISBN-13: 978-0122482908 2. Advances in Cognitive Ergonomics by GavrielSalvendy, WaldemarKarwowski ISBN 9781439834916	
ME 853	**HUMAN FACTOR ENGINEERING**	3 (3 + 0)
Pre-Requisite	NIL	
Course Objectives	• To develop the ability of technologists to design systems that take advantage of what humans are good at. • To provide a set of design principles that focus on the most important element in any system, that is the human	
Course Outline	Introduction: Scope of Ergonomics, Human operator as system components;	

	physical size and shape dynamics, anthropometry, sources and application of energy input sensitivity, central processing capacity, input characteristics, environmental effects, heat and vibration, lightning and noise. Techniques in human factor studies; the assessment of physical activity, subjective assessment technique, methods of work analysis. Design Requirements: Interface design; space requirements and layout visual presentation of information, auditing presentation of information, machine dynamics, control design, environmental factors, jobs aids, System evaluation.	
Recommended Books	1. Human Factors Engineering and Ergonomics: A Systems Approach by Stephen J. Guastello, Routledge, 2006, ISBN: 0805850066, 9780805850062. 2. Human factors in engineering and design McGraw-Hill psychology series by Mark S. Sanders, Ernest James McCormick, 7th edition, McGraw-Hill, 1993, ISBN: 007054901X, 9780070549012.	
ME 854	**PRODUCT LIFE CYCLE MANAGEMENT**	**3 (3 + 0)**
Pre-Requisite	NIL	
Course Objectives	• *Product Lifecycle Management* to reflect the many advances made in PLM. • It includes descriptions of PLM technologies and examples of implementation projects in industry. • *Product Lifecycle Management* will broaden the understanding of PLM, nurturing the skills needed to implement PLM successfully and to achieve world-class product performance across the lifecycle.	
Course Outline	*Product Lifecycle Management* explains what Product Lifecycle Management (PLM) is, and why it's needed. It describes the environment in which products are developed, realised and supported, before looking at the basic components of PLM, such as the product, processes, applications, and people. It addresses the implementation of PLM, showing the steps of a project or initiative, and typical activities. PLM is a mission-critical decision-making system leveraged by the world's most innovative companies to transform their process of innovation on a continuous basis. That is a powerful value proposition in a world where the challenge is to get better products to the market faster than ever before. That is the power of PLM	
Recommended Books	1. Product Lifecycle Management: 21st Century Paradigm for Product Realisation (Decision Engineering) by John Stark, 2011. ISBN-13: 978-0857295453 2. Product Lifecycle Management: Driving the Next Generation of Lean Thinking by Michael Grieves 3. Product Lifecycle Management by AnttiSaaksvuori	
ME 855	**OPERATIONS RESEARCH**	**3 (3 + 0)**
Pre-Requisite		
Course Objectives	The objective is to provide students with • Mathematical models for analysis of real problems in Operations Research. • Model decision making problems using major modeling formalisms of	

	artificial intelligence and operations research, including propositional logic, constraints, linear programs, • Evaluate the computational performance of search, satisfaction, optimization and learning algorithms. • Apply search, satisfaction, optimization and learning algorithms to real world problems • Ability to understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively; • Knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry; • Skills in the use of Operations Research approaches and computer tools in solving real problems in industry	
Course Outline	Linear Programming. Multiple-objectives, Analytic Hierarchy Process (AHP), and Concepts in Game Theory, Concepts in stochastic processes, Markov Chains, Non-linear programming, Some case studies will be used to integrate these topics and thus demonstrate to students how the various techniques are interrelated and how they can be applied to real problems in industry.	
Recommended Books	1. Rader, D. J. 2010, Deterministic Operations Research: Models and Methods in Linear Optimization, J. Wiley & Sons 2. Taha, H. A. 2012, Operations Research, 9th Edition, Pearson **3.** Taylor, B. W. III 2013, Introduction to Management Science, 11th edn, Prentice Hall	
ME 856	**SPECIAL TOPICS IN ENGINEERING MANAGEMENT**	**3 (3 + 0)**
Pre-Requisite		
Course Objectives		
Course Outline		
Recommended Books		