SYLLABUS

Course Title	Thermal Engineering – Concepts &Applications	Course No	ME201T
Course category	PEC	Structure (IPC)	3-0-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Prerequisite	Nil	Effective from	July 2019
Course Objective	The objective of this course is to provide insights on basic principles and concepts of thermodynamics. Also, develop the ability to apply them in a systematic way to analyze basic thermodynamic cycles.		
Course Outcomes	At the end of the course, the student will be able to: 1. Identify different forms of energy. 2. Describe the laws of thermodynamic principles related to various thermal systems. 3. Apply the laws of thermodynamics to estimate the performance parameters of thermal systems. 4. Estimate the properties of ideal gases and pure substances. 5. Analyze the thermodynamic cycles of various thermal systems.		
Contents of the course (With approximate break up of hours)	Fundamentals: System, Control volume, Property, State, Process, Cycle, Equilibrium, Zeroth law, Principles of Thermometry, Energy-Forms of Energy, Heat, Work, Different forms of work.(9) First law: First law Analysis of Closed System for Cyclic & non-cyclic process, Internal energy, Enthalpy, Free expansion process, Application of First law to flow processes, SFEE, Examples of steady flow devices: Nozzle, Diffuser, Turbine, Compressor, Throttling Valve and Heat Exchangers, PMM-I, Limitations of first law.(11) Second law: Qualitative difference between the heat and work, Heat Engines, Refrigerators, Heat Pumps, Kelvin-Planck & Clausius Statements, PMM-II, Carnot Cycle, Reversible &Irreversible cycles. Entropy: Clausius inequality, Definition of Entropy, Demonstration that entropy is a property, T-s diagram, Isentropic efficiency, Available and unavailable energy, Concept of irreversibility and lost work, T-dsequations. (11) Pure Substances and Gases: Properties of pure substances, Water and steam - Constant temperature and constant pressure heating, Use of steam tables: Saturation tables, Superheated tables, Mollier chart, Ideal gas and their mixtures, Real gases. (6) Thermodynamic Cycles: Analysis of Otto cycle, Diesel cycle, Dual cycle, Brayton cycle – Comparison with Carnot cycle. (5)		
Textbooks and References	1. P. K. Nag, “Engineering Thermodynamics,” McGraw-Hill, 6th Edition, 2013. 2. Y. A. Cengel, and M. A. Boles, “Thermodynamics: An Engineering Approach”, McGraw-Hill, 8thEdition, 2011. 3. C. Borgnakke and R. E. Sonntag, “Fundamentals of Thermodynamics,” 7th Edition, Wiley, 2009. 4. Moran, Shapiro, Boettner and Bailey, "Principles of Engineering Thermodynamics", 8th Edition, Wiley, 2015		

Course Title	Mechanics of Materials	Course No	ME202T
Course category	PEC	Structure (IPC)	3-0-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Prerequisite	Engineering Mechanics	Effective from	July 2019
Course Objective	The objective of this course is to introduce the principles of continuum mechanics as applied to the simplified case of elastic solids.		
Course Outcomes	At the end of the course, a student will be able to: 1. Describe the material behavior under different kind of static loadingconditions 2. Analyze the problems related to deformation of elasticbodies 3. Design simple structures under static loadings, i.e. beams, shafts, columns,etc. 4. Design the structures under combined loads 5. Apply the different failure theories based on the application		
Contents of the course (With approximate break up of hours)	Review of equilibrium, compatibility, stress and strain at a point andMohr'scircle.(4) Pure bending of beams – shear force and bending moment diagrams; beams with composite cross- sections; Deflection of beams. (11) Torsion of circular cross sections – application and transmission of torque; Combined loads – application to pressure vessels and springs.(10) Theory of failures for ductile and brittle materials. (6) Buckling of columns – eccentric loading; various end constraints. (6) Virtual work – Energy methods – principle and applications (5)		
Textbooks and References	1. F. P. Beer, E. R. Johnston, J. T. Dewolf, and D. Mazurek, "Mechanics of Materials," McGraw Hill, 7th Edition, 2014. 2. R. C. Hibbeler, "Mechanics of Materials," Prentice Hall, 8th Edition, 2010. 3. A. C. Ugural, "Mechanics of Materials," Wiely, 1st Edition,2007. 4. J. M. Gere and S. Timoshenko, "Mechanics of Materials", PWS Publishing Company, 4th Edition,1997. 5. W. Nashand, N. Malik, "Strength of Materials", McGraw Hill Education Pvt. Ltd, 4th Edition, 2010.		

Course Title	Basic Concepts in Manufacturing Processes	Course No	ME203T
Course category	PEC	Structure (IPC)	3-0-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Prerequisite	Science and Engineering of Materials	Effective from	July 2019
Course Objectives	Students will learn the fundamentals of conventional and non-traditional manufacturing processes and interpret the product requirements to select and/or synthesize suitable manufacturing processes.		
Course Outcomes	At the end of the course, a student will be able to: 1. Determine the appropriate manufacturing process(es) for the product to be made. 2. Analyze the suitability of a manufacturing process to convert the raw material to designed specifications 3. Perform cost analysis for various manufacturing process to minimize the cost of processing thematerial.		
Contents of the course (With approximate break up of hours)	Introduction of manufacturing processes, manufacturing process categories and classification, Basic concepts and applications of casting, Glass working, shaping processes for plastics, processing polymer matrix composites and rubber, powder metallurgy. (7) Metal forming; bulk deformation processes and sheet metal working, Theory of metal machining, machining operations and machine tools, cutting tool technology. (12) Fundamental of welding process, brazing, soldering and adhesive bonding. (5) Additive manufacturing processes, semi-conductor fabrication, micro and nano fabrication and advanced manufacturing processes. (12) Manufacturing Engineering, Economic modelling and cost analysis, Process selection. (6)		
Textbooks and References	1. S. Kalpakjian, and S.R. Schmidt, "Manufacturing Engineering andTechnology," 7th Edition, Pearson India,2009. 2. M. P. Groover, "Principles of Modern Manufacturing," 5th Edition, Wiley, India, 2014. 3. E. P. DeGarmo, J. T. Black, and R. A. Kohser, "DeGarmo's materials and processes in manufacturing," John Wiley & Sons,2011 4. Gibson, D. W. Rosen, and B. Stucker, "Additive manufacturing technologies," Springer, 2010. 5. Stephenson, David A., and John S. Agapiou, "Metal cutting theory andpractice," Vol. 68, CRC press,2005. 6. S. Kalpakjain, and S. R. Schmid, "Manufacturing processes for engineering materials," 5th Edition, Pearson Education, India,2010.		

Course Title	Kinematics of Machines	Course No	ME204T
Course category	PEC	Structure (IPC)	3-0-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Pre-requisite	Engineering Mechanics	Effective from	July 2019
Course Objective	The objective of this course is to provide the fundamentals to understand the kinematics of various mechanisms and machineries.		
Course Outcomes	At the end of the course, a student will be able to: 1. Demonstrate a good understanding of the principles of rigid body motion 2. Predict the degrees of freedom, velocity and acceleration of different mechanisms using graphical or analytical methods. 3. Synthesize the four bar and slider crank mechanism using path synthesis, function generation and point synthesis. 4. Analyze the problems related to cam and follower motions. 5. Illustrate different types of gears, gear trains and analyze the speed of gear train.		
Contents of the course (With approximate break up of hours)	Introduction to mechanisms-rigid body motion- joints, pairs and couplings; Constraints, mobility and degree of freedom, Kutzbach and Grubler criterion, Grashof's law, Inversions of different mechanisms (10) Kinematics (Position, Velocity and Acceleration) of rigid bodies – analytical and graphical methods. (12) Kinematic synthesis of mechanisms, Point synthesis, path synthesis and function generation (10) Gears, Gear trains and cams (10)		
Textbooks and References	1. S. S. Rattan, "Theory of Machines," Tata McGraw-Hill, 2005. 2. J. S. Rao, and R. V. Dukkipati, "Mechanism and Machine Theory," New Age International, 2006. 3. A. Ghosh and A. K. Mallik, "Theory of Mechanism and Machines," Affiliated East –West Press Private Ltd., 2009. 4. T. Bevan, "Theory of Machines," Pearson Education, 3rd Edition, 2009.		

Course Title	Electrical Drives	Course Number	ME205I
Course category	PEC	Structure (IPC)	1-3-3
Offered to	B.Tech, MDM	Status (Core/ Elective)	Core
Prerequisite	Basic Electrical & Electronics Engineering	Effective from	July 2019
Course Objective	In this course, the fundamental applications of electro-mechanical and power electronic systems will be studied as applied to mechanical systems.		
Course Outcomes	At the end of the course, a student will be able to: 1. Understand the working principles of power electronic rectifiers, converters and inverters operate. 2. Understand the control mechanism of electrical drives. 3. Analyze the performance of DC and AC machines. 4. Design the control algorithms for electric drives to achieve the regulation of torque, speed, or position in the above machines. 5. Develop Simulink® models which dynamically simulate electric machine, drive systems and their controllers.		
Contents of the course (With approximate break up of hours)	<u>Theory:</u> The working principle of various power electronic converters (4) Basic concepts of different types of electrical machines and their performance and Speed-Torque characteristics of various types of load and drive motors (4) Basic concepts of special machines such as Stepper motor, Permanent magnet brushless motors, Servo motor. (4) <u>Practice:</u> The following experiments will be conducted: 1. Explanations of basic electrical machine terms and Introduction about MATLAB, SIMULINK 2. Speed control of DC Shunt Motor 3. Study of Fully Controlled and Semi Controlled Rectifier 4. Study of Half Bridge and Full Bridge Inverter 5. Study of Single-phase Sine PWM Inverter 6. Study of 3 phase Square & Sine PWM Inverter 7. Study of DC to DC Buck Converter and Boost Converter 8. Speed Control of BLDC Motor 9. Study of Four Quadrant Operation of DC Drive 10. Speed control of 3-Phase Induction Motor using V/F Control 11. Study of Stepper Motor Control 12. Load Test on Three Phase Squirrel Cage Induction Motor 13. FPGA based Motor Controller 14. Project presentation (any related power electronics project) and Different ranges ofInductor coil designing		
Textbooks and References	1. R. Krishnan, “Electric Motor Drives: Modelling, Analysis, and Control,” Prentice Hall, 2001. 2. N. Mohan, “Electric Drives: An Integrative Approach”, MNPERE, 2001 3. M. Rashid, “Power Electronics: Circuits, Devices & Applications”, 3rd Edition,PrenticeHall, 2003. 4. J. P. Agrawal, “Power Electronic Systems: Theory and Design,” Pearson, 2013.		

Course Title	Machine Drawing and Manufacturability Analysis Practice	Course No	ME206P
Course category	PEC	Structure (IPC)	0-3-2
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Prerequisite	Engineering Graphics	Effective from	July 2019
Course Objective	The objective of this course is to familiarize the students on basics of technical drawing such as part and assembly drawing of different machine elements using drawing instruments. Also, provide the knowledge in 3D modeling and industrial drafting using commercially available software.		
Course Outcomes	At the end of the course, a student will be able to: 1. Develop 3D models of machine components and generate 2D drawing from 3D models 2. Digitize existing products using reverseengineering 3. Create assembled and exploded views of machinecomponents 4. Analyze the machine component design for its manufacturability, environmental impact and ease of assembly using 3D models		
Contents of thecourse	Machine drawing: 1. Introduction to Machine drawing and Conventional representation of different materials and threaded joints 2. Orthographic projections of different part drawings. 3. Generating 2D drawings from 3D models and create production drawings using standard notations. 4. Assembly drawing of simple machine components like cotter and sleeve joint. 5. Assembly drawing of knuckle joint. Modelling using CATIA: 1. Drafting: Development of part drawings for various components in the form of orthographic and isometric. 2. Modeling machine components in 3D modeling software using feature-based design concepts. 3. Modeling machine components in 3D modeling CATIA software using Boolean based design concepts. 4. Assembly Modelling of cotter and sleeve joint in 3D modeling software using feature-based design concepts. 5. Assembly Modelling of knuckle joint in 3D modeling software 6. Term project on assembly modeling of different components like screw jack, plumber block, footstep bearing, connecting rod, clutch, Oldham coupling, etc.		
Textbooks and References	1. N.D Bhatt, "Engineering Drawing", Charotar Publishing house, 2017. 2. K.L. Narayana, P. Kannaiah, K.Venkata Reddy, "Machine Drawing", New age company, 2015. 3. S. Bogolyubov. A. Voinov., "Engineering Drawing", Van Nostrand Reinhold Company, 2001. 4. D. E. Hewitt., "Engineering Drawing and Design for Mechanical Technicians", Macmillan Press Ltd,2006. 5. Boothroyd G., Dewhurst P., and Knight W. A., "Product Design for Manufacture and Assembly", 3rd Edition, CRC Press,2010.		

Course Title	Product Realization Practice	Course No	MEC207P
Course category	PEC	Structure (IPC)	0-3-2
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Prerequisite	Design Realization	Effective from	July 2019
Course Objective	Students will gain a practical knowledge of various manufacturing processes in a hands-on environment through experiments and simulations.		
Course Outcomes	At the end of the course, a student will be able to: 1. Understand the basic manufacturing processes. 2. Accustom to the handling of Machine tools. 3. Realize the products using primary manufacturingprocesses 4. Understand the 3D printer basics.		
Contents of the course	The following experiments will be conducted: 1. Realization of Cylindrical Parts using Traditional Lathe (Turning operation) 2. Realization of Cylindrical Parts using Traditional Lathe (Step Turning operation) 3. Realization of Cylindrical Parts using Traditional Lathe (Threading operation) 4. Realization of Cylindrical Parts using Traditional Lathe (Taper Turning operation) 5. Making of Square box with GI sheet by using Sheet Metal Bending Practice 6. Making of Rectangular box with required dimensions of GI sheet by using Sheet Metal Bending Practice 7. Practice on Universal Milling Machine (Facing operation) 8. Gear Cutting by using indexing on Universal Milling Machine 9. Machining on CNC Router cum Milling machine 10. Developing a physical model by using Fusion Deposition Modelling (3D Printer)		
Textbooks and References	1. E. P. DeGarmo, J. T. Black, and R. A. Kohser, “DeGarmo's materials and processes in manufacturing”, John Wiley & Sons,2011. 2. M. P. Groover, “Principles of Modern Manufacturing”, 5th Edition, Wiley, 2014 3. S. Kalpakjian, and S. R. Schmid, “Manufacturing processes for engineering materials”, 5th Edition, Pearson Education, 2010.		

Course Title	Engineering Economics	Course No	
Course category	HMC	Structure (IPC)	3-0-3
Offered to	B.Tech All branches	Status (Core/Elective)	Core
Prerequisite	Nil	Effective from	July 2019
Course Objective	To develop the basic understanding of various concepts of economics to apply them to engineering thought and comprehend decision making.		
Course Outcomes	After completing the course, a student is empowered to: 1. Understand and coordinate his engineering acumen with economic aspects. 2. Take decisions independently on various aspects of an enterprise functioning 3. Appraise economic influences on decision making 4. Use accounting information for in the process of decision making 5. Apply futuristic economic value in the decision making		
Contents of the course *(With approximate break up of hours)*	Economics for Engineering: Understanding concepts with reference to engineering: economics Micro, macro, demand and supply, relationship with price, market structures, national income, per capita income, GDP, NDP, BOP, Fiscal (taxes) and monetary policies, banking: types of banks, significance of stages of business cycle to engineering. (4) Engineering Economic Decisions: Concepts and types of trade, business and industry - Types of organization of business – Economic decision-making process – Strategic economic decisions (case study) – Principles of economic decisions – Factors influencing decisions: Economic and non-economic. (4) Accounting for Engineers: Financial goals of business – Cash flows: inflow & outflow – Recurring & non-recurring – Revenues & Expenses – The income statement – Classification of assets & liabilities – Types of shares - The Balance sheet. (6) Understanding Financial Statements: Significance of Understanding financial statements from Engineering perspective - Ratios of Profitability, solvency, liquidity and wealth maximization, leverage and turnover. Earnings available to equity shares – Decision making based on understanding of financial statements. (6) Depreciation: Meaning – Reasons - Types – depreciation as non-cash expense – Depreciation as fund for investment - Methods: Straight line, diminishing balances and sinking fund – Decision making on the choice of methods. (4) Cost concepts and Behavior: Meaning of cost – Cost classification: Functional – Cost statement – Decision making using cost statement – Tenders - Fixed and variable costs – other classifications – Decision making using cost behavior: Marginal cost statement - BEP, graphical representation, MS, Profit statement, Sales for Desired profit – P/E ratio and its uses – Decision making using BEP. (6) Capital Budgeting: Significance of financial goals for engineers – concept of Budgeting – Meaning and significance of Capital budgeting decisions – Principles of investing - Traditional methods: payback period and Accounting Rate of Return – Rate of return analysis – Decision making using payback and ARR.(6) Present Worth Analysis: Methods of financing – concept of cost of capital – Overall cost of capital rate as discounting rate - Time value of money – Present worth analysis – Annual Equivalent Analysis - Decision making based on NPV and IRR. Evaluation of Social benefit and social cost projects –B-C Ratio. (6)		
Textbooks and References	1. Samuelson P A, Nordhans W D, “Economics”, McGraw Hill, 1995. 2. Chan S Park, “Contemporary Engineering Economics”, Prentice Hall, 2011. 3. John A. White, Kellie S. Grasman, Kenneth E. Case, Kim LaScola Needy, DavidB. Pratt, “Fundamentals of Engineering Economic Analysis”, First Edition, Wiley, 2014. 4. Blank Tarquin, “Engineering Economy”, 6th Edition. McGraw-Hill, 2005.		

Course Title	Fluid Mechanics and Hydraulic Machinery	Course No	ME208T
Course category	PEC	Structure (IPC)	3-0-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Pre-requisite	Engineering Mechanics	Effective from	July 2019
Course Objectives	In this course, the students will learn the principles and concepts of fluid statics and dynamics and apply the concepts to flow measuring devices, pipes, and hydraulic machinery such as Turbines and Pumps.		
Course Outcomes	After completion of the course, the student will be able to: 1. Understand the concepts of fluid statics and dynamics. 2. Apply the concepts of fluid statics and dynamics to various engineering applications and flow measuring devices. 3. Understand the concepts of laminar & turbulent flows and boundary layer formation. 4. Understand the working principles of hydraulic devices such as Turbines and Pumps. 5. Analyze the performance parameters of hydraulic devices.		
Contents of the course (With approximate break up of hours)	Fluid Statics: Physical properties of fluids - Specific Gravity, Viscosity, Surface Tension, Vapour Pressure and their influence on fluid motion, Basic equations of hydrostatics – pressure measurement, Analysis of submerged surfaces – Buoyancy and stability. (10) Fluid Kinematics and Dynamics: Classification of Flows, Stream function, Velocity potential, Conservation of mass, momentum and energy, Application of Bernoulli's Equation and Momentum equations, Measurement of flow: Venturi-meter, Orifice Meter and Pitot Tube (10) Flow through Pipes and the Concept of Boundary layer: Reynolds Experiment, Losses in pipes, Pipe connections, Total Energy Line, Hydraulic Gradient Line, Water hammer, Laminar & Turbulent Boundary Layer, Boundary Layer Thickness, Boundary layer separation. (8) Hydraulic Turbines: Impact of jets, Classification of Turbines, Pelton Wheel, Francis Turbine, Kaplan Turbine, Velocity diagrams, Governing ofTurbines, Unit and Specific Quantities, Geometric Similarity, Cavitation, Performance characteristic curves. (9) Hydraulic Pumps: Classification of reciprocating and centrifugal pumps, working principles, Velocity triangles, Losses and Efficiencies, Specific Speed, Pumps in Series, Parallel, Performance characteristic curves, NPSH, Cavitation. (5)		
Textbooks and References	1. S K Som, Gautam Biswas and S Chakraborty, "Introduction to Fluid Mechanics & Fluid Machines", McGraw Hill, 3rd edition, 2011. 2. Robert W. Fox, Philip Journal Pritchard and Alan T. McDonald, "Introduction to Fluid Mechanics", 8th Edition, Wiley India Pvt. Ltd.,2013. 3. Merle C Potter, David C Wiggert and Bassem H Ramadan, "Mechanics of Fluids", Cengage Learning India; 4th edition, 2012. 4. Streeter V.L., Benjamin Wylie, Bedford K.W., "Fluid Mechanics", McGraw Hill, 9th Edition, 2017. 5. P. N. Modi and S. M. Seth, "Hydraulics & Fluid Mechanics Including Hydraulics Machines", 22nd Edition, Standard Book House, 2017.		

Course Title	Dynamics of Machines	Course No	ME209T
Course category	PEC	Structure (IPC)	3-0-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Prerequisite	Engineering Mechanics, Kinematics of Machines	Effective from	July 2019
Course Objective	The objective of this course is to learn the fundamentals of static and dynamic force analysis of mechanism and analyze dynamics of machinery such as gyroscopes, flywheels, clutches, brakes and governors and also basics of vibration theory.		
Course Outcomes	At the end of the course, the student will be able to: 1. Analyse the forces in different mechanisms. 2. Apply the analytical and graphical methods for balancing of rotating and reciprocating engines. 3. Design different machinery such as gyroscopes, clutches, brakes, governors and flywheels. 4. Understand the concepts of vibration.		
Contents of the Course (With approximate break up of hours)	Dynamics of rigid body in plane and planar mechanisms – static and dynamic force analysis of slider crank mechanism. (4) Balancing of rotating and reciprocating masses and engine balancing. (7) Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero-planes and ships. (7) Turning moment diagram and flywheel analysis. (4) Clutches-single plate, multi-plate and centrifugal clutch, Simple block brakes, Band brake, internal expanding brake, braking of vehicle. Dynamometers – absorption and transmission types. (7) Governors-spring loaded and gravity-controlled governors. (5) Review of vibrations; free vibrations and harmonically excited vibration of single degree of freedom system; Vibration isolation. (8)		
Textbooks and References	1. S. S. Rattan, “Theory of Machines,” Tata McGraw-Hill, 2005. 2. J. S. Rao, and R. V. Dukkipati, “Mechanism and Machine Theory,” New Age International, 2006. 3. A. Ghosh and A. K. Mallik, “Theory of Mechanism and Machines,” Affiliated East –West Press Private Ltd., 2009. 4. T. Bevan, “Theory of Machines,” Pearson Education, 3rd Edition, 2009. 5. S. S. Rao, "Mechanical Vibrations", 6th edition, Pearson Education, 2017.		

Course Title	Quality Inspection and ProductValidation	Course No	ME210T
Course category	PEC	Structure (IPC)	3-0-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Pre-requisite	Nil	Effective from	July 2019
Course Objective	To impart knowledge on inspection, measurement, quality control, validation and certification of products		
Course Outcomes	At the end of the course, a student will be able to: 1. Understand various metrology principles andtechniques 2. Acquire the knowledge to select suitable techniques and equipment to inspect and to ensure productquality 3. Acquaintance with various quality control methodologies, standards andcertifications. 4. Understand the Inspection and Validation practices adopted in various industries through Case studies.		
Contents of the course (With approximate break up of hours)	Basic concepts: Measurement and inspection; Role of metrology in quality assurance; Errors; Length standards; Gauges and comparators; Linear and angular measurements; Fits and tolerances. (10) Measurement Practices: Optical metrology and laser interferometers; Measurement of flatness, straightness and form errors; Surface finish measurements; CMM; Vision applications in Metrology; Nano-measurements. (10) Statistical Methodologies: Graphical methods, Statistical control charts, Regression analysis, Analysis of variance, Sampling and acceptance. (8) Standards and Certifications: BIS, ISO, SAE, ASME, ASTM, IEEE. (6) Case studies: Inspection and Validation practices adopted in various industries. (8)		
Textbooks and References	1. T. G. Beckwith, R. D. Marangoni, and J. H. Lienhard, “Mechanical Measurements”, 6thEdition, Pearson Higher Education, 2007. 2. R. K. Jain, “Engineering Metrology”, Khanna Publishers, 20thEdition,2014. 3. D. J. Whitehouse, “Hand book of surface and nanometrology”, 2nd Edition, CRC Press,2010. 4. G. T. Smith, “Industrial Metrology”, Springer, 2002. 5. A.M. Badadhe, “Metrology and Quality Control”, Technical Publications, 2006. 6. R. C. Gupta, “Statistical Quality Control”, Khanna Publishers, 8thEdition, 2008.		

Course Title	Quality Inspection and ProductValidation Practice	Course No	ME210P
Course category	PEC	Structure (IPC)	0-3-2
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Pre-requisite	Nil	Effective from	July 2019
Course Objective	Studentswill learn to Calibrate and understand the sources of various measurement errors and familiarize with the use of metrologicalequipment.		
Course Outcomes	At the end of the course, a student will be able to: 1. Identify the suitable metrology instruments, gauges, andtools 2. Calibrate and understand the sources of various measurementerrors 3. Apply various statistical control charts in processcontrol.		
Contents of the course	The following experiments will be performed in this Practice session: 1. Error mapping of measuring Instruments and measurement of Linear dimensions of aluminum rod using Vernier height gauge and Dial Vernier 2. Calibration of Inside micrometer and Digital micrometer by measuring Internal dimensions of Specimen (Washer) 3. Measuring and Comparing the Depth & Thickness of Gear tooth with Theoretical Values 4. Measuring and comparing the internal dimensions of specimens (Gear block, Pipe) by Telescopic gauge 5. Comparing Flatness measurement using Spirit level and Sine bar finding angles of the Specimen 6. Temperature Measurement during the machining operation using Infrared gun 7. Measuring the Angles of the specimen by using Bevel Protractor 8. Calibration of dial gauge & bore gauge and measurement of internal dimensions and bores. 9. Measurement of roundness and cylindricity of the specimen.		
Textbooks and References	1. T. G. Beckwith, R. D. Marangoni, and J. H. Lienhard, “Mechanical Measurements”, 6thEdition, Pearson HigherEducation. 2. R. K. Jain, “Engineering Metrology”, Khanna Publishers, 20thReprint,2014. 3. R. C. Gupta, “Statistical Quality Control”, Khanna Publishers, 8thEdition,2008.		

Course Title	Sensors and Controls	Course Number	ME211I
Course category	PEC	Structure (IPC)	1-3-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Prerequisite	Nil	Effective from	July 2019
Course Objective	The objective of this course is to ensure that the students will be able to identify the suitable sensor for a particular measurement and identify the associated instrumentation devices and controllers. In addition, provides knowledge to work in LabVIEW and to make automated measurement. It also introduces DAQ based measurement in the instrumentation and different control scheme used in the mechanical engineering.		
Course Outcomes	At the end of the course, the student will be able to: 1. Select a suitable sensor for a particular instrumentation task 2. Design signal conditioning circuit and calibrate the sensor 3. Design, analyze and implement virtual instrumentation. 4. Construct an automated measurement setup 5. Choose the right actuating system for a various applications.		
Contents of the course (With approximate break up of hours)	Introduction: Description of measuring devices and dynamic characteristics, active and passive sensors and transducers, classifications Sensors and Transducers: Flow, temperature, force, pressure and torque sensors; Current, torque and speed measurements using digital measurement techniques, Optical sensors-Lasers photo-detectors and optical fibre as sensors Calibration methods, various errors of instrumentation, error analysis, error plots and application of linearization principles, data loggers and actuators. Virtual instrumentation, integration of filters and signal conditioners and data acquisition. Sensor based Control: Types of controllers, electrical, pneumatic and hydraulic prime movers and associated control hardware, closed loop control of microcomputer-based drives. Relay control systems and PLC systems and programming, control including sequence control. Sensor based control of various actuators, mechatronic devices and autonomous mobile robots.		
Textbooks and References	1. Thomas G Beckwith, Roy D Marangoni, John H. Lienhard V., “Mechanical Measurements”, Pearson Prentice Hall, 2009. 2. Doebelin, “Measurement systems: Applications and Design”, 5th Edition, McGraw Hill, 2004. 3. Ian R. Sinclair, “Sensors and Transducers”, Elsevier, 2001, ISBN: 978-0-7506-4932-2. 4. Jon S. Wilson, “Sensor Technology Handbook”, Newnes, 2004, ISBN: 0750677295. 5. Bijoy K. Ghosh, T. J. Tarn, Ning Xi, “Control in Robotics and Automation: Sensor-Based”, 1st Edition, Academic press.		

Course Title	Mechanical Design Practice	Course No	ME212P
Course category	PEC	Structure (IPC)	0-3-2
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Pre-requisite	Nil	Effective from	July 2019
Course Objective	Students will gain practical knowledge on the strength of materials under different loadings, and the kinematics and kinetics of various mechanisms and machineries.		
Course Outcomes	At the end of the course, a student will be able to: 1. Understand the behavior of materials under different kinds of loadingconditions. 2. Apply the principles of balancing of masses to various links, mechanisms and engines. 3. Analyze the principles of cam & follower motion and gyroscopic effect. 4. Evaluate the moment of inertial of rod, and frequency of Single degree of freedom system.		
Contents of the Course	The following experiments will be conducted to: 1. Estimate the Applied torque of given motorized Gyroscope. 2. Study the balancing of rotating masses under static condition and Dynamic condition. 3. Study the pressure distribution in the journal bearing 4. Estimate the critical speed of the shaft with different end conditions. 5. Analyse the follower displacement versus cam rotation angle for different types of cams. 6. Predict the radius of gyration of rod by using bi-filler and tri-filler suspension. 7. Estimate the natural frequency of un-damped free vibrations of spring –mass system. 8. Analyze the natural frequency of forced damped and un-damped vibration of spring mass system. 9. Analyze the natural frequency of torsional vibration of single rotor system using universal vibration test setup. 10. Determine the impact strength of material using impact testing machine 11. Obtain the tensile behaviour of the material under UTM.		
Textbooks and References	1. F. P. Beer, E. R. Johnston, J. T. Dewolf, and D. Mazurek, “Mechanics of Materials”, McGraw Hill, 7thEdition,2014. 2. R. C. Hibbeler, “Mechanics of Materials”, Prentice Hall, 8thEdition, 2010. 3. C. Ugural, “Mechanics of Materials”, Wiley, 1stEdition, 2007. 4. J. M. Gere and S. Timoshenko, “Mechanics of Materials”, PWS Publishing Company, 4thEdition,1997.		

Course Title	Entrepreneurship and Management Functions	Course No	
Course category	HMC	Structure (IPC)	3-0-3
Offered for	B. Tech All Branches	Status (Core/Elective)	Core
Prerequisite	Engineering Economics	Effective from	July 2019
Course Objective	The aim of this course is to introduce the basic Management functions to the U.G. students which enables them to enter into the corporate environment after graduation. This course also brings in Innovation mind set in to students mind by way of introducing to Entrepreneurship eco system.		
Course Outcomes	At the end of the course the student will be able to 1. Understand the corporate management skills and entrepreneurship skills 2. Understand the Management functions in an Enterprise environment 3. Carry out Manager and Leadership functions 4. Understand the Innovation and Entrepreneurship		
Contents of the course(With approximate break up of hours)	Introduction to Entrepreneurship, Manager vs Entrepreneur, Functions and Characteristics of Entrepreneur, Types of Entrepreneurs, Intrapreneurs, Stages in Entrepreneurship process, Role of Entrepreneurs in Society (6) Indian Economy & Industries, Business Opportunities, Preparation of Business Plan, Institutional Support, Startup Eco system (6) Nature of Management, Development of Management Thought, Approaches to Management, Policy, Procedure, Methods and Rules, Planning, Forecasting, Objectives and MBO (8) Staffing, Performance appraisal, Training & Development, Job analysis & Evaluation, Directing, Motivation, Leadership (6) Decision Making, Organization, Delegation of Authority, Departmentation, Span of Management, Types of Organization, Organization Chart and Manuals (8) Supervision, Communication, Controlling, Co-ordination, Management Audit, Business Ethics, Operation Research, Management Information System (8)		
Textbooks and References	1. T. Ramasamy, “Principles of Management”, Himalaya Publishing House, 2018. 2. K. R. Phanesh, “Management & Entrepreneurship”, Sudha Publications, 2014; 3. A. K. Gupta, “Engineering Management”, S. Chand & Company Ltd, 2012.		

Course Title	Heat Transfer	Course No	ME301T
Course category	PEC	Structure (IPC)	3-0-3
Offered for	B. Tech, MDM	Status (Core/Elective)	Core
Pre-requisite	Thermal Engineering – Concepts & Applications Fluid Mechanics and Hydraulic Machinery	Effective from	July 2019
Course Objective	The objective of this course is to understand the basic modes of heat transfer and their application in various Engineering systems.		
Course Outcomes	After completion of the course, students will be able to: 1. Understand the basics of heat transfer and their practical relevance in various simple geometries. 2. Interpret the steady and unsteady state heat transfer scenarios and fins. 3. Apply the relevant expressions to solve free and forced convection problems. 4. Apply the concepts of heat transfer in boiling, condensation and radiation thermal systems. 5. Design the heat exchanger for engineering applications		
Contents of the Course (With approximate break up of hours)	Basics: Basic modes and Applications of heat transfer. (2) Conduction: General heat conduction equation, Initial and boundary conditions, One dimensional steady state conduction in plane and composite systems, Electrical analogy, Systems with variable thermal conductivity, heat generation, Critical radius of insulation, Analysis of Extended surfaces, One dimensional transient conduction. (15) Convection: Dimensional analysis, concept of boundary layer, Forced convection in external and internal flows, natural convection in external flows, heat transfer phenomena in boiling and condensation. (12) Thermal Radiation: Nature of radiation, Concept of Black and Non-black bodies, Laws of Black Body Radiation, Radiation heat exchange between surfaces, Radiation shields. (6) Heat exchangers: Classification, flow arrangement, Overall heat transfer coefficient, fouling, compactness, LMTD & ε-NTU methods of Heat Exchanger analysis (7)		
Textbooks and References	1. J. P. Holman and Souvik Bhattacharyya, “Heat Transfer”, McGraw Hill, 10th edition, 2011. 2. Incropera, Dewitt, Bergmann, Lavine, “Fundamentals of Heat and Mass Transfer”, Wiley, 6th edition, 2010. 3. Frank Kreith, Mark S. Bohn, Raj Manglik, “Principles of Heat Transfer”, Cengage Learning Custom Publishing; 7th International student edition, 2010. 4. M. NecatiOzisik, “Heat Transfer- A basic Approach”,4th Edition, McGraw, 1985. 5. C. P. Kothandaraman and Subramanian, “Heat and Mass Transfer Data Book”, New Age International Publications, 8th Edition, 2012.		

Course Title	Automation in Manufacturing	Course No	ME302T
Course category	PEC	Structure (IPC)	3-0-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Prerequisite	Nil	Effective from	July 2019
Course Objective	The objective of this course is to learn the techniques and methodologies of integrating various mechatronic and automation devices in manufacturing systems. In particular, the contribution of hydraulic, pneumatic, robotic systems and PLCs in manufacturing systems will be studied.		
Course Outcomes	At the end of the course, a student will be able to: 1. Integrate various electro-mechanical devices in manufacturing. 2. Develop pneumatic and hydraulic circuits for manufacturing applications. 3. Automate a manufacturing system with various sensors, actuators and controllers. 4. Understand the concepts of Robotics in Automation.		
Contents of the course (With approximate break up of hours)	Mechatronic Systems: Overview of mechatronic systems and devices in manufacturing, automated feeding, transfer, retrieval mechanisms and devices, AGVs, FMS workstations, material handling and storage systems, overview of sensors, transducers and control systems in manufacturing. (6) Hydraulic Systems: Hydraulic systems: flow, pressure and direction control valves, actuators, supporting and control elements, pumps, servo valves and actuators, electro hydraulic servo- valves, proportional valves and their applications, design of hydraulic circuits for manufacturing applications and performance analysis. (10) Pneumatic Systems: Production, distribution and conditioning of compressed air, system components and graphic representations, design of circuits-switching circuits and sequential circuits, cascade methods, step counter method, compound circuit design. (10) Robotics in Automation: Robot classification and anatomy, forward and inverse kinematics, DH matrix transformation, Jacobian and differential motion, Trajectory planning, Static and dynamic analysis, applications in manufacturing. (12) PLCs and Microprocessors: Basic structure - Input / Output processing - Programming - Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC, Programming and interfacing of microprocessors in manufacturing applications. (6)		
Textbooks and References	1. AnthonyEsposito, "Fluidpower with applications" ,7th Edition,PrenticeHall, 2008. 2. M P. Groover, "Industrial Robotics: Technology, Programming and Applications", McGraw- Hill, 2nd Edition, 2012. 3. K. S. Fu, "Robotics: control, sensing, vision and intelligence",Mcgraw-Hill,1987. 4. Bolton, W., "Mechatronics: electronic control systems in mechanical and electrical engineering", McGraw Hill,2009. 5. DebS.R., "Robotics technology and flexible automation", 2nd Edition, Mc Graw Hill, 2009. 6. Boucher, T. O., "Computer automation in manufacturing - an Introduction", Chapman and Hall, 1996. 7. Morris A. Cohen and Uday M. Apte, "Manufacturing Automation", McGraw Hill, 1997.		

Course Title	Manufacturing Automation Practice	Course No	ME302P
Course category	PEC	Structure (IPC)	0-3-2
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Pre-requisite	Nil	Effective from	July 2019
Course Objective	To acquire hands on experience in integrating various mechatronic and automation devices such as hydraulic, pneumatic, robotic systems, PLCs and computers in manufacturing systems.		
Course Outcome	At the end of the course, a student will be able to: 1.Integrate various electro-mechanical devices in manufacturing. 2.Develop pneumatic and hydraulic circuits for manufacturing applications. 3.Automate a manufacturing system with various sensors, actuators, robot mechanisms, PLCs and other controllers.		
Contents of the course	The following experiments are conducted: 1. Integration of various sensors, actuators and other mechatronic devices in manufacturing applications. 2. Identification of faulty components, orientation errors, assembly errors etc. 3. Computer based design and simulation of automated manufacturing systems. 4. Design, development and implementation of pneumatic and hydraulic circuits for the given manufacturing problem. 5. Programming and integration of robot mechanisms in manufacturing automation. 6. Programming and integration of PLCs and control of equipment in manufacturing. 7. Design and development of microprocessor and computer-based control schemes in manufacturing automation		
Textbooks and References	1. Anthony Esposito, "Fluid power with applications", 7th Edition,PrenticeHall, 2008. 2. M P. Groover, "Industrial Robotics: Technology, Programming and Applications", McGraw- Hill, 2nd Edition, 2012. 3. K. S. Fu, "Robotics: control, sensing, vision and intelligence",Mcgraw-Hill,1987. 4. Bolton, W., "Mechatronics: electronic control systems in mechanical and electrical engineering", McGraw Hill,2009.		

Course Title	Machine Tool Technology	Course Number	ME303T
Course category	PEC	Structure (IPC)	3-0-3
Offered to	B.Tech, MDM	Status (Core/Elective)	Elective
Prerequisite	Basic Concepts in Manufacturing Process	Effective from	July 2019
Course Objective	The objective of this course is to develop competency in understanding of machine tools and its working principles.		
Course Outcomes	At the end of the course, the students will be able to: 1. Understand the design considerations for special features in Machine tools. 2. Apply the knowledge of various machine tools in manufacturing of a product. 3. Design Jigs and Fixtures for work and tool holding in machining a given product.		
Contents of the course (With approximate break up of hours)	Engine Lathe: Principle of working and specification of lathe – Types of lathes – Work holders and tool holders –Lathe accessories- Operations on Lathe- -Taper turning-Thread turning and lathe attachments. (8) Turret and Capstan Lathes: Principle of working -Collet chucks – Other work and tool holding devices – Box and tool layout. (4) Shaping, Slotting and Planing Machines: Principles of working – Principal parts – Specification, classification, operations performed, machining time calculations. (6) Drilling and Boring Machines: Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring machines – Fine boring machines – Jig Boring machine. Deep hole drilling machine. (6) Milling Machines: Principle of working – Specifications – Classifications of milling machines – Principal features of horizontal, vertical and universal milling machines – Machining operations-Types -Geometry of milling cutters –Milling cutters – Methods of indexing – Accessories to milling machines. (6) Grinding Machines – Fundamentals – Theory of grinding –Classification of grinding machine – Cylindrical and surface grinding machine – Tool and cutter grinding machine – special types of grinding machines. (6) Lapping, Honing and Broaching Machines: Comparison to grinding – lapping and honing. Constructional features of speed and feed units, machining time calculations. (6) Jigs and Fixtures: Principles of design of Jigs and fixtures and uses. Classification of Jigs & Fixtures – Principles of location and clamping – Types of clamping & work holding devices. Typical examples of jigs and fixtures. (6)		
Textbooks and References	1. G.C. Sen and A. Bhattacharya, “Principles of machine Tools”, New Central Book Agency. 2. G. Boothroyd, and W.A. Knight, “Fundamentals of machining and machine tools”, 3rd Edition, Taylor & Francis. 3. D. K Pal and S. K. Basu, “Design of Machine Tool”, 4th Edition, Oxford & IBH Publishing Pvt. Ltd. 4. G.E. Dieter, “Engineering Design:A Materials and processing approach”, McGraw Hill, 1991.		

Course Title	Design of Machine Elements	Course No	ME304T
Course category	PEC	Structure (IPC)	3-0-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Prerequisite	Engineering Mechanics Mechanics of Materials	Effective from	July 2019
Course Objective	The objective of this course is to introduce design concepts and procedures necessary to design and/or select a machine component in terms of geometry and materials		
Course Outcomes	At the end of the course, a student will be able to 1. Analyze the stresses in machine elements and structural members under various loads 2. Apply multidimensional failure criteria in the analysis and design of machine components 3. Design various joints in Machine components. 4. Design power transmission systems involving belts and chains 5. Determine the fatigue life of shafts, gears and bearings under varying loads		
Contents of the Course (With approximate break up of hours)	Design philosophy, revision of failure theories, limits, fits and design under static load (4) Design for variable loading - fatigue strength and design; design of shafts. (10) Design of riveted, bolted and welded joints and Power Screws. (10) Design and selection of belt drives. (4) Design of Gears: spur and worm gears, Contact and bending fatigue strength, Gear accuracy. (8) Tribology: Lubricant theories; Design of Journal bearings; Selection of ball and roller bearings (6)		
Textbooks and References	1. V Bhandari, 'Design of Machine Elements', McGraw-Hill Education, 3rd Edition, 2010. 2. R G Budynas, K J Nisbett, 'Mechanical Engineering Design', McGrawHill, 10th Edition, 2014 3. R L Norton, 'Machine Design', Prentice Hall, 5th Edition, 2013 4. C S Sharma and K Purohit, 'Design of Machine Elements', Prentice Hall, 2008 5. P C Gope, 'Machine Design: Fundamentals and Applications', Prentice Hall India, 2011		

Course Title	Microprocessors and Controllers	Course No	ME305I
Course category	PEC	Structure (IPC)	1-3-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Pre-requisite	Nil	Effective from	July 2019
Course Objective	To develop good understanding of operating principles/architecture of microprocessor/microcontrollers, gain comprehension and hands on experience of programming techniques with microprocessors and microcontrollers and also learn practically the concepts of peripherals interfacing with microprocessors and microcontrollers		
Course Outcomes	At the end of the course, a student will be able to: 1. Understand the concepts of binaryandhexa-decimalnumbersystems 2. Familiarize with the architecture of 8085 Microprocessor. 3. Programthe microprocessors/microcontrollers forsolvingpracticalproblems 4. Interface memory/keyboard/display etc. with microprocessors/micro controllers and run the devices like stepper motorsetc.		
Contents of the course (With approximate break up of hours)	Binary and Hexadecimal number systems and conversion, Arithmetic and logical operations, Logic gates, Addition, Subtraction, encoder, decoder, multiplexor, de-multiplexor, and concept of memory Architecture and Programming of 8085 Microprocessor. Interfacing of 8085 with memory and input /output ports, hex keyboards etc., Introduction – Standalone computers versus computers as components – Examples of Embedded computing systems. Elements of embedded controllers such as A/D converters, PWM circuits andtimers Introduction to the 8051 microcontrollers programming and interfacing with A/D, D/A converters, Sensor interfacing and signals conditioning.		
Textbooks and References	1. M. MorrisMano, "DigitalLogicandComputerDesign",1st Edition,Pearson,2013. 2. R. Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 6th Edition, Penram,2013. 3. M.A. Mazidi, J.G. Mazidi and R.D. Mc Kinlay, "Microcontroller and Embedded Systems", 2nd Edition, Pearson Education, 2009. 4. Kenneth J.Ayala, "The 8051 Mocro-controller", 3rd edition, Thomson Delmar Learning. 5. Douglas V. Hall, "Microprocessors and Interfacing: Programming and Hardware", 2nd edition, McGraw-Hill, 1990.		

Course Title	Fluid Mechanics and Heat Transfer Practice	Course No	ME306P
Course category	PEC	Structure (IPC)	0-3-2
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Pre-requisite	Fluid Mechanics and Hydraulic Machinery	Effective from	July 2019
Course Objective	The objective of this course is to familiarize the students with fluid mechanics and heat transfer equipment.		
Course Outcomes	At the end of this course, the student will be able to: 1. Compute the different losses in pipe flows. 2. Estimate the thermal conductivity of different materials, and Fin performance parameters. 3. Evaluate the free and forced convection heat transfer coefficients. 4. Determine the overall heat transfer coefficient of the Drop and Film wise condensation.		
Contents of the course	The following Experiments are designed to: 1. Estimate the major and minor losses in a flow through pipe. 2. Study of linear and radial heat transfer conduction using Fourier's Law. 3. Measurement of thermal conductivity of non-metallic material under steady state experiments. 4. Estimate the Effectiveness and efficiency of the pin fin apparatus under forced condition. 5. Determine the overall heat transfer coefficient of both the Drop and Film wise condensation. 6. Estimate the Heat Transfer coefficient of both Natural and forced convective system.		
Textbooks and References	1. J. P. Holman and Souvik Bhattacharyya, "Heat Transfer", McGraw Hill, 10th edition, 2011. 2. Incropera, Dewitt, Bergmann, Lavine, "Fundamentals of Heat and Mass Transfer", Wiley, 6th edition, 2010. 3. Robert W. Fox, Philip Journal Pritchard and Alan T. McDonald, "Introduction to Fluid Mechanics", 8th Edition, Wiley India Pvt. Ltd.,2013.		

Course Title	Design for Quality and Reliability	Course No	
Course category	DES	Structure (IPC)	3-0-3
Offered for	B. Tech All Branches	Status (Core/Elective)	Core
Prerequisite	Nil	Effective from	July 2019
Course Objective	The objectives of the course are to help engineering students understand the concepts of quality & reliability and also evaluatetheoverallreliabilityofasystemfromcomponentreliability.		
Course Outcomes	Attending the course would enable the student to: 1. Modelrepairableandnon-repairablesystemsandcalculatefailurerate,repairrate,reliability andavailability 2. Use variousprobabilitydensitydistributionssignificanttoreliabilitycalculations. 3. Fitagivenfailuredataset of aproductintoaWeibulldistributionandestimatethereliability parameters.		
Contents of the Course (With approximate break up of hours)	Concepts of Product Quality, Quality Function Deployment / House ofQuality, SixSigma (8) Concepts of Reliability, Basicconcepts of repairableandnon-repairablesystems, Reliability, AvailabilityandMaintainability (8) Failure dataanalysis, Fitting discrete and continuous distributions to failure data sets, Weibull analysis, estimation of importantreliabilityparameters (10) Calculation of System Reliability from Component reliabilities, Markovmodeling of repairableandnon-repairablesystems, Reliability LogicDiagrams, Fault-treeanalysis (10) Preventive and Predictive maintenance, Failure Modes and Effects Analysis. (6)		
Textbooks and References	1. Louis Cohen, Joseph P. Ficalora, "Quality Function Deployment and Six Sigma: A QFD Handbook", Second Edition, Prentice Hall, 2009. 2. V. N. A.Naikan, "Reliability Engineering and Life Testing", PHI Learning, 2010. 3. SingiresuS. Rao, "Reliability Engineering", PearsonEducation,2014. 4. Patrick O Connor, "Practical Reliability Engineering", John Wiley,2009. 5. B.L. Hansen and P.M. Ghare, "Quality Control and Applications", Prentice Hall, 1997.		

Course Title	Computational Methods in Engineering	Course No	ME307T
Course category	PEC	Structure (IPC)	3-0-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Pre-requisite	Engineering Mechanics, Fluid Mechanics, Heat Transfer, Mechanics of Materials	Effective from	July 2019
Course Objective	The objective of this course is to provide the fundamentals of finite element and finite difference methods, and modeling assumptions to solve structural and heat transfer problems.		
Course Outcomes	At the end of the course, a student will be able to 1. Understand the importance of obtaining approximate solutions to various practical problems 2. Model machine elements and structures, and analyze the stresses and strains 3. Analyze the heat transfer problems		
Contents of the course(With approximate break up of hours)	Fluid flow & Heat Transfer: Difference representation of PDEs including errors, consistencyand stability. (6) Application of Numerical Methods to Heat equation, Laplace's equation and Burgers'equation. Application of Finite Volume Formulation to One-dimensional Steady diffusion.(12) Boundary value problems - Classical solution methods: Weighted residual techniques and Rayleigh-Ritz method. (9) Finite Element Method: Discretization, shape functions, boundary conditions, element stiffnessmatrix, assembly technique for global matrices - Numerical integration - Application totrusses, beams and heat transfer problems. Tutorials. (15)		
Textbooks and References	1.Richard H. Pletcher, John C. Tannehill, Dale Anderson, "Computational Fluid Mechanicsand Heat Transfer", Third Edition (Series in Computational and Physical Processes inMechanics and Thermal Sciences), CRC Press, 2012. 2. T R Chandrupatla and A D Belegundu, 'Introduction to Finite Elements in Engineering',3rd Edition, PHI Learning, 2009 3. J N Reddy, 'An Introduction to the Finite Element Method', McGraw-Hill Education, 3rd Edition, 2005 4. Patankar, S.V., Numerical Heat Transfer and Fluid Flow, McGraw-Hill, 1980. 5. Muralidhar, K., Sundarajan T., "Computational Fluid Flow and Heat Transfer", NarosaPublishing House, New Delhi, 1995. 6. Versteeg Henk Kaarle, MalalasekeraWeeratunge, "An introduction to computational fluiddynamics: The finite volume method", Pearson Education, 2007. 7. Seshu P., "Finite Element Analysis", Prentice Hall India, 2003. 8. JacobFish and Ted Belytschko, "A first Course in Finite Elements", John Wily & Sons,2007		

Course Title	Mechanical Design Simulation Practice	Course No	ME307P
Course category	Mechanical Engineering	Structure (IPC)	0-3-2
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Pre-requisite	Heat Transfer Mechanics of Materials	Effective from	July 2029
Course Objective	To make acquainted the students using computer aided engineering tools to design and analyze the structural, fluid flow and heat transfer related systems.		
Course Outcomes	At the end of the course, a student will be able to: 1. Draw 1D, 2D and 3D Finite Element Models of mechanical systems. 2. Understand the solution techniques available in computer-aided engineering tools. 3. Evaluate the design of mechanical systems by conducting stress analysis, thermal analysis or fluid flow analysis.		
Contents of the course	Creation of Finite Element Models and Evaluation of Displacements, Stresses and Reaction Forces of axially and transversely loaded members, thin plates or discs, long pipes or dams, and brackets using Static Structural Analysis. Evaluation of natural frequencies and mode shapes of axially and transversely loaded members using Dynamic Structural Analysis. Construction of Finite Element Models and study of temperature distribution in fins or composite plane walls and chimneys or other plane sections using Thermal Analysis. Building of Finite Element Models and study of velocity distribution of fluid in channels or pipes over bluff bodies using steady state fluid flow analysis.		
Textbooks and References	1. Saeed Moaveni, "Finite Element Analysis: Theory and Application with ANSYS", Pearson, 2011. 2. Tirupathi R. Chandrupatla and Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall of India,2001. 3. Erdogan Madenci and Ibrahim Guven, "The Finite Element Method and Applications in Engineering Using ANSYS", Springer,2015.		

Course Title	Thermal Energy Systems	Course No	ME308T
Course category	PEC	Structure (IPC)	3-0-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Prerequisite	Thermal Engineering. - Concepts and Applications	Effective from	July 2019
Course Objective	The objective this course is to provide an insight of fundamentals and salient features of major energy conversion systems using the concepts of Thermal Engineering.		
Course Outcome	At the end of the course the student will be able to: 1. Understand the concepts of a Steam power plant. 2. Comprehend the concepts a Gas turbine plant. 3. Acquire the knowledge of the Internal Combustion engine components. 4. Appreciate the concepts of Refrigeration and their applications. 5. Analyze the psychrometric properties and processes used in Air Conditioning systems.		
Contents of the course (With approximate break up of hours)	Steam power cycles: Steam Power plant and its components, site selection, Carnot Vapour Power Cycle, Rankine cycle, Rankine Cycle with Reheat, Superheat, and Regeneration, Plant efficiency, Cogeneration. (8) Gas Turbines: Gas turbine plant and its components, Brayton cycle, Classification, Analysis of Closed and Open cycle Gas Turbine plants, Methods of improving performance, Intercooler, Regeneration and Reheating, Applications. (5) Internal Combustion Engines: Basic components and nomenclature, Classification, working principles of 2-stroke & 4-stroke SI and CI, Engines, Air-standard and Real cycles, Fuels, Stoichiometric Air-Fuel ratio, Combustion: Detonation and Knocking, Carburetion, Injection, Ignition and cooling systems, Parameters of performance, Exhaust emissions. (15) Refrigeration: Gas Refrigeration system, Vapour compression cycle, Effect of sub-cooling and superheating, Multistage systems, Cascade systems, Vapour Absorption cycle, Refrigerants (9) Air-conditioning: Psychrometric properties, Psychrometric chart, Psychrometric processes, Components of Air conditioning system, Classification of Air conditioning systems (5)		
Textbooks and References	1. T. D. Eastop, A. McConkey, "Applied Thermodynamics for Engineering Technologists", 5th Edition, Pearson India,2002. 2. P. K. Nag, "Power Plant Engineering", 4thEdition, McGraw Hill, 2014. 3. Wilbert F. Stoecker and J.W. Jones, "Refrigeration and Air Conditioning", 2nd Edition, McGrawHill,2002. 4. John B. Heywood, "Internal Combustion Engine Fundamentals,McGraw Hill,2011. 5. V. Ganesan, "Internal Combustion Engines", 4th edition, McGraw Hill, 2012. 6. V. Ganesan, "Gas Turbines" – McGrawHill, 3rd Edition, 2010. 7. H. I. H. Saravanamuthoo, H. Cohen, G. F. C. Rogers, "Gas Turbine Theory", 5th Edition, Pearson, 2001.		

Course Title	Thermal Engineering Practice	Course No	ME308P
Course category	PEC	Structure (IPC)	0-3-2
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Pre-requisite	Heat Transfer	Effective from	July 2019
Course Objective	The objective of this course is to imbibe the practical knowledge in various modern thermal systems		
Course Outcome	At the end of the course, the student will be able to: 1. Estimate the heat transfer coefficients of various heat exchangers. 2. Study the performances of Solar PV Trainer kit and Wind energy trainer kit. 3. Familiarize the students with Refrigeration and Air-Conditioner test rigs. 4. Familiarize the students with IC engines.		
Contents of the course	The following experiments are conducted to: 1. Find out the COP of a Refrigeration Test rig at various loading conditions. 2. Estimate the COP of Air Conditioner Test rig at various loading conditions. 3. Determine the overall heat transfer coefficient and dirt coefficient of the given shell and tube heat exchanger. 4. Determine the overall heat transfer coefficient and film coefficient for jacketed vessel with coil heat exchanger. 5. Determine LMTD, effectiveness and overall heat transfer coefficient for parallel and counter flow heat exchanger for concentric tube flow. 6. Understand relationship of heat transfer and flow regime in a plate heat exchanger geometry. 7. Study the performance of Petrol Engine 8. Study the performance of Solar PV Trainer kit. 9. Study the performance of Wind energy trainer kit.		
Textbooks and References	1. J. P. Holman and Souvik Bhattacharyya, "Heat Transfer", 10th edition, McGraw Hill, 2011. 2. V. Ganesan, "Internal Combustion Engines", 4th edition, McGraw Hill, 2012. 3. Wilbert F. Stoecker and J.W. Jones, "Refrigeration and Air Conditioning", 2ndEdition, McGraw Hill, 2002. 4. P. K. Nag, "Power Plant Engineering", 4th Edition, McGraw Hill, 2014.		

Course Title	Product Design Practice	Course No	
Course category	DES	Structure (IPC)	0-3-2
Offered for	B.Tech All Branches	Status (Core/Elective)	Core
Prerequisite	Design Realization Practice, Product Realization Practice	Effective from	July 2019
Course Objective	Students will develop cross-discipline products and prototype them using product realization tools in a multi- disciplinary team setting.		
Course Outcomes	By the end of the course, the students would be able to: 1. Develop cross disciplinaryidea 2. Conceive, design and prototype an innovativeidea 3. Work in cross-functional groups and to apply the concepts learnt in theory to a practical problem 4. Manage group projects, maintain timeliness and follow method-oriented approach to problemsolving		
Details about the course	This course is an inter-disciplinary team based product design and prototyping course. Theconcept of the course is to provide hands on learning experience in interdisciplinary fields of engineering and exposure to the context of a "real" product design problems. In this course students will design a product by following the systematic product design process. A team consist of students from different discipline will choose their own innovative product and while designing, students will consider many issues like market opportunities, formal requirements and constraints, the environment in which the product will be used, product look and feel; technical legitimacy, and manufacturing considerations for theproducts. During the course, students will learn and put in to practice team working, project management and product realization practices commonly found in product developers in industry. Throughout the semester, the student teams have several opportunities to present their progress to their fellow students and faculty.		
Textbooks and References	1. Carl Liu, "Innovative Product Design Practice", Kindle Edition, ASIN:B00B29V9RQ 2. Bjarki Hallgrimsson, "Prototyping and Modelmaking for Product Design", Laurance King Publishing Limited, 2012.		

Course Title	Mechanical Vibrations	Course Number	ME501T
Course category	PEC	Structure (IPC)	3-0-3
Offered to	B.Tech, MDM	Status (Core/ Elective)	Elective
Prerequisite	Dynamics of Machines	Effective from	July 2019
Course Objective	The objective of this course is to learn the fundamentals of vibration theory and model realworld mechanical vibration problems.		
Course Outcome	At the end of this course, the student will be able to: 1. Understand the free and forced vibration of single, two and multi degree of freedom systems. 2. Understand the working principle of vibration measuring instruments 3. Mathematically model vibration problems and to mitigate vibration effects 4. Design and develop vibration absorbers, dampers and vibration isolators 5. Analyze vibration of continuous systems such as shaft, rod and beams.		
Contents of the course (With approximate break up of hours)	Introduction to vibration and its effects, linear and non linear systems, degrees of freedom, continuous systems and discrete systems.(4) Single Degree of Freedom Systems- formulation, energy method, Newton -Euler method, Free vibration, Un-damped and damped free vibration, Forced vibration, harmonic excitation, solution of differential equation of motion, Vector approach, Complex frequency response, Magnification factor Resonance, Rotating/reciprocating unbalances, Force Transmissibility, Motion Transmissibility, Vehicular suspension, Vibration measuring instruments, Case studies on forced vibration.(10) Two Degree of Freedom Systems: Free and forced vibration of linear systems, Eigen values and Eigen vectors, Normal modes and mode superposition, Application to two degree of freedom systems. (10) Multi degree of freedom systems: Introduction, Formulation of equations of motion, Free vibration response, Natural modes and mode shapes, Orthogonally of model vectors, normalization of model vectors, mode super position, Forced vibration analysis through model analysis, Model damping, Rayleigh's damping, Introduction to experimental model analysis.(10) Continuous Systems: Vibration of strings, rod, shaft, beams and membranes. (8)		
Textbooks and References	1. W. T. Thomson, M. D. Dahleh and C. Padmanabhan, "Theory of Vibrations with Applications", 5th edition, Pearson Education, 2008. 2. S. S. Rao, "Mechanical Vibrations", 6th Edition, PearsonEducation, 2017. 3. L. Meirovitch, "Fundamentals of Vibrations", Waveland Pr Inc, 2010. 4. C. Sujatha, "Vibration and Acoustics", 1st edition, Tata McGrawHill, 2010. 5. Preumont, "Vibration Control of Active Structures-An Introduction", Springer, 3rd Edition, 2011. 6. A.K. Mallik and S. Chatterjee, "Principles of Passive and Active Vibration Control", 1stEdition, Affiliated East West Press, 2014. 7. D. J. Mead, "Passive Vibration Control", 1st edition, John Wiley & Sons, 1998.		

Course Title	Advanced Solid Mechanics	Course Number	ME502T
Course category	PEC	Structure (IPC)	3-0-3
Offered to	B.Tech, MDM	Status (Core/ Elective)	Elective
Prerequisite	Mechanics of Materials	Effective from	July 2019
Course Objective	The objective of the course is to provide the advanced analysis techniques for the boundary value problems in solid structures.		
Course Outcomes	At the end of the course, the student will be able to: 1. Apply the stress-strain relations for linearly elastic members using normal stress, shear stress and distortion energy theories. 2. Analyse the mechanical structures using energy methods. 3. Design straight beams, curved and asymmetrical bending of beams 4. Analyse the beams under unsymmetrical loading. 5. Apply shear centre of thin wall beams, torsion & axisymmetric problems		
Contents of the course (Withapproximate break up ofhours)	Analysis of Stress – Traction vector, stress tensor, Principle stresses, Hydrostatic and deviatoric stresses Analysis of Strain – displacement field, deformation tensor, strain tensor, principle strain (14) Stress-Strain Relations for Linearly Elastic Solids-Anisotropic, isotropic behaviour (6) Theories of Failure: Significance of the theories of failure, Factor of safety in design. (5) Energy Methods: Hooke's law and the principle of superposition, Work done by forces and elastic strain energy stored, Reciprocal theorem, First theorem of Castigliano, Theorem of virtual work. (5) Bending of Beams: Straight beams and asymmetrical bending, Bending of curved beams. (6) Torsion & Axisymmetric Problems: Torsional of general prismatic bars-solid sections, Stresses in composite tubes, Thermal Stresses. (6)		
Textbooks and References	1. Irving H. Shames, "Mechanics of Deformable Solids", Krieger Pub Co, 2008. 2. L.S. Srinath, "Advanced Mechanics of Solids", 3rd Edition,TMH, 2009.		

Course Title	Computer Aided Design andManufacturing	Course No	ME503T
Course category	PEC	Structure (IPC)	3-0-3
Offered for	B.Tech, MDM	Status (Core/Elective)	Core
Pre-requisite	Engineering Graphics	Effective from	July 2019
Course Objective	The objective of this course is to provide the fundamental concepts of computer aided design and manufacturing through geometric modeling and their representations.		
Course Outcomes	At the end of the course, a student will be able to: 1. Understand the hardware and software requirements of CAD/CAM. 2. Formulate the mathematical equations for geometrical entities such as curves, and surfaces. 3. Understand 3D-solid representationtechniques 4. Develop CNC programs for machining complexgeometries		
Contents of the course(With approximate break up of hours)	Overview of CAD/CAM: Hardware and software requirements in CAD/CAM, Introduction to geometric representation- Implicit, explicit, parametric equations; Transformations in 2D and 3Dprojections (8) Parametric curves: Differential geometry of curves, Cubic Hermite curves - Algebraic and geometric form, Blending functions, subdivision, re-parameterization and composite Hermite curves, continuity aspects, Bezier curves - control polygons and Bernstein basis, de Casteljau algorithm, continuity aspects, rational Beziers, B-spline curves - periodic, open and non- uniform knot vectors and corresponding curves, rational B-splines, NURBS curve(8) Parametric surfaces: Hermite surface - algebraic and geometric form, subdivision and reparameterization, continuity of surfaces, Bezier surface - control net representation, continuity aspects, rational Bezier surfaces, B-Spline surfaces - periodic, open and non-uniform knot vectors and corresponding surfaces, rational B-splines, NURBS surface(8) Representation of solids: Topology of surfaces, Euler and modified form of equations, representations - Quadtree, Octree, Halfspace, Boundary Representation (B-Rep), Constructive Solid Geometry (CSG), Boolean operations in 2D - set membership classification, Union, DifferenceandIntersection (8) Data exchange in CAD/CAM: CNC part programming for ordinary and complex geometry, CNC Program generation from CAD models, Concepts of native and neutral file formats for data exchange, Interfacing with manufacturing systems, Concepts of reverse engineering, Rapid prototyping, Computer aidedprocessplanning (10)		
Textbooks and References	1. Zeid. I, "CAD/CAMTheoryandPractice",TataMcGrawHill, 2006. 2. Rogers, D.FandAdams,J.A, "MathematicalElementsforComputerGraphics",McGraw Hill, 2002. 3. CheeKaiChua,KahFaiLeong,ChuSingLim, "Rapidprototyping",WorldScientific, 2010. 4. Rogers. D.F, "An Introduction to NURBS", Morgan Kaufmann,2001. 5. J. Hoschekand D. Lasser, "ComputerAidedGeometricDesign",AKPeters,1996. 6. MortensonM.E, "GeometricModeling",JohnWiley,1985. 7. Gerald E. Farin, "Curves and Surfaces for CAGD", Morgan Kaufmann,2002.		

Course Title	Modern Manufacturing Technology	Course Number	ME504T
Course category	PEC	Structure (IPC)	3-0-3
Offered to	B.Tech, MDM	Status (Core/Elective)	Elective
Prerequisite	Basic Concepts in Manufacturing Process	Effective from	July 2019
Course Objective	To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design.		
Course Outcomes	At the end of the course, the students will be able to: 1.Model the material removal in various modern manufacturing processes. 2. Analyze the processes and evaluate the role of each process parameter during machining of various advanced materials. 4. Select the best process out of the available various advanced manufacturing processes for the given job assignment. 5. Understand requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials.		
Contents of the course (With approximate break up of hours)	**Modern Machining Processes**: Electro Discharge Machining (EDM), Processes mechanism of material removal, parameters effects EDM &application,Electrical Discharge Grinding(EDG), Electrochemical Machining (ECM)Processes, Mechanism of material removal, Tool design, Parameters affecting ECM,Applications, Electro-Chemical Honing(ECH), Electrochemical Deburring (ECD), Electrochemical Grinding(ECG), Electrochemical Discharge Grinding (ECDG), Chemical Machining.(15) Ultrasonic Machining (USM), Cutting Tool System Design, Mechanism of cutting, Parameters affects USM applications. Abrasive Jet Machining (AJM), Variables of AJM, Nozzle Design, Laser Beam Machining (LBM), Thermal and Non-thermal analysis, and applications, Electron – Beam Machining (EBM) and its mechanism, Applications, Plasma Arc Machining (PAM), Equipment, Arc transfer mechanism, Metallurgical efforts, Safety precautions and applications, Plasma are surfacing and plasma Arc Springing, Iron Beam Machining (IBM) and water Jet Machining (WJM). (13) **Modern Forming Processes**: Measurement of stress and strain under high strain rate, principles of drop forging operation cam plastometer and mushrooming of billets, formability criteria, explosive forming, electro hydraulic forming, magnetic pulse forming, pneumatic mechanical high velocity forming, comparison with conventional process, introduction to kinetic forming, explosive welding. (14)		
Textbooks and References	1.Pandey, P.C. and Shan H.S., "Modern Machining Processes", Tata McGraw Hill, 2004. 2. D. Fishlock and K. W. Hards, "New ways of working with metals" – GerogeNewnes Ltd., 1965 3."HMT - Production Technology", Tata McGraw Hill, 2004, 1980. 4. "ASME -High velocity forming of metals", PHI Publishers.		

Course Title	Operation Research	Course Number	ME505T
Course category	PEC	Structure (IPC)	3-0-3
Offered to	B.Tech, MDM	Status (Core/Elective)	Elective
Prerequisite	Linear Algebra	Effective from	July 2019
Course Objective	The objective of this course is to introduce the concepts of formulating an engineering problem into a mathematical model to develop an optimal solution.		
Course Outcomes	After completion of the course student will be able to: 1. Apply linear programming approach for optimizing the objectives of industrial oriented problems. 2. Formulate and solve Transportation Models and assignment Models 3. Implement the strategies in competitive situations and Identify the replacement period of the equipment. 4. Analyze the waiting situations in an organization. 5. Determine the optimum inventory level and resolve the complex problem into simple problems by dynamic programming approach and apply optimum strategies.		
Contents of the course (With approximate break up of hours)	Introduction to Operations Research, operations research models, applications. (2) Linear programming: Formulation, Graphical solution, Simplex method, artificial variables techniques, Two–phase method, Big-M method, Duality Principle. (7) Transportation and Assignment problems: Formulation, Optimal solution, unbalanced transportation problem, Degeneracy, Variants of Assignment Problem-Traveling Salesman problem. (7) Game theory: Minimax (maximin) Criterion and optimal strategy, Solution of games with saddle points, Rectangular games without saddle points, 2 X 2 games – dominance principle – m X 2 & 2 X n games and graphical method. Theory of replacement: Introduction, Replacement of Equipment that Deteriorates Gradually, Replacement of Equipment that fails suddenly, Group Replacement. (9) Waiting lines: Single Channel – Poisson arrivals – exponential service times – with infinite population and finite population models. (6) Inventory models: Introduction, terminology, EOQ, deterministic models — Instantaneous production, finite production, continuous demand, purchase inventory models with one price break and multiple price breaks. (6) Dynamic programming: Introduction, Bellman‘s Principle of optimality, Applications of dynamic programming, capital budgeting problem, shortest path problem, linear programming problem. (5)		
Textbooks and References	1. Singiresu S Rao, "Engineering Optimization: Theory and Practice", 4th edition, Wiley, 2009. 2. Hiller &Libermann, “Introduction to Operation Research”, 9th Edition, McGraw Hill, 2009 3. A. M. Natarajan, P. Balasubramani, A. Tamilarasi, "Operations Research", 2nd edition, Pearson Education, 2014. 4. Taha, "Introduction to Operation Research, 9th edition, PHI, 2010.		

Course Title	Computational Fluid Dynamics	Course Number	ME506T
Course category	PEC	Structure (IPC)	3-0-3
Offered to	B.Tech, MDM	Status (Core/Elective)	Elective
Prerequisite	Fluid Mechanics, Heat Transfer	Effective from	July 2019
Course Objective	The objective of this course is to introduce the numerical techniques and its role in the field of heat transfer and fluid flow. Also, to enable the students to understand the various discretization methods and methodologies.		
Course Outcomes	After completion of the course student will be able to: 1. Formulate the basic fluid dynamics problem mathematically 2. Analyze the mathematical behaviour of partial differential equations 3. Understand various solution methodologies. 4. Apply the FDM and FVM techniques to solve heat transfer problems. 5. Solve the elementary incompressible fluid problems using the CFD techniques		
Contents of the course (With approximate break up of hours)	Basics of Computational fluid dynamics, Governing equations of fluid mechanics and heat transfer, Physical boundary conditions - elliptic, parabolic and hyperbolic equations, Finite different formulation, stability analysis (6) Solution methodologies: Direct and iterative methods, Thomas algorithm, relaxation method, alternating direction implicit method. (8) Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, grid generation. (10) Finite volume formulation of steady one-dimensional convection and diffusion problems, central, upwind, hybrid and power-law schemes; Discretization equations for two-dimensional convection and diffusion. (10) Numerical methods for Navier-Stokes equation - Turbulence models: mixing length model, Two equation (k-epsilon) model (8)		
Textbooks and References	1. Patankar. S. V, "Numerical Heat Transfer and Fluid Flow", CRC Press, 1980. 2. H. Versteeg, W. Malalasekera, "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", 2nd Edition, PHI, 2007 3. J. D. Anderson, "Computational Fluid Dynamics - Basics with Applications", Mc Graw Hill, 1995. 4. K. Muralidhar, T. Sundararajan, "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, 1995. 5. T. K. Sengupta, "Fundamentals of Computational Fluid Dynamics", University Press, 2004.		

Course Title	Optimization techniques for Mechanical Engineers	Course Number	ME507T
Course category	PEC	Structure (IPC)	3-0-3
Offered to	B.Tech All Branches	Status (Core/Elective)	Free Elective
Prerequisite	Calculus, Differential Equations	Effective from	July 2019
Course Objective	The objective of this course is to make the students of Mechanical Engineering be aware of the optimization problems and available mathematical tools to solve them.		
Course Outcomes	After completion of the course student will be able to: 1. Familiarize with the curve fitting techniques. 2. Understand the concepts and need for optimisation. 3. Familiarize with the various calculus and search techniques of optimisation problems. 4. Familiarize with the Non-traditional optimisation techniques.		
Contents of the course (With approximate break up of hours)	Introduction: Introduction to system design, Morphology of design with a flow chart, Concept of workable design, practical example on workable system and optimal design. (4) System Simulation: Successive substitution method, Newton Raphson method: One and Multiple unknowns, Gauss Siedel method, Rudiments of finite difference method for partial differential equations, with examples. (5) Regression and Curve Fitting: Need for regression in simulation and optimization; Concept of best fit and exact fit; Concept of least square regression fit; Gauss Newton method for nonlinear least squares regression (7) Optimization: Basic ideas, Need for optimisation, formulation, graphical method, linear programming problems, simplex method, Types of optimisation problems: Calculus methods; Lagrange multipliers, search techniques, local and global optimum. (18) Non-traditional optimization techniques: Genetic Algorithms, Simulated Annealing, Particle swam optimisation algorithm, Artificial Neural networks. (8)		
Textbooks and References	1. C. Balaji, "Essentials of Thermal System Design and Optimization", 2nd Edition, Ane Books, 2019. 2. Kalyanmoy Deb, "Optimization for Engineering Design: Algorithms and Examples", 2nd edition, Prentice Hall India, 2012. 3. S. S. Rao, " Engineering Optimization: Theory and Practice", 4th edition, John Wiley & Sons, 2009 4. Yogesh Jaluria, "Design and Optimization of Thermal Systems", McGraw Hill, 1998.		

Course Title	Automobile Engineering Systems	Course Number	ME508T
Course category	PEC	Structure (IPC)	3-0-3
Offered to	B.Tech All Branches	Status (Core/Elective)	Free Elective
Prerequisite	Nil	Effective from	July 2019
Course Objective	The objective of this course is to learn about the automobile layout, Engine Emissions, working of Transmission system, Steering system, Suspension system, Braking system, Fuel system and different Electrical systems.		
Course Outcomes	After completion of the course student will be able to: 1. Acquire the basic knowledge of anatomy of an Automobile and its components. 2. Understand the working principles of suspension, transmission, control systems of an automobile. 3: Realize the functions of various electrical and electronic systems used in automobiles. 4: Understand the role of alternative flues and pollution free vehicles.		
Contents of the course (With approximate break up of hours)	Introduction: Principles of Engine operation, engine parts, cooling systems, lubrication systems, fuel systems, Emission standard and Testing. (10) Structures: Construction, function, loading, principles of suspension systems and mechanics. (6) Transmission systems: Clutch, Fly-wheel, Gear boxes-types and construction. (6) Vehicle controls: Steering geometry and types, Brakes- types and construction. (6) Auto electrical and electronics: Battery generator, starting motor, lighting and ignition, Electronic Fuel injection. (6) Alternative concepts: Alternative fuels, basics of electric and hybrid vehicles, fuel cells. (8)		
Textbooks and References	1. J. Heitner, "Automotive Mechanics", 2nd Edition, CBS Publisher, 2006. 2. H. Heisler, "Advanced Vehicle Technology", 2nd Edition, Butterworth-Heinemann Series, 2002. 3. Kirpal Singh, "Automobile Engineering - Vol I & II", 13th Edition, Standard Publishers Distributors, 2014. 4. David A Crolla, "Automotive Engineering", 1st edition, Butterworth-Heinemann series, 2009. 5. "Automotive handbook", 3rd Edition, Robert Bosch GmbH, S.A.E., 1993.		

Course Title	Nonlinear Dynamics	Course Number	ME509T
Course category	PEC	Structure (IPC)	3-0-3
Offered to	B.Tech All Branches	Status (Core/ Elective)	Free Elective
Prerequisite	Linear Algebra	Effective from	July 2019
Course Objective	The objective of the course is to provide the primary tools to deal with the nonlinear dynamical equations from various physical scenarios.		
Course Outcomes	After completing this course, the student will be able to: 1. Interpret the nonlinear dynamical equation geometrically 2. Understand the system qualitatively without solving the nonlinear system. 3. Understand the deep simplicity in the chaotic system.		
Contents of the course (With approximate break up of hours)	Introduction to nonlinear dynamics; Flows on the line – geometrical way of thinking, Linear stability analysis, existence and uniqueness. (5) Bifurcations – saddle node, trans-critical, pitch fork; Flow on the curve – uniform and non-uniform oscillator (10) Linear two-dimensional systems – classification; Phase plane – phase portrait, fixed points and linearization, conservative systems. (5) Limit cycles – Ruling out closed orbits, Poincare – Bendixson theorem, Lienard systems, Relaxation Oscillators, Weakly nonlinear oscillators; Hopf bifurcation, Global bifurcation of cycles, Poincare map (10) Lorenz equation, chaos on a strange attractor, Lorenz map; 1D maps – Fixed points and cobwebs, Logistic maps, periodic window; Fractals, strange attractors. (12)		
Textbooks and References	1. Steven H Strogatz, "Nonlinear Dynamics and Chaos", Perseus books, 1994. 2. J D Murray, "Mathematical Biology – an introduction", Springer.		

Course Title	Operations and Supply Chain Management	Course Number	ME510T
Course category	PEC	Structure (IPC)	3-0-3
Offered to	B.Tech All Branches	Status (Core/Elective)	Free Elective
Prerequisite	Linear Algebra	Effective from	July 2019
Course Objective	This course introduces the basics of Operations and Supply Chain Management. The concepts in Operations Management are restricted to the planning and operational decisions within an organization while the supply chain concepts are for a network of organizations.		
Course Outcomes	After completion of the course student will be able to: 1. Apply the forecasting techniques in estimating the number of products. 2. Use the inventory management techniques to determine the optimum quantity of material. 3. Decide the dispatch procedure required for a production processes and other activities. 4. Acquaintance to the concepts Supply chain Management		
Contents of the course (With approximate break up of hours)	Forecasting: Need for forecasting, Quantitative methods. (3) Facility layout and location: Qualitative aspects, Quantitative models for layout decisions, Product, process xed position, group layout, Location decisions-quantitative models. (6) Capacity and aggregate planning, Capacity measurement, Long-term and short-term strategies,Aggregate planning. (3) Inventory management: Various costs in inventory management and need, Deterministic modelsand discounts, Probabilistic inventory management. (6) Scheduling models and applications, Scheduling in MRP system, Sequencing rules and applications,Batch production sequencing and scheduling. (4) Introduction to supply chain: Definition, complexity, key issues, Centralized vs. decentralizedsystems. (3) Value of information and supply chain integration: Bullwhip effect, Push-based, pull basedsystems. Outsourcing: Make or buy decisions. Transportation decision: Drivers of the decision,Network design decisions, Cross-docking, trans-shipment. (8) Distribution and logistics in supply chains: Direct shipment/intermediate storage policies, Vehiclerouting models, Third-party logistics. (5) Information technology in supply chain, Enabling supply chain through IT, ERP vendor platforms, Service oriented architecture (SOA), RFID (4)		
Textbooks and References	1. R. Panneerselvam, Production/Operations Management, Prentice Hall of India Pvt Ltd, 2007. 2. P.Rama Murthy, Production and Operations Management, New Age International, 2nd Edition, 2005. 3. S.N.Chary, Production and Operations Management, TMH, 4th Edition 2010. 4. Samuel Eilon, Elements of Production Planning and Control, Universal Publishing Corporation, 2004. 5. Joseph.G.Monks, Operations Management, McGraw-Hill Inc., 3rd Revised edition.		