VIT
UNIVERSITY
(Estd. u/s 3 of UGC Act 1956)
Vellore - 632 014, Tamil Nadu, India

SCHOOL OF MECHANICAL AND BUILDING SCIENCES

CURRICULUM

B. Tech. MECHANICAL ENGINEERING

Breakup of Courses

Sl. No	Category	Total number of Credits
1	University Core	33
2	University Elective	6
3	Programme Core	129
4	Programme Elective	15
Minimum Total Number of Credits		**183**

Breakup of Category

Category	Number of Credits	%	Recommended %
Engineering	116	66.3	64
Humanities	11	6.3	8
Management	9	5.1	8
Sciences	39	22.3	20
Sub Total	175		
University Elective	6		
Co/Extra-Curricular Activity	2		
TOTAL	**183**	**100**	**100**

B. Tech. MECHANICAL ENGINEERING CURRICULUM

University Core

Course Code	Course Title	L	T	P	C	Category	Version	Course Prerequisite
ENG101	English for Engineers – I	2	0	2	3	Humanities	1.0	VIT EPT (or) ENG001
ENG102	English for Engineers – II	2	0	2	3	Humanities	1.0	ENG101
CHY101	Engineering Chemistry	3	0	2	4	Science	1.0	-
CHY104	Environmental Studies	3	0	0	3	Science	1.0	-
FRE101/ GER101/ JAP101/ CHI101	Foreign Language	2	0	0	2	Humanities	1.0	-
MAT101	Multivariable Calculus and Differential Equations	3	1	0	4	Science	1.0	-
ITE101	Problem Solving Using 'C'	2	0	2	3	Engineering	1.0	-
PHY101	Modern Physics	3	0	2	4	Science	1.0	-
HUM121	Ethics and Values	2	0	2	3	Management	1.0	-
MEE498	Comprehensive Examination	-	-	-	2	Engineering	1.0	-
XXX497	Co/Extra-Curricular Activity	-	-	-	2	-	1.0	
					33			

University Electives

Course Title	L	T	P	C
University Elective - I	-	-	-	3
University Elective - II	-	-	-	3
				6

Programme Core

Course Code	Course Title	L	T	P	C	Category	Version	Course Prerequisite
MAT104	Probability and Statistics	3	1	0	4	Science	1.1	MAT101
MAT105	Differential and Difference Equations	3	1	0	4	Science	1.1	MAT101
MAT201	Complex Variables and Partial Differential Equations	3	1	0	4	Science	1.00	MAT105
MAT205	Applied Numerical Methods	3	1	0	4	Science	1.00	MAT201
PHY102	Material Science	3	0	2	4	Science	1.00	-
CHY102	Materials and Instrumental Techniques	3	0	2	4	Science	1.00	-
MEE107	Engineering Drawing – I	0	0	4	2	Engineering	1.10	-
MEE108	Engineering Drawing – II	0	0	4	2	Engineering	1.00	MEE107
MEE102	Workshop Practice	0	0	2	1	Engineering	1.10	-
MEE104	Workshop Practice – II	0	0	2	1	Engineering	1.00	MEE102
EEE101	Basic Electrical & Electronics Engineering	3	0	2	4	Engineering	1.00	-
MEE202	Engineering Mechanics	3	1	0	4	Engineering	1.00	-
MEE203	Materials Engineering and Technology	2	1	2	4	Engineering	1.01	PHY102
MEE204	Engineering Thermodynamics	2	1	0	3	Engineering	1.01	-
MEE205	Fundamentals of Manufacturing Processes	3	0	2	4	Engineering	1.01	-
MEE206	Fluid Mechanics	2	1	2	4	Engineering	1.00	-
MEE207	Computer Aided Machine Drawing	0	0	4	2	Engineering	1.01	MEE108
MEE214	Strength of Materials	2	1	2	4	Engineering	1.01	MEE202
MEE215	Kinematics of Machinery	2	1	0	3	Engineering	1.11	MEE202 / MEE208
MEE216	Thermal Engineering Systems	2	1	2	4	Engineering	1.10	MEE204
MEE217	Machining Processes and Metrology	3	0	2	4	Engineering	1.01	MEE205
MEE301	Dynamics of Machinery	2	1	2	4	Engineering	1.10	MEE215
MEE302	Design of Machine Elements	2	1	0	3	Engineering	1.01	MEE214
MEE303	Heat and Mass Transfer	3	1	2	5	Engineering	1.00	MEE204
MEE304	Turbomachines	2	1	2	4	Engineering	1.02	MEE204, MEE206
MEE218	Hardware Project	0	0	4	2	Engineering	1.01	MEE217
MEE305	Design Project	0	0	4	2	Engineering	1.01	MEE302
MEE306	Design of Transmission Systems	3	1	0	4	Engineering	1.01	(MEE301, MEE302) or MEE222
MEE307	CAD/CAM	2	0	4	4	Engineering	1.01	MEE302
MEE399	Industrial Internship	-	-	-	2	Engineering	1.00	-
MEE308	Industrial Engineering and Management	3	0	0	3	Management	1.00	-
MEE437	Operations Research	2	1	0	3	Management	1.01	MAT104
HUM101	Psychology and Sociology	3	0	0	3	Humanities	1.00	-
MEE499	Project Work	-	-	-	20	Engineering	1.00	-

Programme Electives (Credits to be earned: 15)

Course Code	Course Title	L	T	P	C	Category	Version	Course Prerequisite
MEE209	Instrumentation and Control Engineering	2	1	2	4	Engineering	1.01	-
MEE213	Robotics	3	0	0	3	Engineering	1.01	-
MEE228	Power Plant Engineering	2	1	0	3	Engineering	1.00	MEE 204
MEE243	Fundamentals of Mechatronics Systems	3	0	2	4	Engineering	1.10	EEE101
MEE230	Renewable Energy Sources	3	0	0	3	Engineering	1.10	-
MEE244	Industrial Automation Controllers	2	1	2	4	Engineering	1.10	EEE101
MEE309	Internal Combustion Engines	3	0	0	3	Engineering	1.01	MEE216
MEE380	Surface Engineering	3	0	0	3	Engineering	1.01	MEE205
MEE311	Non-Destructive Evaluation and Testing	3	0	0	3	Engineering	1.01	MEE203, MEE205
MEE312	Refrigeration and Air Conditioning	2	1	0	3	Engineering	1.01	MEE216
MEE401	Total Quality Management and Reliability	3	0	0	3	Engineering	1.10	MEE308
MEE381	Nanotechnology	3	0	0	3	Engineering	1.01	MEE203
MEE338	Design of Composite Materials	2	1	0	3	Engineering	1.00	MEE203, MEE214
MEE339	Tribology	2	1	0	3	Engineering	1.01	MEE202, MEE206 / 240
MEE430	Acoustics and Noise Control Engineering	2	1	0	3	Engineering	1.01	MEE301
MEE431	Product Design	2	1	0	3	Engineering	1.00	MEE302
MEE432	Tool Design	2	1	0	3	Engineering	1.10	MEE217, MEE302
MEE336	Finite Element Analysis	2	1	2	4	Engineering	1.01	MAT205, MEE214
MEE340	Product Design For Manufacturing	2	1	0	3	Engineering	1.00	MEE217
MEE433	Mechanical Vibrations	2	1	0	3	Engineering	1.01	MEE301
MEE341	Metal Casting Technology	3	0	0	3	Engineering	1.00	MEE205
MEE342	Welding Engineering	3	0	0	3	Engineering	1.01	MEE205
MEE434	Production Planning and Control	3	0	0	3	Engineering	1.01	MEE308
MEE435	Lean Enterprises and New Manufacturing Technology	3	0	0	3	Engineering	1.01	MEE308
MEE343	Metal Forming Theory and Practice	3	0	0	3	Engineering	1.01	MEE203, MEE205
MEE344	Modeling and Simulation of Manufacturing Systems	3	0	0	3	Engineering	1.00	MAT104
MEE345	Gas Dynamics and Jet Propulsion	2	1	0	3	Engineering	1.00	MEE204, MEE206
MEE322	Fuels and Combustion	3	0	0	3	Engineering	1.01	MEE204
MEE346	Fluid Power Systems	3	0	0	3	Engineering	1.01	MEE206
MEE405	Computational Fluid Dynamics	2	1	2	4	Engineering	1.10	MAT205, MEE206 / 240, MEE303

Programme Electives contd…

Course Code	Course Title	L	T	P	C	Category	Version	Course Prerequisite
MEE416	Solar Thermal Power Engineering	3	0	0	3	Engineering	1.01	MEE303
MEE428	Automobile Engineering	3	0	0	3	Engineering	1.01	MEE301, MEE302
MEE347	Advanced Machining Processes	2	1	0	3	Engineering	1.00	MEE217
MEE348	Cryogenic Engineering	2	1	0	3	Engineering	1.01	MEE216
MEE420	Nuclear Power Engineering	3	0	0	3	Engineering	1.00	-
MEE349	New Venture Planning and Management	3	0	0	3	Management	1.01	-
MEE350	Facilities and Process Planning	3	0	0	3	Engineering	1.01	MEE308
MEE351	Rapid Manufacturing Technologies	3	0	0	3	Engineering	1.10	MEE205
MEE389	Micro and Nano Machining	3	0	0	3	Engineering	1.00	MEE217
MEE241	Automotive Electronics and Instrumentation Systems	3	0	0	3	Engineering	1.00	-
MEE333	Hydrogen and Fuel Cells	3	0	0	3	Engineering	1.10	MEE204
MEE410	Petroleum Technology	3	0	0	3	Engineering	1.00	-
MEE364	Automotive Aerodynamics	2	1	0	3	Engineering	1.00	-
MEE353	Vehicle Technology (Automotive Chassis and Body Engineering)	2	1	0	3	Engineering	1.00	-
MEE227	Safety and Hazard Analysis	2	1	0	3	Engineering	1.00	-
MEE235	Alternative Fuels	3	0	0	3	Engineering	1.00	-
MEE239	Project Management	3	0	0	3	Engineering	1.00	-

MEE107	ENGINEERING DRAWING – I	0	0	4	2
Prerequisite	-				
Objectives:	1. To create awareness and emphasize the need for Engineering Graphics in all the branches of engineering. 2. To follow basic drawing standards and conventions. 3. To develop skills in three-dimensional visualization of engineering component.				
Expected Outcome:	On completion of this course, the students will be able to 1. Prepare drawings as per standards (BIS). 2. Solve specific geometrical problems in plane geometry involving lines, plane figures and special Curves. 3. Produce orthographic projection of engineering components working from pictorial drawings.				
Unit I					
Introduction to Engineering Drawing: Principles of Engineering Graphics and their Significance, Drawing Instruments and their Use, Dimensioning principles, Conventions in Drawing Curves Used in Engineering Practice & their Constructions: Conic Sections including the Rectangular Hyperbola- General method only.					
Unit II					
Drawing of Projections or Views: Principles of Orthographic Projections, Conventions, Projection of Points in all quadrants and Projection of Lines (first angle projection) inclined to both planes, True lengths, Traces.					
Unit III					
Projections of Planes: Projections of regular Planes in simple position, inclined to both the planes, Auxiliary planes and views					
Unit IV					
Projection of Solids: Projection of Solids in simple position, inclined to both the planes, Auxiliary views.					
Unit V					
Sections and Sectional Views: Right Regular Solids- Prism, Cylinder, Pyramid, Cone. Auxiliary views for true shape of sections					
Text Books					
1. Engineering Drawing, N.D. Bhat / Charotar. 2. Engineering Drawing and Graphics, Venugopal K, New Age International.					
References					
1. Engineering drawing- P.J. Shah. / S. Chand. 2. Engineering Drawing- Narayana and Kannaiah / Scitech Publishers. 3. Engineering Drawing- Johle / Tata Mc Graw Hill					
Mode of Evaluation	Tutorials / Class Tests / Lab Exam				

MEE102	WORKSHOP PRACTICE	0	0	2	1
Prerequisite	-				
Objectives:	1. To train the students in metal joining process like welding, soldering, etc. 2. To impart skill in fabricating simple components using sheet metal. 3. To cultivate safety aspects in handling of tools and equipment.				
Expected Outcome:	On completion of this course, the students will be able to 1. Welding and soldering operations. 2. Fabrication of simple sheet metal parts.				
Unit I	Welding Shop				
1. Instruction of BI standards and reading of welding drawings. 2. Butt Joint 3. Lap Joint 4. TIG Welding 5. MIG Welding					
Unit II	Sheet Metal Shop				
1. Making of Cube 2. Making of Cone using development of surface. 3. Making of control panel using development of surface.					
Unit III	Soldering Shop				
1. Soldering and desoldering of Resistor in PCB. 2. Soldering and desoldering of IC in PCB. 3. Soldering and desoldering of Capacitor in PCB.					
Unit IV	Bosch Tools				
Demonstration of all BOSCH TOOLS					
Text Books					
Workshop Manual prepared by VIT staff					
Mode of Evaluation	Tutorials / Class Tests / Lab Exam				

MEE 108	ENGINEERING DRAWING – II	0	0	4	2
Prerequisite	MEE107				
Objectives:	1. To prepare sectional views of solids. 2. To draw the development of surfaces and estimate the sheet metal requirement. 3. To develop skills in three-dimensional visualization of engineering components. 4. To provide students with the basic knowledge and skills in producing Engineering Graphics and with the capability to read and interpret engineering drawings. 5. To develop an understanding of solid modelling using the SolidWorks software.				
Expected Outcome:	On completion of this course, the students will be able to 1. Prepare sectional views of solids. 2. Estimate the sheet metal requirement for fabrication. 3. Draw isometric drawings of combined solids and simple components. 4. Prepare solid modelling of machine components using the Solidworks software.				
Unit I	Introduction to CAD				
Practice of some figures using CAD					
Unit II	Development and Interpenetration of Solids				
Development of Surfaces of Right Regular Solids- Prisms, Cylinder, Pyramid, Cone and their parts.					
Unit III	Transformation of Projections				
Conversion of Isometric Views to Orthographic views, Conventions					
Unit IV	Isometric Projections				
Principles of Isometric Projection, Isometric scale, Isometric views, Isometric Projection of Objects.					
Unit V	Perspective Projections				
Perspective View- Points, Lines, Plane Figures and Simple Solids. Vanishing Point Methods (General Method only).					
Text Books					
1. Engineering Drawing, N.D. Bhat / Charotar. 2. Engineering Drawing and Graphics, Venugopal / Newage International.					
References					
1. Engineering drawing- P.J. Shah. / S. Chand. 2. Engineering Drawing- Narayana and Kannaiah / Scitech Publishers. 3. Engineering Drawing- Johle / Tata Mcgraw Hill.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

50 % Manual Practice and 50% CAD Practice

MEE104	WORKSHOP PRACTICE - II	0	0	2	1
Prerequisite	MEE102				
Objectives:	1. To train the students in safety handling of tools, equipment and machineries. 2. To carry out exercise in metal removal process by using drilling and lathe machines. 3. To train students in plumbing operation and techniques. 4. To expose the student in house wiring. 5. To train students in basic carpentry exercise using modern Bosch Tools.				
Expected Outcome:	On completion of this course, the students will be able to 1. Basic operation in drilling and lathe. 2. Plumbing and simple house wiring. 3. Basic wooden components				
Unit I	Machine Shop				
1. Drilling and Countersinking using Drilling machine 2. Drilling and Tapping 3. Lathe Exercise - Facing operation 4. Lathe Exercise - Straight turning and Chamfering					
Unit II	Plumbing Shop				
1. L – Joint 2. T - Joint					
Unit III	House Wiring Shop				
1. Single point wiring 2. Staircase wiring					
Unit IV	Bosch Tools Exercises				
1. Planning & Polishing operation 2. Sawing operation 3. Profile cutting 4. Making of rectangular slot					
Text Books					
Workshop Manual prepared by VIT staff					
Mode of Evaluation	Tutorials / Class Tests / Lab Exam				

MEE202	ENGINEERING MECHANICS	3	1	0	4
Prerequisite	-				
Objectives:	1. To calculate the reactive forces. 2. To analyse the structures. 3. To know the geometric properties of the different shapes. 4. To teach energy and momentum methods.				
Expected Outcome:	Student will be able to 1. Solve the engineering problems in case of equilibrium conditions. 2. Calculate the reaction forces of various supports of different structures. 3. Solve the problems involving dry friction. 4. Determine the centroid, centre of gravity and moment of inertia of various surfaces and solids. 5. Solve the problems involving dynamics of particles and rigid bodies				
Unit I	Statics of Particle				
Introduction to Mechanics – Fundamental Principles – Laws of Mechanics, Lame's theorem, Parallelogram and triangular Law of forces, Coplanar forces – Free body diagram – Equilibrium of particles - Equilibrium of particle in space					
Unit II	Statics of Rigid Body and Friction				
Single equivalent force – Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis –Varignon's theorem – Equilibrium of Rigid bodies in two dimensions. Characteristics of dry friction – Problems involving dry friction – Ladder – Wedges.					
Unit III	Properties of Sections				
Centroid – First moment of area – Theorems of Pappus and Guldinus – Second moment of area – Moment and Product of inertia of plane areas – Transfer Theorems – Polar moment of inertia – Principal axes – Mass moment of inertia- Derivation of mass moment of inertia for rectangular section prism, sphere from first principle – relation to area moments of inertia					
Unit IV	Dynamics of Particles				
Displacements, Velocity and acceleration, their relationship – relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies- Impact - direct and central impact – coefficient of restitution.					
Unit V	Dynamics of Rigid Bodies				
General plane motion –Velocity and Acceleration- Absolute and Relative motion method - Equilibrium of rigid bodies in plane motion- Newton's Law- D'Alembert's Principle- Work Energy Principle-Principle of impulse momentum for rigid bodies in plane motion					
Text Books					
1.Ferdinand P. Beer, E. Russell Johnston (2010), Vector Mechanics for Engineers: Statics and Dynamics (9th Edition), Tata McGraw-Hill International Edition. 2. J. L. Meriam and L. G. Kraige (2006), Engineering Mechanics: Statics and Dynamics (6th Edition), Wiley Publishers					
References					
1. Irving H. Shames, (2003), Engineering Mechanics – Statics and Dynamics, Prentice-					

Hall of India Private limited. 2. Russell C Hibbeler, (2009), Engineering Mechanics: Statics and Dynamics (12th Edition), Prentice Hall. 3. Anthony M. Bedford and Wallace Fowler (2007), Engineering Mechanics: Statics and Dynamics (5^{th} Edition), Prentice Hall.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE203	MATERIALS ENGINEERING AND TECHNOLOGY	2	1	2	4
Prerequisite	PHY102				
Objectives:	1. The main objective of this course is to provide the basic knowledge needed to explore the discipline of materials science and engineering. 2. To develop the knowledge of how the structure of materials is described technically, including crystallography, microstructure, defects, and phase diagrams 3. To develop the knowledge of how the properties of materials are described technically and how material failure is analyzed 4. To introduce the concepts of structure-property relationships 5. To develop knowledge in various class of materials and their applications				
Expected Outcome:	Student will be able to 1. Understand how materials are formed and their classification based on atomic arrangement 2. Describe the mechanical behaviour of metallic systems and its importance 3. Evaluate system for fatigue failures 4. Gain knowledge on different class of materials and their applications 5. Evaluate the failure mode of the materials and to know the steps to be taken to prevent the failures				
Unit I	Basic Concepts				
Introduction to Materials Science, Defects-Point, Line, Planar, Volume- Slip planes and slip systems, Schmid's rule, Polymorphism and allotropy - Solidification– Nucleation and Growth mechanism, Cooling curve of pure metal and alloy					
Unit II	Phase Diagrams and Phase Transformation				
Phase, Gibbs's Phase rule, Solubility and Solid Solutions - Iso-morphous alloy system - Binary Eutectic alloy system (Lead-Tin System), Eutectoid and Peritectic system, Iron-Iron carbide phase diagram- Invariant reactions, Evolution of Microstructure, Phase Transformation-Temperature-Time-Transformation (TTT) and Continuous Cooling Transformation (CCT) Diagrams - Steels, Cast Irons and Stainless steels – types and applications – Effects of alloying elements					
Unit III	Heat Treatment & Surface Heat treatments				
Heat Treatment – Annealing and its types, Normalizing, Aus-tempering, Mar-tempering, Quenching and Temper heat treatment, Hardenability – Basic concepts of wear and corrosion & their types - Surface hardening processes – Flame and induction hardening, Carburizing, Nitriding and Carbonitriding					
Unit IV	Mechanical Properties of Materials				
Tension, Compression, Shear and Torsional Test of Metals -Stress-strain behaviour of ferrous & non-ferrous metals, polymer and ceramics - True stress and strain relations - Flexural Test, Hardness measurement tests, Fracture of metals - Ductile Fracture, Brittle Fracture, Fatigue – Endurance limit of ferrous and non-ferrous metals – Fatigue test; Creep and stress rupture– mechanism of creep – stages of creep and creep test, Strengthening mechanisms					
Unit V	Non Ferrous Alloys & Advanced materials				
Non Ferrous Alloys of Aluminum, Magnesium, Copper, Nickel, Titanium – Microstructure and mechanical property relationships; Composites – Classification, Processing, Metal Matrix, Ceramic Matrix, polymer matrix – properties and applications; Ceramics – Alumina, Zirconia, Silicon Carbide, Sialons, Reaction Bonded Silicon Nitride(RBSN),					

Processing, properties and applications of ceramics, Glasses – properties and applications.	
Text Books	
1. W.D. Callister, Jr.,(2010), Materials Science and Engineering: An Introduction, 8th ed., Wiley & Sons	
Reference Books	
1. J.C. Anderson, K.D. Leaver, P. Leavers and R.D. Rawlings, (2003), Materials Science for Engineers, 5th edition, Tata McGraw Hill Publishers. 2. William F. Smith and Javad Hashemi (2004), Foundations of Materials Science and Engineering 4th ed., Mc Graw Hill. 3. Sidney H Avner, (2005) "Introduction to Physical Metallurgy, Tata McGraw Hill Publishing Company Limited 4. Krishnan K. Chawla, (2007) Composite materials, Science and Engineering 2nd edition, Springer 5. Lawrence E.Murr (2000), Failure analysis, Marcel Dekker Inc.publications.	
Mode of Evaluation	Mini-Project/Assignment/ Seminar/Written Examination.

MEE203L	MATERIALS ENGINEERING AND TECHNOLOGY LAB
Objectives:	1. To train students in the preparation of samples to perform characterization such as microstructure, volume fraction of phases, determination of porosity, film thickness, grain size and avoid measurement. 2. To help the students understand the microstructure of engineering materials, phase diagrams, various testing standards and acquire knowledge on the material behaviour by conducting tests. 3. To teach students how to improve the mechanical properties of materials by various methods.
Expected Outcome:	Student will be able to 1. Acquire experimentation skills in the field of metallurgy. 2. Develop theoretical understanding of the mechanical properties of materials by performing experiments. 3. Apply the knowledge of phase diagrams and testing methods in related areas. Know how to improve structure of materials for various industrial applications.

Experiments
1. Metallographic sample preparation 2. Phase diagram determination 3. Microstructures of plain carbon steel 4. Microstructures of cast iron 5. Heat treatment of plain carbon steels 6. Hardness measurement 7. Phase analysis and porosity determination using image analysis soft ware 8. Microstructure of non-ferrous alloys 9. Determination of grain size 10. NDT testing – using ultrasonic flaw detector 11. Stress analysis using XRD pattern 12. Creep Test

References	Lab Manual Prepared by VIT Staff
Mode of Evaluation	Experiments/Record work/Oral/ Practical Examination

MEE204	ENGINEERING THERMODYNAMICS	2	1	0	3
Prerequisite	-				
Objectives:	1. To teach students the basic principles of classical thermodynamics and prepare them to apply basic conversion principles of mass and energy to closed and open systems. 2. To enable the students to understand second law of thermodynamics and apply it to various systems, note the significance of the results and to know about availability, entropy and second law aspects of daily life. 3. To teach students about properties of pure substances and to analyze the performance of thermodynamic air and vapour power cycles. 4. To help the students understand various gas laws and equations of state and apply them to solve problems of gas mixtures in estimating enthalpy, entropy, specific heat and internal energy. 5. To teach students about fuels and combustion phenomenon, solve problems on stoichiometry, complete combustion, gravimetric and volumetric analysis.				
Expected Outcome:	Student will be able to 1. Demonstrate an understanding of the concepts such as conservation of mass, conservation of energy, work interaction, heat transfer and first law of thermodynamics. 2. Identify closed and open systems and analyze related problems. 3. Apply the concept of second law to design simple systems. 4. Analyze the performance of gas and vapor power cycles and identify methods to improve thermodynamic performance. 5. Demonstrate the importance of phase change diagrams of various pure substances. 6. Apply gas laws to mixtures. 7. Analyze problems of combustion and stoichiometry.				
Unit I	Basic Concepts and First Laws Thermodynamics				
Basic concepts of Thermodynamics - Thermodynamics and Energy - Closed and open systems - Properties of a system - State and equilibrium - Processes and cycles - Forms of energy - Work and heat transfer - Temperature and Zeroth law of thermodynamics - First law of thermodynamics - Energy balance for closed systems - First law applied to steady – flow engineering devices					
Unit II	Second Law of Thermodynamics				
Limitations of the first law of Thermodynamics - Thermal energy reservoirs - Kelvin-Planck statement of the second law of thermodynamics - Clausius statement - Equivalence of Kelvin-Planck and Clausius statements - Refrigerators, Heat Pump and Air-Conditioners –COP - Perpetual Motion Machines - Reversible and Irreversible process - Carnot cycle – Entropy - The Clausius inequality - Availability and irreversibility - Second law efficiency.					
Unit III	Vapour and Gas Power Cycles				
Properties of pure substance-Property diagram for phase - change processes - Carnot vapour cycle - Rankine cycle - Methods for improving the efficiency of Rankine cycle - Ideal Reheat and Regenerative cycles - Binary vapour cycles - Combined gas - vapour power cycles - Analysis of power cycles - Carnot cycle - Air standard assumptions - Otto cycle - Diesel and Dual cycles - Brayton cycle - Stirling and Ericsson cycles					

Unit IV	Ideal Gas Mixtures	
Ideal and real gases - Vander Waals equation - Principle of corresponding states - Ideal gas equation of state - Other equations of state - Compressibility factor - Compressibility charts - Composition of gas mixtures - Mass and mole fractions - Dalton's law of additive pressures - Amagat's law of additive volumes - Relating pressure, volume and temperature of ideal gas mixtures - Evaluating internal energy - enthalpy - entropy and specific heats.		
Unit V	Fuels and Combustion	
Types of fuels - Exothermic and endothermic reactions - Combustion equations – Stoichiometry - Combustion analysis by mass and volume - Conversion of gravimetric to volumetric analysis - Conversion of volumetric to gravimetric analysis - Analysis of exhaust gas - Excess air and air-fuel ratio - Combustion problem by mole method - Complete combustion of fuel - Calorific value – Definition - Types of calorimeter.		
Text Books		
1. P K Nag, (2009), Engineering Thermodynamics, Tata McGraw-Hill Publishing Company Ltd. 2. Yunus A. Cengel Michael A. Boles, (2005), Thermodynamics: An Engineering Approach, McGraw-Hill Science.		
References		
1. Yunus A. Cengel, (2005), Thermodynamics: An Engineering Approach, Tata McGraw-Hill Publishing Company Ltd. 2. Y.V.C.Rao, (2004), An Introduction to Thermodynamics, Universities Press. 3. C. P. Arora, (2005) Thermodynamics, Tata McGraw-Hill Publishing Company Ltd. 4. David R. Gaskell, (2003), Introduction to Thermodynamics of Materials, Taylor and Francis Publisher.. 5. M. Achuthan, , (2004), Engineering Thermodynamics, Prentice Hall India Limited. 6. Eastop, (2004), Applied Thermodynamics for Engineering Technologies, Addison-Wesley Logman Limited.		
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination	

MEE205	FUNDAMENTALS OF MANUFACTURING PROCESSES	3	0	2	4
Prerequisite	-				
Objectives:	To help students acquire knowledge about the behaviour and manufacturing properties of all engineering materials and basic concepts of foundry and casting processes. 2. To teach students various methods of welding, cold and hot working and forming. 3. To enable students understand forging, molding and powder metallurgy processes in detail.				
Expected Outcome:	Student will be able to 1. Demonstrate an understanding of various materials and their properties employed in different manufacturing processes. 2. Understand the principles of foundry and casting. 3. Choose materials in a manufacturing process based on their properties. 4. Study in detail about the modern welding processes followed in industries. 5. Conduct experiments on various manufacturing processes and to automate them. 6. Design gating system, dies for forging and powder metallurgy processes. 7. Demonstrate an ability to solve engineering problems in welding and powder metallurgy processes pertaining to the selection of process parameters. 8. Demonstrate an ability to use manaufacuring techniques for economic production. 9. Choose correct manufacturing process for a particular engineering application.				
Unit I	Metal Casting Processes				
Manufacturing- selecting manufacturing process – global competitiveness of manufacturing costs – Fundamentals of materials- their behavior and manufacturing properties – Ferrous metals and alloys – Non ferrous metals and alloys –Fundamentals of metal casting – Fluidity of molten metal – Solidification time – Sand casting – Shell mold casting - Investment casting - Plaster mold casting – Ceramic mold casting – Die casting - Centrifugal casting – Melting practice and furnaces - Defects in sasting – Testing and inspection of casting.					
Unit II	Joining Processes				
Metal fusion welding processes – Oxyfuel gas welding – Arc welding processes – Consumable electrode: SMAW- SAW – GMAW – FCAW – Electro gas welding – Electro slag welding – Non-consumable Electrode: GTAW- AHW- PAW – EBM – LBM – Solid state welding processes: Ultrasonic welding – Friction welding – Friction stir welding - Resistance welding – Weld quality – Testing welded joints.					
Unit III	Metal Forming Processes				
Cold and Hot working: Rolling – Forging – Extrusion – Drawing – Sheet metal forming processes – High Energy Rate Forming Processes: Explosive Forming – Electro Hydraulic Forming – Electro Magnetic Forming.					
Unit IV	Processing of Powder Metals, Ceramics and Glass				
Production of metal powders: Compaction – Sintering and Finishing – Design considerations for powder metallurgy and Process capability – Shaping of ceramics –					

Forming and shaping of glass – Design considerations for ceramics and glass – Processing of superconductors.		
Unit V	Processing of Plastics and Composite Materials	
Types of Plastics – Types of Molding: Injection molding – Blow molding – Compression molding – Transfer molding – Thermoforming – Reinforced plastics – Metal Matrix Composites – Ceramic Matrix Composites.		
Text Books		
1. Serope Kalpakjian; Steven R. Schmid (2010), Manufacturing Engineering and Technology, 6th Edition, Publisher: Prentice Hall, ISBN-10 0-13-608168-1, ISBN-13 978-0-13-608168-5. 2. P.N.Rao. (2009), Manufacturing Technology – Foundry, Forging and Welding, Tata McGraw Hill Publishing Company Ltd., New Delhi.		
References		
1. Hajra Choudhury S.K. (2004), Elements of Manufacturing Technology, Vol. - I, Media Publications.		
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination	

MEE205L	FUNDAMENTALS OF MANUFACTURING PROCESSES LAB
Objectives :	1. To enable the students understand the basic concepts of molding and the sequence of processes involved in the preparation of green sand mold. 2. To teach students how to determine permeability number, grain fineness number, compressive and shear strength of molding sand etc., 3. To teach students how to perform simple welding operations using Arc, TIG and MIG welding machines. 4. To help students perform some simple exercises on lathe such as turning, thread cutting, drilling, boring etc.
Expected Outcome:	Student will be able to 1. Acquire knowledge about green sand molding process, gates and risers. 2. Acquaint with basic welding processes and cutting parameters of turning processes, thread cutting etc. 3. Make decisions on various cutting parameters for different materials in lathe operations.
Experiments	
FOUNDRY 1. Preparation of Green sand mold using wooden pattern 2. Determination of Grain Fineness Number 3. Determination of Permeability Number 4. Determination of Compressive and Shear strength of molding sand 5. Demonstration of pouring the Non Ferrous Metal by using Crucible Tilting Furnace	
WELDING 6. Arc welding – Straight line Beads and Butt joint 7. Preparation of TIG weld Lap joint 8. Preparation of MIG weld ‘T’–joint LATHE (Simple operations only) 9. Facing and Straight Turning 10. Shoulder Turning 11. Taper Turning	
References	Lab Manual Prepared by VIT Staff
Mode of Evaluation	Experiments/Record work/Oral/ Practical Examination

MEE206	FLUID MECHANICS	2	1	2	4
Prerequisite	-				
Objectives:	1. The aim of this course is to introduce and explain basic fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc. Also to learn fluid properties and hydrostatic law – to understand the importance of flow measurement and its applications in Industries and to obtain the loss of flow in a flow system. 2. The development of boundary layers and advancement of practical hydraulics and understanding the concept of advanced fluid mechanics.				
Expected Outcome:	Student will be able to 1. To find frictional losses in a pipe when there is a flow between two places. 2. Calculate the conjugate depths in a flow. 3. Analyse the model and the prototype. 4. Find the dependent and independent parameters for a model of fluid flow. 5. Explain the various methods available for the boundary layer separation.				
Unit I	Fluid Properties and Hydrostatics				
Density – Viscosity – Surface tension – compressibility – capillarity – Hydrostatic forces on plane – inclined and curved surfaces – buoyancy – centre of buoyancy – metacentre.					
Unit II	Fluid Dynamics				
Control volume – Fluid Kinematics - Types of flows; Steady flow, Unsteady flow, Uniform and Non Uniform flow, Rotational flow, Irrotational flow, 1-D, 2-D, 3-D flows– Streamline and Velocity potential lines- Euler and Bernoulli's equations and their applications – moment of momentum – Momentum and Energy correction factors – Impulse – Momentum equation-Navier-Stokes Equations-Applications.					
Unit III	Open Channel Flow				
Flow through pipes – Open Channels and Measurement pipe flow: Darcy's law – Minor losses – Multi reservoir problems – pipe network design – Moody's diagram – Hagen Poiseuille equation – Turbulent flow. Specific Energy – Critical flow concept – specific force – Hydraulic jump – uniform flow and gradually varying flow concepts. – Measurement of pressure – flow – velocity through pipes and open channels.					
Unit IV	Dimensional Analysis				
Dimensional homogeneity – Raleigh and Buckingham π theorems – Non-dimensional numbers – Model laws and distorted models-Unit quantities-Specific quantities					
Unit V	Boundary layers				
Boundary layers – Laminar flow and Turbulent flow – Boundary layer thickness – momentum – Integral equation – Drag and lift-Separation of boundary layer-Methods of separation of boundary layer					
Text Books					
1. Dr.R.K.Bansal, (2000), Fluid Mechanics and Hydraulic Machines, Laxmi Publication (P) Ltd., New Delhi.					
References					
1. P.N.Modi and S.M.Seth (1999), Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House, Naisarak, Delhi. 2. Vijay Gupta and S.K.Gupta, (1999), Fluid Mechanics and Applications, New-Age International Ltd. 3. D.S. Kumar,(2004), Fluid Mechanics and Fluid Power Engineering, Katson Publishing House, Delhi.					

4. V.L. Streeter, (2001), Fluid Mechanics, McGraw Hill Book Co.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE206L	FLUID MECHANICS LAB
Objectives:	1. To enable students understand the properties of fluid, types of fluid and types of flow. 2. To teach students about flow measuring devices such as orifice meter and venture. 3. To help the students acquire knowledge about flow through pipes.
Expected Outcome:	Student will be able to 1. Analyze various flow problems and fluid characteristics. 2. Determine the losses of flow through various mediums like pipes. 3. Apply the concept of fluid mechanics to design various systems.
Experiments	
1. Flow through Orifice a) Constant Head Method b) Variable Head Method 2. Flow through Mouth Piece a) Constant Head Method b) Variable Head Method 3. Flow through Triangular Notch 4. Flow through Rectangular Notch 5. Flow through Venturimeter 6. Flow through Orifice Meter 7. Flow through Pipes 8. Flow through Annulus Double pipe 9. Reynold's apparatus 10. Verification of Bernoulli's Apparatus 11. Measurement of lift and drag of an aerofoil 12. Measurement of static pressure distribution around an aerofoil using wind tunnel apparatus.	
References	Lab Manual Prepared by VIT Staff
Mode of Evaluation	Experiments/Record work/Oral/ Practical Examination

MEE207	COMPUTER AIDED MACHINE DRAWING	0	0	4	2
Prerequisite	MEE108				
Objectives:	1. To introduce students to the basics and standards of engineering drawing related to machines and components. 2. To teach students technical skills regarding assembly, production and part drawings. 3. To familiarize students with various limits, fits and tolerances. 4. To help students gain knowledge about standard CAD packages on modeling and drafting.				
Expected Outcome:	Student will be able to 1. Acquire the knowledge of various standards and specifications about standard machine components. 2. Make drawings of assemblies with the help of part drawings given. 3. Ability to select, configure and synthesize mechancial components into assemblies. 4. Apply the knowledge of fits and tolerances for various applciaitons. 5. Able to model components of their choice using CAD software. 6. Get exposure to advanced CAD packages.				
Unit I	Drawing Standards				
Code of Practice for Engineering Drawing - BIS specifications –Conventional representation – Welding symbols - riveted joints - keys - fasteners – Reference to hand book for the selection of standard components like bolts - nuts - screws - keys etc.					
Unit II	Limits, Fits and Tolerances				
Limits - Fits and tolerances – Allocation of fits for various mating parts – Tolerance data sheet – Tolerance table preparation –Geometric tolerance.					
Unit III	Computer Aided Assembly and Detailed Drawing				
Solid modeling of simple and intricate machine and automobile components - Surface modelling of automobile body and Appliances(electrical and domestic) - Preparation of assembled and detailed drawings of I.C.Engine components viz: Cylinder head - Piston - Connecting rod and Crankshaft assembly - Carburettor - Fuel pump etc.,					
Text Books					
Bhatt, N.D., (1999), Machine Drawing , Published by R.C.Patel, Chartstar Book Stall, Anand, India.					
References					
1. James Barclay, Brian Griffiths, (2003), Engineering Drawing for Manufature. 2. Cecil Jensen, Jay Helsel and Donald D. Voisinet, (2000), Computer-aided engineering drawing, McGraw-Hill: New York 3. Sidheswar, N., Kanniah, P. and Sastry, V.V.S., (2005), Machine Drawing .					
Mode of Evaluation	Experiments/Record work/Oral/ Practical Examination				

MEE214	STRENGTH OF MATERIALS	2	1	2	4
Prerequisite	MEE202				
Objectives:	1. To develop the relationship between the loads applied to a non-rigid body and the internal stresses and deformations induced in the body. 2. To study the general state of stresses and strains in a given loaded member and the magnitude and direction of the principal stresses 3. To understand the different approaches to calculate slope and deflection for various types of beams. 4. To analyze the columns with different edge conditions by using different theories.				
Expected Outcome:	Student will be able to 1. Apply concepts of strength of materials to obtain solutions to real time Engineering problems. 2. Able to analyze the different types of loading and the consequent deflection.				
Unit I	Stresses and Strains				
Definition/derivation of normal stress, shear stress, and normal strain and shear strain – Stress-strain diagram- Elastic constants – Poisson's ratio – relationship between elastic constants and Poisson's ratio – Generalised Hook's law – Strain energy – Deformation of simple and compound bars – thermal stresses.					
Unit II	Simple Bending				
Types of beams: Cantilever, Simply supported, Overhanging: Shear Force and Bending Moment Diagrams Theory of simple bending – bending stress and shear stress in beams.					
Unit III	Deflection of Beams				
Deflection of beams by Double integration method – Macaulay's method – Area moment theorems for computation of slopes and deflections in beams – Conjugate beam method.					
Unit IV	Torsion and columns				
Introduction to Torsion – derivation of shear strain – Torsion formula – stresses and deformations in circular and hollow shafts – Stepped shafts – shafts fixed at the both ends – Stresses in helical springs. Theory of columns – Long column and short column - Euler's formula – Rankine's formula - Secant formula - beam column.					
Unit V	Bi-axial Stress system				
Biaxial state of stress – Stress at a point – stresses on inclined planes – Principal stresses and Principal strains and Mohr's circle of stress, Theories of failure Thin cylinders and shells – deformation of thin cylinders and shells; Thick Cylinders, Shrink fits, Compounding. Fundamentals of theory of elasticity.					
Text Books					
S. Ramamrutham and R. Narayanan, (2003), Strength of Materials, Dhanpat Rai Publications.					
References					
1. Rowland Richards, (2000), Principles of Solid Mechanics, CRC Press. 2. Timoshenko, S.P. and Young, D.H., (2000), Strength of Materials, East West Press Ltd. 3. R.K. Bansal, (2000), Strength of Materials, Laxmi Publications.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE214L	STRENGTH OF MATERIALS LAB
Objectives:	1. To help the students gain experience in the determination of creep for various materials and understand how this property varies with time. 2. To provide students an opportunity to learn how to measure hardness of materials and analyze how heat treatment affects hardening. 3. To impart knowledge on phase development of two isomorphous metals. 4. To teach students determine phases present in a material using XRD graph.
Expected Outcome:	Student will be able to 1. Interpret hardness curve measured after heat treatment. 2. Find correlation between material structure and its creep. 3. Index XRD plot and determine phases of a material. 4. Perform non destructive failure analysis.
EXPERIMENTS:	
1. Evaluation of Engineering Stress / Strain Diagram on Steel rod, Thin and Twisted Bars under tension. 2. Compression test on Bricks, Concrete blocks. 3. Deflection test – Verification of Maxwell theorem. 4. Comparison of hardness values of Steel, Copper and Aluminium using Brinell and Rockwell hardness measuring machines. 5. Estimation of Spring Constant under Tension and Compression. 6. Estimation of Notch Toughness of Steel using Charpy Impact Testing Machine. 7. Double shear test in U.T.M. 8. Fatigue test on Steel 9. Load measurement using Load indicator, Load coils. 10. Strain measurement using Rosette Strain Gauge.	
References	1. Lab Manual prepared by VIT faculty 2. Relevant BIS Codes 2004
Mode of Evaluation	Experiments/Record work/Oral/ Practical Examination

MEE215	KINEMATICS OF MACHINERY	2	1	0	3
Prerequisite	MEE202				
Objectives:	1. To familiarize students with basic types of mechanisms, joints and degrees of freedom to perform position, velocity and acceleration analysis using graphical and analytical methods. 2. To provide students an understanding of different types of mechanisms. 3. To teach the basics of synthesis of simple mechanisms. 4. To teach students the kinematic analysis of cam-follower motion and gear train configurations.				
Expected Outcome:	Student will be able to 1. Demonstrate an understanding of the concepts of various mechanisms and pairs. 2. Do velocity and acceleration analysis of simple mechanisms. 3. Design a layout of cam for specified motion. 4. Synthesis simple mechanisms for function, path generation and body guidance 5. Demonstrate an understanding of principle of gears.				
Unit I	Basics of Mechanisms				
Introduction to mechanisms and its terminologies - Degree of freedom – Mobility - Kutzbach criterion - Grubler's criterion for planar mechanisms - Grashoff's law - Kinematic Inversions of 4-bar chain - Single slider and double slider crank chains - Quick return mechanism - Limiting positions - Mechanical advantage - Transmission angle - Ratchets and escapements – Indexing Mechanisms – Rocking Mechanisms – Straight line generators.					
Unit II	Kinematic Analysis of Simple Mechanisms				
Displacement, velocity and acceleration analysis in simple mechanisms having turning, sliding and rolling pair - Coriolis acceleration using graphical relative motion method - Instantaneous center method - Four bar and slider crank mechanisms - Analytical method for four bar and slider crank mechanisms.					
Unit III	Synthesis of Simple Mechanisms				
Classification of kinematic synthesis problems - Two position synthesis of slider crank and crank rocker mechanisms - Three position synthesis of double rocker mechanism - Chebychev spacing - Freudenstein analytical method - synthesis of function generator using three precision positions, Graphical and analytical design of a four bar linkage for body guidance, path generation by graphical method.					
Unit IV	Kinematics of CAMS				
Types of cams and followers - Definitions related cam profile - Derivatives of follower motion – High speed cams – Undercutting - Graphical disk cam profile design - Simple harmonic motion, Constant acceleration and deceleration, constant velocity, Cycloidal motion for knife edge and roller (in-line and offset), flat faced and oscillating followers - Tangent cam with roller follower - circular arc cam with flat faced follower.					
Unit V	Kinematics of Gears and Gear Train				
Spur gear terminology and definitions - Law of toothed and involute gearing - Interchangeable gears - Gear tooth action - Interference and undercutting - Basics of nonstandard gear teeth -Helical – Bevel – Worm - Rack and pinion gears, cycloidal tooth properties - Comparison of involute and cycloidal tooth forms. Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains – Sun and Planet Gear -					

Differentials – Automobile gear box.	
Text Books	
1. S.S. Rattan, (2009), “Theory of Machines”, Third Edition, Tata McGraw-Hill. 2. Ambekar A.G, (2007) “Mechanism and Machine Theory” Prentice Hall of India, New Delhi.	
Reference Books	
1. John J. Uicker, Jr., Gordon R. Pennock and Joseph E. Shigly, (2008), “Theory of Machines and Mechanisms”, Third Edition, Oxford University Press. 2. Hamilton H Mabie and Charles F Reinholtz, (1987), “Mechanisms and Dynamics of Machinery”, Fourth Edition, John-Wiley and Sons, Inc, New York. 3. Ghosh A. and Mallick A.K., (1988), “Theory of Mechanisms and Machines”, Affiliated East-West Press Pvt. Ltd., New Delhi. 4. Kenneth J Waldron and Gary L Kinzel, (2004), “Kinematics, Dynamics, and Design of Machinery”, John-Wiley and Sons Inc., New York.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE216	THERMAL ENGINEERING SYSTEMS	2	1	2	4
Prerequisite	MEE204				
Objectives:	1. To enable the students understand the principles, working and performance of IC engines 2. To introduce students to the working of compressors, steam nozzles and various refrigeration and air-conditioning systems. 3. To teach students the principles of waste heat recovery and thermal storage systems.				
Expected Outcome:	Student will be able to 1. Solve problems on internal combustion engines and prepare heat balance sheet. 2. Get an insight of various components and principles of engines, compressors etc. 3. Design refrigeration and air-conditioning system for a particular application. 4. Demonstrate the knowledge of waste heat recovery and thermal storage.				
Unit I	IC Engines				
Review of construction and working of two stroke and four stroke engines – Types of carburetor – Wankel engines – SI engines – Fuel systems – Simple carburetor – Ignition systems – Combustion – Detonation factors and remedies – Rating of fuels – Introduction to multi point and microprocessor based fuel injection system CI engines – Fuel injection system – Fuel pump – Combustion – Knocking – Factors and remedies – Rating of fuels – Cooling and lubrication of IC engines.					
Unit II	Performance of IC Engines				
Supercharging and turbocharging of IC engines and their effect on various parameters – Stratified charged engines – Lean burn engines; Performance test- Measurement of brake power – Indicated power – Fuel consumption – Air consumption; Heat balance test – heat carried away by exhaust gases and Morse test on IC engines – Standard testing procedure of IC engines – Performance curves and effect of various parameters on the performance of the engines.					
Unit III	Positive Displacement Compressors and Steam Nozzles				
Reciprocating compressors – Construction – Working – Effect of clearance volume – Multi staging - Volumetric efficiency - Isothermal efficiency. Steam Nozzle – One-dimensional steady flow of steam through a convergent and divergent nozzle – Equilibrium and Meta stable flow.					
Unit IV	Refrigeration				
Reverse Carnot cycle- Bell-Colman's cycle – Air craft refrigeration cycles – Vapor compression cycle – Components – Working – P-H and T-S diagrams – Calculation of COP – Effect of sub-cooling and super-heating – Vapour absorption system – Ideal and actual cycles – Cryogenic engineering- Introduction – Liquefaction of gases – Application.					
Unit V	Air Conditioning and Waste Heat Recovery Systems				
Psychometric - Processes – Chart – Summer and winter air conditioning – Cooling load calculations – SHF – RSHF – GSHF – ESHF components used in air conditioner – Types of air conditioning units. Sources of waste heat – Heat recovery for industrial application – Thermal storage-principles and applications of hot and cold systems – Sensible heat and latent heat system – Phase change storage materials.					
Text Books					

1. Rajput R.K., (2010), Thermal Engineering, Eighth Edition, Laxmi Publications(P) Ltd. 2. Mathur.M.L & Sharma R.P, (2009), Internal Combustion Engine, Dhanpat Rai Publications.	
References	
1. Manohar Prasad., (2007), Refrigeration and Air Conditioning, New Age International . 2. Soman.K, (2011), Thermal Engineering , PHI Learning Private Ltd.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE216L	THERMAL ENGINEERING SYSTEMS LAB
Objectives:	1. To teach students how to apply the knowledge of Thermodynamics and Thermal Engineering Systems to conduct experiments. 2. To help the students measure thermal properties, temperature effect on other properties of processes and use various working fluids.
Expected Outcome:	Student will be able to 1. Conduct the experiments on various thermal engineering systems and calculate performance oriented. 2. Analyze the performance of blowers, fan, internal combustion engines and refrigeration systems.
Experiments	
1. Performance and Heat balance test on S.I & C.I engines 2. Morse test 3. Measurement of Frictional power using retardation. 4. Determination of calorific value of fuels 5. Performance test on reciprocating air compressor 6. Performance test on air blower 7. Performance test on vapour compressor refrigeration system 8. Performance test on air-conditioning system 9. Test on Boiler 10. Test on Steam turbine.	
References	Lab Manual prepared by VIT faculty
Mode of Evaluation	Experiments/Record work/Oral/ Practical Examination

MEE217	MACHINING PROCESSES AND METROLOGY	3	0	2	4
Prerequisite	MEE205				
Objectives:	1. To help students acquire knowledge about the theory of metal cutting, mechanism of machining and the parameters that influence the machining processes. 2. To teach different operations involved in various machines such as turning, shaping, slotting, milling, grinding etc. 3. To teach students different gear generation methods and principles of nontraditional machining processes 4. To explain the different instruments for linear and angular measurements, surface finish etc.,				
Expected Outcome:	Student will be able to 1. Understand the mechanisim of chip formation in machining. 2. Understand the various machining processes such as turning, drilling, boring, shaping, slotting, milling and grinding. 3. Understand the principle of gear generation and non-traditional machining processes. 4. Identify and suggest correct manufacturing process for particular application. 5. Know the principle of different metrology instruments.				
Unit I	Theory of Metal Cutting				
Mechanism of chip formation - Orthogonal and Oblique cutting - Machining forces - Merchant's Circle Diagram - Thermal aspects of metal machining - Cutting fluids - Machinability - Cutting tool materials - Tool wear and Tool life calculations.					
Unit II	Lathe and Basic Machine Tools				
Lathe - Types - Operating Parameters - lathe operations – Tool nomenclature - Work holding devices. Shaping - Planing - Slotting – Drilling - Boring – Reaming – Tapping – Broaching.					
Unit III	Milling and Grinding Machines				
Milling machines - Cutters - Milling operations - Indexing. Grinding – Types of grinding machines - Grinding wheel designation and selection - Bond and Bonding processes.					
Unit IV	Gear Generation and Nontraditional Machining Processes				
Gear generating principles - Gear Hobber - Gear finishing methods - Bevel gear generator. Classification of Nontraditional Machining process – Principle of AJM, WJM, USM, EDM, ECM, LBM - Process characteristics – Applications.					
Unit V	Metrology and Instrumentation				
Measurement standards - Linear, angular and form measuring instruments – Comparators – Gauge blocks – Gauges - Optical instruments – Profilometer – Coordinate measuring machine. Non-Contact Measurement Techniques, Gear Measurement, Introduction to Nano-Measurement.					
Text Books					
1. S. Kapakjian and S.R. Schmid, (2010), Manufacturing Engineering and Technology, 6th Edition, Pearson Education (Singapore) Pvt. Ltd. 2. P. N. Rao, (2009), Manufacturing Technology, Vol. 2, 2nd ed., Tata McGraw Hill Publications.					
Reference Books					
1. P.C. Sharma, (2000), Text book of Production Technology, S.Chand & Company Ltd,					

New Delhi. 2. O.P. Khanna & M. Lal (2006), A Text book of Production Technology, Dhanpat Rai Publications, New Delhi.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE217L	MACHINING PROCESSES AND METROLOGY LAB
Objectives:	1. To enable the students understand the basic operations involved in various machines such as turning, shaping, slotting, milling, grinding machine, etc. 2. To measure cutting forces, average chip-temperature and surface finish during turning process, and study the effect of process parameters. 3. To train students on handling of various metrolgy intruments.
Expected Outcome:	Student will be able to 1. Acquire knowledge about manufacturing process. 2. Conduct experiments to understand the mechanisim of chip formation 3. Make decisions on various cutting parameters for different materials in various machining operations. 4. Caliberate metrolgy instruments 5. Measure linear, angular and circular features.

Experiments

I. MACHINING EXPERIMENTS

1. Experiments on Lathe to establish the cutting speed, feed and depth of cut on cutting forces.
2. Measurement of flank wear using Tool Maker's microscope and plotting the effect of turning parameters on average flank wear.
3. Effect of cutting speed, feed and depth of cut on average surface roughness for a given work and tool material during turning process.
4. Measurement of cutting tool temperature in turning and plotting effect of turning parameters on average temperature.
5. Machining slots using shaping and slotting machines
6. Gear cutting using milling and gear hobbing machines.
7. Surface grinding and measurement of surface roughness for different feed rate.
8. Grinding of single point cutting tool as per given specifications (to check the tool angles).
9. Study on Electrical discharge die sinking and wire-EDM. (Only demonstration)

II METROLOGY EXPERIMENTS

1. Calibration of the following instruments:
   i. Calibration of Micrometer ii. Calibration of Mechanical Comparator
   ii. Calibration of Vernier Caliper iv. Calibration of Dial Gauge
2. Measurement of taper angle using
   i. Bevel Protractor ii. Dial Gauge iii. Sine-Bar
3. Alignment tests:
   i. Parallelism of the spindle ii. Circularity & Concentricity of the spindle
4. Gear parameters Measurement
   i. Diameter, pitch/module ii. Pitch circle diameter iii. Pressure angle iv. Tooth thickness

References	Lab Manual prepared by VIT faculty
Mode of Evaluation	Experiments/Record work/Oral/ Practical Examination

MEE301	DYNAMICS OF MACHINERY	2	1	2	4
Prerequisite	MEE215				
Objectives:	1. To understand the concepts of turning moment diagrams, flywheel design and the dynamics of reciprocating engines. 2. To understand the balancing procedures for rotating and reciprocating masses, rotors and engines. 3. To understand the fundamentals of free and forced vibrations. 4. To understand the mechanisms for control				
Expected Outcome:	Student will be able to 1. Demonstrate an understanding of turning moment diagrams in various applications. 2. Demonstrate skills to design flywheel for an IC engine and punching press with the consideration of geometrical and economical constraints. 3. Perform static and dynamic balancing of high speed rotary and reciprocating machines. 4. Analyze free and forced vibrations of machines, engines and structures. 5. Calculate gyroscopic couple on various vehicles and apply concept of governors.				
Unit I	Dynamic Force Analysis				
D'Alembert's principle – Equivalent offset inertia force – Dynamic analysis of four bar mechanism – Dynamic Analysis of reciprocating engines – Piston effort, Crank effort, Turning moment on crankshaft, Inertia of connecting rod – Inertia force in reciprocating engines (Graphical method). Turning moment diagrams – Single and multi cylinder engines – Fluctuation of energy – Fly Wheels – Applications in engines and punching presses.					
Unit II	Balancing				
Static and Dynamic balancing of rotating masses – Balancing of reciprocating masses – Balancing of locomotives – Partial balancing of reciprocating masses – Multi cylinder Inline and radial engines.					
Unit III	Vibration – Singh Degree of Freedom Systems				
Introduction to vibration – Terminology – Classification of vibrations – Undamped and Damped free vibration of single degree of freedom systems – Viscous damping – Introduction to coulomb damping. Forced vibration – harmonic excitation – Magnification factor – Vibration isolation and Transmissibility					
Unit IV	Transverse and Torsional Vibration Systems				
Transverse vibrations of shafts and beams – Rayleigh's and Dunkerley's method – Whirling of shafts. Torsional vibrations – Single rotor, two rotors and three rotors systems – Free vibration of geared systems.					
Unit V	Mechanism for Control				
Functions of Governors – Gravity controlled and Spring controlled governor characteristics. Stability – Hunting and Isochronisms. Effect of friction – Calculation of equilibrium speeds and ranges of speed of governors. Gyroscopic couple – Gyroscopic effects on the movement of air planes and ships – Stability of two wheel drive and four wheel drive – Gyroscope stabilization.					
Text Books					
1. S.S. Rattan, (2009), "Theory of Machines", Third Edition, Tata McGraw-Hill Publishing					

Company Ltd. 2. John J. Uicker, Jr., Gordon R. Pennock and Joseph E. Shigly, (2008), "Theory of Machines and Mechanisms", Third Edition, Oxford University Press.	
References	
1. Hamilton H Mabie and Charles F Reinholtz, (1987), "Mechanisms and Dynamics of Machinery", Fourth Edition, John-Wiley and Sons, Inc., New York. 2. Ghosh A. and Mallick A.K., (1988), "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi. 3. William T Thomson, Marie Dillon Dahleh and Chandramouli Padmanabhan, (2004), "Theory of Vibration with applications", Fifth Edition, Pearson Education Publishers.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE301L	DYNAMICS OF MACHINERY LAB
Objectives:	1. To understand the concepts of inversions and synthesis of mechanisms 2. To understand fundamentals of machine vibrations 3. To understand gyroscopic effect of two wheelers, four wheelers, and aircrafts. 4. To understand speed control of machines using governors
Expected Outcome:	Student will be able to 1. Synthesis simple mechanisms 2. Draw cam profiles 3. Measure Gyroscopic torque 4. Understand free, forced damped vibrations 5. Measure Radius of Gyrations of compound pendulum, plate
Experiments	
1. Natural frequency of longitudinal vibraton of spring mass system. 2. Determination of torsional vibration frequency of a single rotor system 3. Analysis of Cam and plotting the Cam profile 4. Motorised gyrocope 5. Watts Governor 6. Undamped free vibration of equivalent spring mass system 7. Damped vibration of equivalent spring mass system 8. Radius of gyration of compound pendulum 9. Radius of gyration of connecting rod 10. Porter governor and Watts's governor 11. Static and dynamic balancing of rotors 12. Critical speed of whirling of shaft 13. TRI –FILAR / BI-FILAR System 14. Static and dynamic analysis using simulation software.	
References	Lab Manual prepared by VIT faculty
Mode of Evaluation	Experiments/Record work/Oral/ Practical Examination

MEE302	DESIGN OF MACHINE ELEMENTS	2	1	0	3
Prerequisite	MEE214				
Objectives:	1. To understand the design methodology for machine elements. 2. To analyse the forces acting on a machine element and apply the suitable design methodology. 3. To understand the various standards and methods of standardisation. 4. To apply the concept of parametric design and validation by strength analysis.				
Expected Outcome:	Student will be able to 1. Analyze and select machine elements/components. 2. Know the applications of the various elements, materials used to make them, and methods used 8. Integrate various machine elements and components into the design of a machine or mechanical system through a design project.				
Unit I	Introduction to Design Process				
Introduction to Design process – Factors – Materials selection direct - Bending and Torsional stress equation - Impact and Shock loading - Stress concentration factor - Size factor - Surface limits factor - Factor of safety - Design stress - Theories of failures – Problems.					
Unit II	Fatigue strength and design of springs				
Variable and cyclic loads – Fatigue strength – S- N curve – Continued cyclic stress – Soderberg and Goodman equations – Design of Helical – Leaf - Disc springs under Constant and Varying loads.					
Unit III	Design of Shafts and Joints				
Design of Shafts – Riveted joints, Welded joints and Screwed fasteners, Computer aided design of machine elements.					
Unit IV	Design of Couplings				
Design and drawings of couplings – Rigid – Flexible – Design and Drawings of Cotter joints - Knuckle joints, Computer aided design of machine elements.					
Unit V	Design of Engine Components				
Design and Drawings of Piston – Connecting rod – Crankshaft – Flywheel, Design of Cams for parabolic – SHM and Cycloidal follower motions. Computer aided design of machine elements.					
Text Books					
1. Joseph Edward Shigley and Charles, R. Mischke, (2008) Mechanical Engineering Design, McGraw –Hill International Editions. Eighth Edition. . 2. Bhandari.V.B. “Design of Machine elements”, (2010) Tata Mc Graw Hill Book Co, Third Edition. 3. R.S.Khurmi, J.K.Gupta. “Machine Design”, (2008) Eurasia Publishing House (Pvt.) Ltd.Revised Edition.					
References					
1. Design Data book– PSG College of Technology, Coimbatore., 2006 2. Juvinal, R.C., Fundamentals of Machine component Design, John Wiley, 2002.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE303	HEAT AND MASS TRANSFER	3	1	2	5
Prerequisite	MEE204				
Objectives:	1. To teach the students to comprehend and evaluate various modes of heat and mass transfer. 2. To help the students to design fin enhanced systems, evaporators, condensers and heat exchangers. 3. To enable the students understand boundary layer theory, condensation and boiling. 4. To expose students to heat exchangers and heat pipes.				
Expected Outcome:	Student will be able to 1. Apply basic principles of fluid mechanics, thermodynamics, heat transfer for designing heat and mass transfer systems. 2. Model heat, mass and momentum transport systems and develop predictive correlation. 3. Assess and evaluate various designs for heat and mass transfer and optimize the solution				
Unit I	Conduction – I				
Basic concepts – conduction - convection and radiation – Laws – General equation of heat conduction – Derivation in cartesian - cylindrical and spherical coordinates – One dimensional steady state heat conduction in simple geometries – plane wall - cylinder and sphere – Heat transfer composite walls - composite cylinders and composite spheres – Critical thickness of insulation – Thermal contact resistance – Overall heat transfer coefficient – Electrical analogy – Heat generation in plane wall - cylinder and sphere – Extended surfaces – general equations – types and applications of fins – Fin efficiency and effectiveness – Fin performance.					
Unit II	Conduction – II				
Two and Three dimensional steady state heat conduction – Analytical - Graphical and Numerical methods – Conduction shape factor – Unsteady state heat conduction – Lumped parameter system – Non-dimensional numbers in conduction – Significance of Biot and Fourier numbers – Transient heat flow in semi-infinite solid – Use of Heisler and Grober charts					
Unit III	Convection				
Boundary layer theory – Conservation equations of mass - momentum and energy for laminar flow over a flat plate – Turbulent flow over a flat plate – Flow over cylinders - spheres - tube bank – Internal flow through pipes – annular spaces – Analogy between momentum and heat transfer – Natural convection in vertical - inclined and horizontal surfaces – Mixed convection – Dimentional analysis.					
Unit IV	Condensation, Boiling and Radiation				
Condensation and Boiling – Filmwise and dropwise condensation – Film condensation on a vertical plate – Regimes of Boiling – Forced convection boiling – Radiation heat transfer – Thermal radiation – Laws of radiation – Black body concept – Emissive power – Radiation shape factor – Gray bodies – Radiation shields					
Unit V	Heat Exchanger and Mass Transfer				
Heat Exchangers – Types and practical applications – Use of LMTD – Effectiveness – NTU method – Compact heat exchangers – Plate heat exchangers – Fouling factor – Heat pipes – Types and applications – Principle of Mass Transfer-Mass transfer by molecular diffusion – Fick's law of diffusion – Analogy of heat and mass transfer.					
Text Books					
1. R. C. Sachdeva, (2005), Fundamentals of Heat and Mass Transfer, New Age					

International (P) Ltd.	
References	
1. Yunus A. Cengel, (2000) Heat Transfer-A Practical Approach, Tata McGraw Hill Publishing Company Limited. 2. P. K. Nag, (2005), Heat Transfer, Tata McGraw Hill Publishing Company Limited. 3. J. P. Holman, (2005), Heat Transfer, 9th Edition, McGraw-Hill Publishing Company Limited. 4. S. P. Venkateshan, (2004), First Course in Heat Transfer, Ane Books Publishers. 5. Sarit K Das, (2005), Process Heat Transfer, Narosa Publishing House. 6. P. S. Ghoshdastidar, (2005), Heat Transfer, Oxford University Press. 7. Y. V. C. Rao, (2001), Heat Transfer, First Edition, Universities Press (India) Limited. 8. Frank P. Incropera and David P. Dewitt, (2002), Fundamentals of Heat and Mass Transfer, Fifth Edition, John Wiley & Sons. 9. C. P. Kothandaraman and S. Subramanyan, (2004), Heat and Mass Transfer Data Book, Fifth Edition, New Age International Publishers.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE303L	HEAT AND MASS TRANSFER LAB
Objectives:	1. To enable the students to do experimentation on heat transfer equipment and improve practical knowledge of the systems. 2. To develop trouble shooting abilities of students for practical heat transfer systems. 3. To teach students how to measure heat transfer through various systems.
Expected Outcome:	Student will be able to 1. An ability to demonstrate the fundamental principles of heat transfer in practice. 2. Design and test practical heat transfer systems like heat exchangers, condensers, evaporators etc. 3. Develop empirical correlations for predicting heat and mass transfer rates for a given system. 4. Troubleshoot existing engineering heat transfer systems and develop alternatives and more energy efficient systems.

Experiments

1. Thermal conductivity studies of a metal bar and an insulating powder.
2. Thermal conductivity studies of a composite wall.
3. Thermal conductivity studies of a given liquid.
4. Transient heat conduction studies using a semi-infinite solid.
5. Two-dimensional heat conduction in finite solids and irregular geometries.
6. Unsteady state heat transfer studies of a system using the lumped capacity method.
7. Convective heat transfer studies – Natural convection and Forced convection mode.
8. Efficiency calculations of a pin fin – Natural and Forced convection mode.
9. Two phase heat transfer studies using boiling heat transfer apparatus.
10. Pool boiling studies using critical heat flux apparatus.
11. Phase change cooling of electronic components
12. Radiation heat transfer studies using the Stefan Boltzmann apparatus and emissivity studies of a given test surface.
13. Heat transfer studies using a plate type heat exchanger.
14. Heat transfer studies in a double pipe heat exchanger using parallel and counter flow of fluids.
15. Heat transfer studies using a Finned tube heat exchanger.
16. Heat transfer studies in a regenerative heat exchanger.

References	Lab Manual prepared by VIT faculty
Mode of Evaluation	Experiments/Record work/Oral/ Practical Examination

MEE304	TURBOMACHINES	2	1	2	4
Prerequisite	MEE204, MEE206				
Objectives:	1. To enable the students know the operation of turbomachines for compressible and incompressible fluids. 2. To provide students thorough understanding of velocity triangles, thermodynamic plots and losses in turbo-machinery. 3. To introduce students to fans, turbines, pumps etc.				
Expected Outcome:	Student will be able to 1. Solve analytical problems in turbo-machines for both compressible and incompressible fluid flows. 2. Demonstrate the knowledge of working, stages, performance characteristics, governing and selection of turbo-machinery.				
Unit I	Energy Transfer				
Definition and classification of Turbomachines, Specific work - T-s and H-s diagram - Equation of energy transfer - Losses - Various efficiencies - Effect of reheat - Preheat. Aero–Foil section - Cascading of compressor and Turbine blades - Energy Transfer in terms of lift and drag co-efficient for compressor and turbine blades - Variation of lift - Deflection and stagnation pressure loss with incidence.					
Unit II	Fans, Blowers and Compressors				
Centrifugal fans - Blowers and Compressors - construction details - Inducers - Backward and Radial blades - Diffuser - volute casing stage work - Stage pressure rise - Stage pressure co-efficient - Stage efficiency - Degree of reaction - Various slip factors H-S diagram for centrifugal compressor. Axial flow Fans and Compressors - Stage velocity triangles - Blade loading and flow co-efficient - Static pressure rise - H-S diagram - Degree of reaction - Work done factors - Free and Forced Vortex flow performance - Stalling and Surging.					
Unit III	Steam and Gas Turbines				
Axial turbine stages - Stage velocity triangle - Work - Single stage Impulse Turbine - Speed ratio maximum utilization factor - Multistage velocity compounded impulse - Multi stage pressure compounded impulse - reaction stages - Degree of reaction - Zero reaction stages - Fifty percent reaction stages - Hundred percent reaction - Negative reaction - Free and Forced vortex flow. Inward flow radial turbine stages - IFR Turbine - T-s diagram - and degree of reaction - Steam turbine governing – Features of Steam turbine and Gas turbine.					
Unit IV	Hydraulic Pumps				
Centrifugal pumps – Work done - Head developed - Pump output and Efficiencies - priming - minimum starting speed - performance of multistage pumps - Cavitation - methods of prevention - Pump characteristics. Axial flow pumps – Characteristics - Constructional details - Non-dimensional parameters – Efficiencies - Vibration and Noise in hydraulic pumps.					
Unit V	Hydraulic Turbines				
Classification of hydraulic turbines - Pelton wheel - Francis turbine - Kaplan and Propeller turbines - Velocity triangles - Specific speed - Theory of draft tube - Governing - Performance characteristics - Selection of turbines.					
Text Books					
1. S.M. Yahya, (2002), Turbine, Fans and Compressors, TMH, 2002.					
References					
1. Douglas J.F., Gasiorek, J.M and Swaffield J.A. (1999), Fluid Mechanics, Addison –					

Weisly 2. Dixon, S.L, (1999), 'Fluid Mechanics and Thermodynamics of Turbomachinery', Pergamon Publishers. 3. Kadambi and Prasad, (1997), Energy conversion Vol. III – Turbomachines, Wiley Eastern. A.H. Church and Jagadish Lal, (2000), Centrifugal Pumps and Blowers; Metropolitan Book Co, Pvt. Ltd.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE304L	TURBOMACHINES LAB
Objectives:	1. To teach students how to find performance characteristics of various pumps. 2. To enable them understand the procedure for finding the performance characteristics of different types of turbines.
Expected Outcome:	Student will be able to 1. Select pumps for a wide range of applications and heads. 2. Select turbines for various applications. 3. To do performance testing of pumps and turbines.
Experiments	
1. Performance Characteristics of a Centrifugal Pump (Rated Speed) 2. Performance Characteristics of Centrifugal Pump (Variable Speed) 3. Performance Characteristics of a Jet Pump 4. Performance Characteristics of a Self Priming Pump 5. Performance Characteristics of a Reciprocating Pump 6. Performance Characteristics of a Submersible Pump 7. Performance Characteristics of a Gear Pump 8. Characteristics Test on Pelton Turbine 9. Characteristics Test on Kaplan Turbine	
References	Lab Manual prepared by VIT faculty
Mode of Evaluation	Experiments/Record work/Oral/ Practical Examination

MEE306	DESIGN OF TRANSMISSION SYSTEMS	3	1	0	4
Prerequisite	MEE301, MEE302				
Objectives:	1. To understand the various elements involved in a transmission system. 2. To analyse the various forces acting on the elements of a transmission system. 3. To design the system based on the input and the output parameters. 4. To produce working drawings of the system involving pulleys, gears, clutches and brakes.				
Expected Outcome:	Student will be able to 1. Design pulleys, chain drives, rope drives and belt drives. 2. Determine performance requirements in the selection of commercially available transmission drives. 3. Design Brakes and Clutches 4. Design various types of gear boxes. 5. Know the applications of the various systems, materials used to make them, and methods used.				
Unit I	Design of bearing and flexible power transmission systems				
Design of sliding contact bearing using Sommerfield number – Design using Mckee's equation – Selection of rolling contact bearings. Design of Belts – Flat Belts and Pulleys – V Belts and Pulleys – Design of chain drives – Wire ropes.					
Unit II	Spur Gear				
Gear geometry – Kinematics – Forces on gear tooth – Stresses in Gear tooth – Selection of gear material based on bending stress and contact stress – Design of Spur gear – Power transmitting capacity. Computer – Aided Spur gear Design and Analysis.					
Unit III	Helical, Bevel and Worm Gears				
Parallel Helical Gears – Kinematics – Tooth proportions – Force analysis – Stresses in Helical gear – Design of helical gear – Crossed Helical gears – Straight Bevel gears – Kinematics – Force analysis – Stresses in straight bevel gear tooth – Design of bevel gear – Worm gearing – Kinematics – Forces - Friction and Efficiencies – Stresses in worm gear tooth.					
Unit IV	Design of Gear boxes				
Design of Speed reducers – Design of multi speed gear boxes for machine tools – Structural and ray diagrams.					
Unit V	Motion control: clutches, brakes and cams				
Internal – Expanding Rim clutches and Brakes – External – Contracting Rim clutches and Brakes – Band type Clutches – Core clutches and Brakes – Energy considerations – Temperature rise – Friction materials.					
Text Books					
1. Joseph Edward Shigley and Charles, R. Mischke, (2000), Mechanical Engg. Design, McGraw –Hill International Editions.					
References					
1. Design Data, (2005), PSG College of Technology, DPV Printers, Coimbatore. 2. Malisa, (2000), Hand Book of Gear Design, Tata Mc Graw Hill, International Edition . 3. V.B. Bhandari , (2001), Design of Machine elements, Tata Mc Graw Hill.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE307	CAD/CAM	2	0	4	4
Prerequisite	MEE302				
Objectives:	1. To understand the basics of CAD/CAM. 2. To gain exposure over the concepts of computer graphics. 3. To learn about the geometric issues concerned to the manufacturing and its related areas. 4. To understand the latest advances in the manufacturing perspectives.				
Expected Outcome:	Student will be able to 1. Understand the importance of CAD/CAM principles in the Product development. 2. Develop programs related to manufacturing using codes. 3. Analyze the importance of networking in manufacturing environment.				
Unit I	Computer Hardware				
Product Development Cycle – Introduction to CAD/CAM – Graphics I/O Devices - Bresenham's Algorithm and DDA, Graphics software, Clipping, Hidden line/surface removal, Color models Lighting and shading - Graphics Standards – Neutral File formats – IGES, STEP					
Unit II	Principles of Computer Graphics				
Geometric Modeling – Wireframe, Surface and Solid – Parametric representation of curves & surfaces - CSG and B-Rep- World/device coordinate representations, 2D and 3D geometric transformations, Matrix representation, translation, scaling, shearing, rotation and reflection, composite transformations, concatenation.					
Unit III	CNC Machine Tools				
Introduction to NC, CNC, DNC- Manual part Programming – Computer Assisted Part Programming – Examples using NC codes- Adaptive Control – Canned cycles and subroutines – CAD / CAM approach to NC part programming – APT language, machining from 3D models					
Unit IV	Group Technology, CAPP and FMS				
Introduction to part families-parts classification and cooling – group technology machine cells-benefits of group technology – Process Planning – CAPP & types of CAPP – Flexible manufacturing systems (FMS) – the FMS concept-transfer systems – head changing FMS – Introduction to Rapid prototyping, Knowledge Based Engineering.					
Unit V	CIM				
CIM wheel – CIM Database- CIM-OSI Model– Networking Standards in CIM Environment – Network structure – Network architecture –TCP/IP, MAP – Virtual Reality, Augmented Reality- Artificial Intelligence and Expert system in CIM.					
Text Books					
1. CAD/CAM: Principles and Applications 3rd Edition, Tata McGraw Hill, India, 2010. 2. Ibrahim Zeid and R. Sivasubramaniam, 2nd Edition, Tata McGraw Hill, India, 2009					
Reference Books					
1. Mikell P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, 2007 2. James A. Rehg, Henry W. Kraebber, "Computer Integrated Manufacturing", Pearson Education. 2007 3. Donald Hearn and M.Pauline Baker "Computer Graphics" with OpenGL Prentice Hall, International, 2010					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE307L	CAD/CAM LAB

CAD EXPERIMENTS

1. Structural analysis of Trusses
2. Structural analysis of Beams
3. Structural analysis of Frames
4. Plane stress/Plane strain analysis
5. Model analysis of different structures
6. Steady state thermal analysis
7. Transient thermal analysis
8. Flow analysis
9. Thermo-mechanical analysis

CAM EXPERIMENTS

1. Manual part programming using G and M codes for Turning, Step turning, Taper turning, multiple turning, Facing, Multiple facing, thread cutting and radius turning on cylindrical components.
2. CNC Milling program involving linear motion and circular interpolation.
3. CNC Milling program involving contour motion and canned cycles.
4. CNC Milling program involving Pocket milling
5. Diagnosis and trouble shooting in CNC machine
6. CNC code generation using any CAM software.
7. Simulation of machining operations using any CAM software.
8. Route sheet generation using CAM software.
9. Study and practical demonstration on Wire-Cut EDM,
10. Study and practical demonstration on Coordinate measuring machine,
11. Study and practical demonstration on Vertical Machining center and Horizontal Machining center
12. Study on Rapid Prototyping Technologies, Student shall submit team work in the form of project /assignments with neat documentation.

Reference Books	Lab Manual prepared by VIT faculty
Mode of Evaluation	Experiments/Record work/Oral/ Practical Examination

MEE308	INDUSTRIAL ENGINEERING AND MANAGEMENT	3	0	0	3
Prerequisite	-				
Objectives:	1. To enable the students understand the demand forecasting techniques and costing. 1. To provide students an insight into the concepts of industrial engineering and organization. 2. To familiarize the students with principles of work-study and Ergonomics. 3. To introduce students to various aspects of plant design and materials planning.				
Expected Outcome:	Student will be able to 1. Conduct market research, demand forecasting and costing 2. Demonstrate the knowledge of designing plants and controlling production. 3. Optimize the resources of an organization and improve productivity.				
Unit I	Demand Forecasting and Elements of Cost				
Macro and micro economics - Demand and supply – Factors influencing demand – Elasticity of demand – Demand forecasting – Time series - Exponential smoothing casual forecast - Delphi method – Correlation and Regression - Barometric method – Long run and Short run forecast. Elements of cost – Determination of Material cost - Labour cost - Expenses – Types of cost – Cost of production - Over head expenses – Problems.					
Unit II	Industrial Organisation				
Introduction to Industrial Engineering – Concepts - History and Development of Industrial engineering – Roles of Industrial Engineer – Applications – Productivity – Factors affecting productivity – Increasing productivity of resources – Kinds of productivity measures.					
Unit III	Work Design				
Introduction to work study – Method study – Time study – stopwatch time study - Standard data - Method Time Measurement (M-T-M) – Work sampling – Ergonomics.					
Unit IV	Plant Layout and Group Technology				
Plant location - Factors - Plant layout - Types - Layout design process - Computerized Layout Planning – Construction and Improvement algorithms -ALDEP - CORELAP and CRAFT. Group technology-Problem definition - Production flow analysis - Heuristic methods of grouping by machine matrices – Flexible Manufacturing System - FMS work stations-Material handling and Storage system-Cellular Manufacturing System.					
Unit V	Production Planning and Control				
Types of productions, Production cycle-Process planning, Forecasting, Loading, Scheduling, Dispatching, Routing- Simple problems. Materials Planning – ABC analysis – Incoming materials control – Kanban system – Just in time. MRP systems- Master Production Schedule – Bill of Materials – MRP calculations - MRP II.					
Text Books					
1. R.Danreid & Sanders., (2009), Operations Management, John Wiley & Sons 2. Buffa E.S., (2009), Modern Production / Operational Management, John Wiley & Sons					
References					
1. Nigel Slack, Stuart Chambers, Robert Johnston., (2010)Operation Managenment,					

Pearson Education 2. Panneerselvam. R. (2006), Production/Operations Management, Prentice Hall of India Pvt Ltd.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE437	OPERATIONS RESEARCH	2	1	0	3
Prerequisite	MAT104				
Objectives:	1. To provide students the knowledge of optimization techniques and approaches. 2. To enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research. 3. To teach students about networking, inventory, queuing, decision and replacement models. 4. To introduce students to research methods and current trends in Operations Research.				
Expected Outcome:	Student will be able to 1. Apply operations research techniques like L.P.P, scheduling and sequencing in industrial optimization problems. 2. Solve transportation problems using various OR methods. 3. Illustrate the use of OR tools in a wide range of applications in industries. 4. Analyze various OR models like Inventory, Queing, Replacement, Simulation, Decision etc and apply them for optimization. 5. Gain knowledge on current topics and advanced techniques of Operations Research for industrial solutions.				
Unit I	Linear Models				
Introduction to Operations Research – Linear Programming - Mathematical Formulation – Graphical method – Simplex method – Duality – Two – Phase Simplex method – Transportation problems – Northwest Corner method – Vogel's Approximation method – MODI method – Assignment problems – Applications.					
Unit II	Sequencing and Networks				
Sequencing –Problem with N jobs and 2 machines - 3 machines and 'M' machines. Network models – Basic Concepts – Construction of Networks – Project Network – CPM and PERT - Critical Path Scheduling – Crashing of Network.					
Unit III	Inventory Models				
Inventory models – Various Costs and Concepts–EOQ–Deterministic inventory models – Production models – Stochastic Inventory models – Buffer stock.					
Unit IV	Queuing Models				
Queuing models – Poisson arrivals and Exponential service times – Single channel models and Multi channel models. Simulation – Basic concepts – Advantages and Disadvantages – Random number generation – Monte-Carlo Simulation – Simulation models.					
Unit V	Decision Models				
Decision models – Game theory – Two person zero sum game – Graphic solution - Property of dominance – Algebraic solution. Replacement models – Items that deteriorate with time - When money value changes – Items that fail completely – Individual replacement and Group replacement.					
Text Books					
1. Kanti Swarup, Gupta P.K., and Manmohan, (2004), Operations Research, S.Chand & sons.					

2. Hamdy Taha, (2009), Operations Research: An Introduction, Pearson Education Inc.	
References	
1. Hira D S and Gupta P K, (2007), Operations Research,S.Chand & Sons. 2. Panneerselvan. R. (2006), Operation Research, Prentice Hall of India Pvt Ltd	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

HUM101	PSYCHOLOGY AND SOCIOLOGY	3	0	0	3
Prerequisite	-				
Objectives:	1. To teach students how to describe human behavior using appropriate concepts 2. To enable the students understand the contributions made by eminent thinkers and researchers to the pool of knowledge in the field 3. To make students realize the relevance of Sociology and Psychology in the context of the present day organizations				
Expected Outcome:	Student will be able to 1. To become aware of the causes and consequences of Social and Psychological problems 2. To be able to understand the impact of social environment on individuals and groups 3. To be able to utilize the knowledge of Sociology and Psychology to improve the quality of living of self and of people in general				
Unit I	Psychology Introduction				
Definition and Scope of Psychology; Psychology as a science. Personality: Definition, types of personality, Measurement of Personality. Type 'A' Personality, Anger scale, well-being scales. Behavior Modification: Perception, Motivation, and Learning, Relaxation Techniques, Assertive Training, and Desensitization Procedures.					
Unit II	Applications				
Application of Psychology: Industry: Selection, Training, motivation and Productivity, Team building, Stress-management. Marketing: Consumer Behavior and Advertising; Self-Development: Application of Psychology in building memory and creativity.					
Unit III	Sociology – Introduction				
Sociology: Definition and nature; Society and Social Processes:- Competition, cooperation and conflict, Social groups – Types and characteristics; Social Institutions: Marriage: and family: and their impact on individuals; Functions and dysfunctions of religion					
Unit IV	Social concerns				
Major Social Concerns: Social Stratification: Nature and types, Prejudices Social Mobility, Types, facilitating and hindering factors. Social Changes:- Urbanization, westernization, and pluralism; Demographic variables – Fertility, mortality, Sex-ratio, literacy, Life-expectancy. Social Problems:- Crime, Social unrest, Beggary. Alcoholism and substance abuse, Prostitution, Gender injustice and child Abuse. Social Movements:- Sarvodaya, Bhoodan, Chipco, Dravidian and the Dalit Movements.					
References					
1. Grace Davie: Sociology of Religion, Sage Publications 2007 2. Sharmila Rege: Sociology of Gender, Sage Publications 2003 3. Meena Hariharan and Radhanath Rath: Coping With Life Stress, Sage Publications 2008 4. Robbins Stephen: Organizational Behavior, P. Prentice Hall International, Inc. Eaglewood Cliffs, 2002					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE209	INSTRUMENTATION AND CONTROL ENGINEERING	2	1	2	4
Prerequisite	-				
Objectives:	1. To understand the characteristics of a instrumentation system. 2. To impart the principle and operation of different types of sensors, transducers and instrumentations used in engineering practices. 3. To understand the process control and data acquisition techniques for industrial applications. 4. To apply the control engineering principles for controlling the physical systems found in modern manufacturing, processing environments.				
Expected Outcome:	Student will be able to 1. Select the suitable instrumentation systems for monitoring and control of industrial processes. 2. Build mathematical models for controlling the simple physical systems using transfer functions. 3. Use the suitable techniques for analyzing the response time and stability of the control systems.				
Unit I	General concepts of Measurement System				
Introduction – functional elements of measurement system – classification – static and dynamic characteristics of instruments – errors in measurements – calibration. Transduction principles: resistive, capacitive, inductive, piezo-electric, photo-voltaic, thermo-electric, magnetic, ultrasonic and pneumatic.					
Unit II	Measurement of displacement, force, torque and speed				
Measurement of displacement: Potentiometer, LVDT, capacitive and digital transducers. Measurement of Force: Strain gauge, load cells - Measurement of torque - Measurement of Speed: magnetic and optical methods.					
Unit III	Measurement of temperature, pressure, flow and vibration				
Measurement of temperature: Bi-metallic, thermocouple, RTD, thermistor, pyrometer- Measurement of pressure: deadweight, manometer, elastic elements, McLeod and Pirani gauges - Measurement of flow: hot wire anemometer, magnetic flow meter, ultrasonic meter - Measurement of vibration using accelerometers.					
Unit IV	Control System and Analysis				
Introduction – open and closed loop systems – Transfer function: Block diagram reduction algebra, signal flow graphs – Frequency domain analysis: Polar and Bode plots – Stability: Routh - Hurwitz Criterion.					
Unit V	Process control systems				
Position and speed control: servomotor and stepper motor. Development of control systems: temperature, pressure, flow, liquid level control – case study on data acquisition and control system.					
Text Books					
1. Ernest O. Doeblin (2004), Measurement Systems: Application and Design, 5th Edition, Tata McGraw- Hill. 2. Katsuhiko Ogata (2010), Modern Control Engineering, 5th Edition, Prentice Hall of India Pvt. Ltd.					
Reference Books					
1. J.P. Holman (2004), Experimental Methods for Engineers, Tata McGraw-Hill. 2. Williams Bolton (2004), Instrumentation and control, Elsevier Ltd. 3. Kevin James (2000), PC Interfacing and Data Acquisition: Techniques for Measurement,					

Instrumentation and Control, Newnes Publishers.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE209L	INSTRUMENTATION AND CONTROL ENGINEERING LAB
Objectives:	1. Learn to apply mathematics and engineering principles to measurement problems in Engineering 2. Design and conduct experiments and interpret data 3. Learn professional measurement techniques used to engineer thermal and mechanical systems.
Expected Outcome:	Student will be able to 1. Apply the fundamental principles of measurements, error analysis, instrumentation methodology, and experimental design to the solution of practical problems related to experimental measurement and data analysis. 2. Demonstrate a working knowledge of the theoretical basis for operation of instruments, sensors, and associated equipment by analyzing practical problems dealing with the use of such instruments, sensors, and equipment.
Experiments	
1. Pressure measuring devices – Pressure and Vacuum gauge calibration 2. Temperature measuring devices like Platinum resistance thermometer, Thermocouples etc 3. Speed measuring devices like Tachometer, Stroboscope etc 4. Force measuring devices , Load cells and Proving rings 5. Torque measuring devices	
References	Lab Manual Prepared by VIT Staff
Mode of Evaluation	Experiments/Record work/Oral/ Practical Examination

MEE228	POWER PLANT ENGINEERING	2	1	0	3
Prerequisite	MEE204				
Objectives:	1. To teach students about the working of various power generation units and steam cycles. 2. To introduce students to steam generators, combustion and firing methods in order to make the fullest use of thermal power potentialities of the country. 3. To enable students understand in detail about nuclear, gas turbine, hydro and diesel power plants which play an important role in power generation.				
Expected Outcome:	Student will be able to 1. Understand basic power generation types and steam cycles. 2. Know about the kind of boilers being used in various industries and their applicability. 3. Solve problems related to gas turbine and Rankine cycles. 4. Distinguish between various power generation units and choose one that meets desired economic, environmental and social requirements 5. Gain knowledge of contemporary issues like nuclear waste disposal, supercharging of diesel engines and combined cycle power plants.				
Unit I	Introduction to Power Plants				
Power plants-Features - Componets and layouts-Working principle of Steam - Hydro - Nuclear - Gas Turbine and Diesel power plants-Selection of site-Analysis of steam cycles-Rankine cycle-Reheating and Regenerative cycles					
Unit II	Steam Generators				
Boiler classification-Types of Boiler-Fire tube and Water tube boilers-High pressure and Supercritical boilers-Positive circulation boilers-Fluidized bed boiler-Waste heat recovery boiler-Feed water heaters-Super heaters-Reheaters-Economiser-Condenser-Cooling tower-Feed water treatement-Air heaters					
Unit III	Combustion and Firing Methods				
Coal handling and preparation-Combustion equipment and firing methods-Mechanical stokers-Pulverized coal firing systems-Cyclone furnace-Ash handling systems-Electrostatic precipator-Fabric filter and Bag house-Forced draft and Induced draft fans-Chimney					
Unit IV	Nuclear and Gas Turbine Power Plants				
Principles of nuclear energy-Energy from nuclear reactions-Energy from fission and fuel Burnup-Decay rates and Half-Lives-Boiling water reactor-Pressurized water reactor-Pressurized Heavy Water Reactor-Gas cooled reactor-High temperature gas cooled reactor-Pebble bed reactor-Fast breeder reactor-Liquid metal fast breeder reactor-reactor materials-Radiation shielding-Waste disposal-Gas turbine power plant-Open and closed cycles-Intercooling - Reheating and Regenerating-Combined cycle power plant					
Unit V	Hydro and Diesel Power Plants				
Classification of Hydro-electric power plants and their applications-Selection of prime movers-Governing of turbine-Diesel power plant- Subsystems-Starting and stopping-Heat balance-Supercharging of Diesel engines					
Text Books					
P. K. Nag, (2001), Power Plant Engineering: Steam and Nuclear, Tata McGraw-Hill					

Publishing Company Ltd., Second Edition.	
References	
1. M. M. El-Wakil, (1999), Power Plant Technology, McGraw-Hill International Editions 2. Black and Veatch, (1998), Power Plant Engineering, CBS Pub and Distributors, New Delhi. 3. R. K. Rajput, (2005), A Text Book of Power Plant Engineering, Laxmi Publications (P) Ltd.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE243	FUNDAMENTALS OF MECHATRONICS SYSTEMS	3	0	2	4
Prerequisite	EEE101				
Objectives:	1.To introduce integrated approach to the design of complex engineering systems 2. To provide knowledge of sensors, actuators and selection for an application. 3. To expose interfacing of devices with controllers.				
Expected Outcome:	Student will be able to 1. Identify the elements of mechatronics system. 2. Select suitable sensors, actuators and controllers to meet specific requirements. 3. Demonstrate intelligent mechatronics system for engineering applications.				
Unit I	Introduction to Mechatronics				
Introduction to Mechatronics – Conventional and Mechatronics approach in designing products - Mechatronics design process - Mechatronics in Manufacturing – Adoptive and distributed control systems – Modeling and simulation of mechatronics systems.					
Unit II	Sensors and actuators				
Overview of sensors and transducers – Microsensors - Signal conditioning – Operational amplifiers – Protection – Filtering - Analog and Digital converters. Electro – pneumatics and Electro – hydraulics - Solenoids – Direct Current motors – Servomotors – Stepper motors - Micro actuators; Drives selection and application.					
Unit III	Microprocessor based Controllers				
Architecture of microprocessor and microcontroller – System interfacing for a sensor, keyboard, display and motors - Application cases for temperature control, warning and process control systems.					
Unit IV	Programmable Logic Controllers				
Architecture of Programmable Logic Controllers – Input/Output modules – programming methods – Timers and counters – Master control – Branching – Data handling – Analog input/output – Selection of PLC and troubleshooting.					
Unit V	Intelligent Mechatronics and Case Studies				
Fuzzy logic control and Artificial Neural Networks in mechatronics – Algorithms – Computer – based instrumentation - Real-time Data Acquisition and Control – Software integration - Man-Machine interface -Vision system – Mechatronics system case studies.					
Text Books					
Bolton .W, (2008), Mechatronics, 4rd Edition, Pearson Education.					
References:					
1. DevdasShetty, Richard A. Kolk (2011), “Mechatronics System Design”, PWS Publishing Company. 2. Dan Necsulescu, (2002), “Mechatronics”, 3rd Edition, Pearson Education. 3. Michael B. Histand and David G. Alciatore (2005), “Introduction to Mechatronics and Measurement systems”, McGraw-Hill. 4. B.P. Singh (2002), “Advanced Microprocessor and Microcontrollers”, New Age International Publisher.					
Mode of Evaluation: Quiz/Assignment/ Seminar/Written Examination					

MEE243L	FUNDAMENTALS OF MECHATRONICS SYSTEMS LABORATORY
Objectives:	1. To introduce mechatronics design principles for automation. 2. Design and development of PLC controlled systems. 3. To be trained in sofwares used to engineer systems.
Expected Outcome:	Student will be able to 1. applythe fundamental principles of integral design to the solution of practical problems related automation systems . 2. demonstrate a fundamental knowledge ofsensors, actuators and associated control systems. 3. select appropriate sensors and actuators and program the controllers in automating systems.

Experiments:

1. Overview of commonly used electronics components and test equipments.
2. Design of microcontroller based control system for simple applications.
3. Interfacing sensors and actuators with PLC systems.
4. Control of DC Motor, stepper motor and servomotor.
5. Design and control of electro-pneumatic and electro-hydraulic systems.
6. Data acquisition with data logger.
7. Design and analysis mechatronics systems with automation softwares.
8. Study and demonstration of modular automation and robotic systems.
9. Study and demonstration of SCADA systems.
10. Study and demonstration of computer aided inspection and CNC systems.

References: Laboratory manual prepared by VIT Faculty

Mode of Evaluation: Laboratory Report // Mini-Project / Practical Examination

MEE230	RENEWABLE ENERGY SOURCES	3	0	0	3
Prerequisite	-				
Objectives:	1. To provide students an overview of global energy resources. 2. To introduce students to bio-fuels, hydrogen energy and solar energy. 3. To enable the students understand the importance of energy efficiency and conservation in the context of future energy supply. 4. To expose students to future energy systems and energy use scenarios with a focus on promoting the use of renewable energy resources and technologies.				
Expected Outcome:	Student will be able to 1. Possess the knowledge of global energy resources. 2. Use the renewable technologies like solar, biomass, wind, hydrogen etc. to produce energy. 3. Involve in optimizing and selecting an alternate source of energy.				
Unit I	Biofuels				
Biofuels classification – Biomass production for energy forming – Energy through fermentation – Pyrolysis – Gasification and combustion - Biogas - Aerobic and Anaerobic bio conversion process - Feed stock - Properties of bio-gas composition - Biogas plant design and operation - Alcoholic fermentation.					
Unit II	Hydrogen Energy				
Electrolytic and thermo chemical hydrogen production – Metal hydrides and storage of hydrogen – Hydrogen energy conversion systems hybrid systems – Economics and technical feasibility.					
Unit III	Solar Energy				
Solar radiation - Availability- Measurement and estimation- Isotropic and an isotropic models - Introduction to solar collectors (liquid flat- Plate collector - Air heater and concentrating collector) and thermal storage - Steady state transient analysis - Photovoltaic solar cell - Hybrid systems - Thermal storage- Solar array and their characteristics evaluation – Solar distillation – Solar drying.					
Unit IV	Ocean Thermal Energy Conversion				
Geothermal - Wave and Tidal energy - Availability - Geographical distribution - Power generation using OTEC - Wave and Tidal energy - Scope and economics - Geothermal energy - Availability - Limitations.					
Unit V	Wind Energy				
Wind energy - General considerations - Wind Power plant design – Horizontal axis wind turbine - Vertical axis wind turbine - Rotor selection - Design considerations - Number of blades - Blade profile - Power regulation - Yaw system - Choice of power plant - Wind mapping and selection of location - Cost analysis and economics of systems utilizing renewable sources of energy.					
Text Books					
David Merick, Richard Marshall, (2001), Energy, Present and Future Options, Vol. I and II, John Wiley and sons.					
References					
1. Gerald W. Koeppl, (2002), Patnam's power from wind, Van Nostrand Reinhold Co. 2. Ritchie J.D., (1999), Source Book for Farm Energy Alternative, McGraw Hill.					

<table>
<tr><td colspan="2">3. Twidell, J.W. and Weir, A.D., (1999), Renewable Energy Resources, ELBS.
4. Koteswara Rao, M. V. R., (2006), Energy Resources-Conventional and Non Conventional, Second Edition, BS Publications.
5. Khan, B. H., (2009), Non-Conventional Energy Resources, Second Edition, Tata McGraw Hill.
6. Chetan Singh Solanki, (2009), Renewable Energy Technologies: A Practical Guide for Beginners, Second Printing, PHI Learning Private Limited.
7. Mukherjee, D. and Chakrabarti, S., (2005), Fundamentals of Renewable Energy Systems, New Age International (P) Limited
8. Chauhan, D.S. and Srivastava, S.K. (2006), Non-Conventional Energy Resources, New Age International (P) Limited</td></tr>
<tr><td>Mode of Evaluation</td><td>Quiz/Assignment/ Seminar/Written Examination</td></tr>
</table>

MEE430	ACOUSTICS AND NOISE CONTROL ENGINEERING	2	1	0	3
Prerequisite	MEE301				
Objectives:	1. To provide introduction to students the fundamentals of acoustics related to generation, transmission and control techniques 2. To enable the students acquaint with principles and properties of room acoustics, acoustic materials, instrumentation and signal analysis techniques 3. To provide in depth knowledge to students in machinery acoustics, standards and control measures at source and path 4. To introduce students to diagnostics for effective maintenance				
Expected Outcome:	Student will be able to 1. Solve complicated problems in acoustics 2. Demonstrate the knowledge of noise and physiological effects 3. Exposed to acoustic instrumentation and noise control techniques				
Unit I	Introduction to Acoustics				
Introduction to Acoustics- terminology - limits and standards – Sound sources and propagation – Plane and spherical waves - Near and far field - Free and reverberant field - Anechoic and Reverberant chambers.					
Unit II	Acoustic evaluation techniques				
Room Acoustics - Reverberation time - Acoustic materials - Absorption and absorption coefficient - Evaluation techniques.					
Unit III	Noise and physiological effects				
Noise and Physiological effects - Loudness - Hearing - Mechanism - Weighted - Networks - Noise standards for traffic - Community - Aircraft - Environmental and Machinery acoustics.					
Unit IV	Acoustic Instrumentation				
Acoustic Instrumentation. Sound level and intensity meters - Octave analyzers - Calibration - Sound power estimation - Instruments for building acoustics - Speech interference - Sound systems and Auditorium acoustics.					
Unit V	Noise control techniques				
Noise control techniques – At source and transmission path - Barriers and Enclosures - Machinery acoustics and levels - Near field monitoring and diagnostics - Active noise control techniques.					
Text Books					
J.D. Irwin and E.R.Graf, (2001), Industrial noise and Vibration control, Prentice Hall Inc.					
References					
1. Bies and Colin. H. Hanson, (2001): Engg. Noise Control, E & FN SPON. 2. Noise Control Hand Book of Principles and Practices, David M.Lipsdomls Van Nostrand Reinhold Company. 3. Acoustic and Noise Control, (2000), B.J. Smith, R.J.Peters, Stephanie Owen.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE381	NANOTECHNOLOGY	3	0	0	3
Prerequisite	MEE203				
Objectives:	1. To enable the students understand the basic concepts of Nanotechnology 2. To enhance the knowledge of students in nanomaterials 3. To familiarize the students with the properties of nanomaterials and their applications 4. To expose the students MEMS / NEMS devices and their applications				
Expected Outcome:	Student will be able to 1. Use Nanomaterials for various industrial applications 2. Design MEMS / NEMS devices for various applications 3. Demonstrate the knowledge of devices used in MEMS/NEMS				
Unit I	Introduction to Nanoscience& Technology				
Single crystal, polycrystal and a nanocrystal- Nano in nature- Significance of nanostructures-- Present and future applications of nanomaterials - Classification of nanomaterials - magic numbers- Electronic and structural magic numbers - bulk to nanotransition- Size dependent property changes-Factors leading to changes-Surface to volume ratio and quantum confinement-Surface energy- Interatomic and intermolecular forces- -Forces acting between nanoparticles- van der Waals forces-hydrphobic and hydrophilic forces- agglomeration of nanoparticles-stabilization of nanoparticles					
Unit II	Synthesis, characterization of nanomaterials and mechanical properties:				
Bottom-up and top down approaches- Inert gas condensation- Ball milling and Sol –gel - lithographic techniques- Particle size determination- XRD- laser diffraction- SEM,TEM, Raman ,Infrared spectroscopies , AFM and contact angle measurement and porosimeter – phase transitions in nano systems- Inverse-Hall-Petchbehaviour–mechanical properties of nanomaterials					
Unit III	Applications of Nanomaterials in automobiles, aerospace, energy and biomedical areas:				
Metallic nanoparticles, Cu, Ag,Au,Pd,Rh ,Modulus and hardness, melting point depression , catalytic, antifungal and anti bacterial properties, chemical sensors ,CeO2- fuel efficiency – magnetic nanoparticles - solar cell applications- biomarkers, anticancer drug - Metal oxide nano particles- nanopoplyemers and composites- superhydrophobicity- hydrogen storage , - fabrication, structure, electrical , vibrational and mechanical properties , applications in field emission- computers, mechanical reinforcement- Nanocoatings - TiO2 and ZrO2 and Al2O3 – nanoceramic coating for biomedical implants-Thin films – Electrophoretic deposition, PVD,CVD and ALD					
Unit IV	CNT and Graphene				
Discovery of C60 and other fullerenes, carbon nanotubes, Energy levels- Synthesis of CNT and purification, structure, electrical , and mechanical properties , ,Energy levels applications in field emission, computers, fuel cells, chemical sensors, catalysis, mechanical reinforcement-graphene ,preparation and applications,					

Unit V	Nanomachines and Nanodevices:	
Microelecrtoromechanical systems- (MEMS) –Nanoelectromechanical systems (NEMS), Fabrication-nanodevices and nanomachines , molecular and supramolecular switches . Nano tribology		
Text Books		
1. Charles P. Poole, Frank J. Owens, (2000), Introduction to Nanotechnology, John Wiley & Sons. 2. Nanomaterials:Synthesis, properties and applications C.N.R.Rao, P.J.Thomas and U.Kulkarni, Springer-Verlag (2007)		
References		
1. Nanocrystalline materials,Glieter, Progress in Materials Science Vol. 33, pp. 223-315, 1989 2. Mechanical alloying and milling, C. Suryanarayana, Progress in Materials Science 46 (2001) 1,184 3. Guozhong Cao, Nanosructures and nanomarterials , Imperial college press , 2003 4. H.Nalwa ; Encyclopedia of nanoscience and nanotechnology.Ameriacan Scientific publishers 5. T. Pradeep, Nano: The Essentials Understanding Nanoscience and Nanotechnology, New Delhi, 2007, reprinted 2008, 2009 & 2010, McGraw Hill Education, New Delhi 2008		
Mode of Evaluation	Assignment/ projects Seminar/Written Examination	

MEE338	DESIGN OF COMPOSITE MATERIALS	2	1	0	3
Prerequisite	MEE203, MEE214				
Objectives:	1. To enable the students understand the properties and design of composite materials 2. To familiarize the students with the manufacturing methods for composites 3. To teach the practical requirements associated with joining and manufacturing				
Expected Outcome:	Student will be able to 1. Design and manufacture composite materials for various applications 2. Conduct mechanical testing of composite structures and analyse failure modes 3. Synthesize structures for environmental effects 4. Analyse economic aspects of using composites 5. Understand the relevance and limitations of the destructive and non-destructive test methods used for composites 6. Demonstrate the ability to use appropriate design and analysis tools and techniques				
Unit I	Introduction				
Definitions: Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites					
Unit II	Manufacturing methods				
Hand and spray lay-up, press molding, injection molding, resin injection, RRIM, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface, Theories of adhesion; absorption and wetting, interdiffusion, electrostatic, chemical, mechanical. Measurement of interface strength. Characterization of systems; carbon fibre/epoxy, glass fibre/polyester, etc. Influence of interface on mechanical properties of composite.					
Unit III	Mechanical Properties				
Stiffness and Strength: Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibers, Short fiber systems, woven reinforcements – length and orientation distributions. Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear. Fracture: Typical fracture processes; effect of transverse ply. Review of fracture mechanics methods and application to composites. Impact: Typical impact damage; role of fibre, matrix and interface. Low and high speed impact test methods. Fatigue: Behavior of notched and unnotched specimens. Tension testing of composites. Fatigue damage – Effect of matrix and fibre properties. Implications for component design. Environmental Effects: Influence of moisture and other contaminants on fibre, matrix, interface and effect on mechanical properties. Stress corrosion cracking. Influence of high and low temperatures.					
Unit IV	Laminates				
Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Plate Stiffness and Compliance, Computation of Stresses, Types of Laminates -, Symmetric Laminates, Anti-symmetric Laminate, Balanced Laminate, Quasi-isotropic Laminates, Cross-ply Laminate, Angle-ply Laminate. Orthotropic Laminate, Laminate Moduli, Design Using Carpet Plots, Stiffness Controlled Design, Design for Bending, Hygrothermal Stresses.					
Unit V	Joining Methods and Failure Theories				
Joining –Advantages and disadvantages of adhesive and mechanically fastened joints.					

Typical bond strengths and test procedures. Design philosophy and procedures (systems approach). Simple design studies (pressure vessels, torsion bar); factors of safety. Case studies for failure design process, materials selection, manufacturing method. Economic aspects of using composites. Stress Analysis: Free edge stresses; typical distributions, significance of stacking sequence, significance of ply blocking, effect on failure modes, experiment al evidence. Development of engineer's theory of bending for thin walled beams comprising several different materials and analysis of the shear flow distribution. Buckling; strut buckling, buckling of especially orthotropic plates, significance of bending-twisting coupling.

Text Books	

1. K.K. Chawla, (1998), Composite Materials, Springer-Verlag, New York

References

1. B.T. Astrom, (1997), Manufacturing of Polymer Composites, Chapman & Hall
2. Stuart M Lee, J. Ian Gray, Miltz, (1989), Reference Book for Composites Technology, CRC press
3. Frank L Matthews and R D Rawlings, (2006), Composite Materials: Engineering and Science, Taylor and Francis.
4. D. Hull and T.W. Clyne, (1996), Introduction to Composite Materials, Cambridge University Press.
5. M.R. Piggott, (1998), Load Bearing Fibre Composites, Pergamon press, Oxford.
6. F. Ashby and D.R.H. Jones, (1999), Engineering Materials, Pergamon press
7. R.W. Davidge and A. Kelly, (1999), Mechanical behavior of ceramics, Cambridge university press
8. Andrew C. Marshall, (1998), Composite Basics, Marshall Consulting.

Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE339	TRIBOLOGY	2	1	0	3
Prerequisite	MEE202, MEE206 (or) MEE240				
Objectives:	1. To introduce tribology as an important design consideration that affects the performance of engine and automotive elements. 2. To teach different bearing types, modeling and performance considerations. 3. To introduce concepts in friction and wear phenomena.				
Expected Outcome:	Student will be able to 1. Select tribological elements based on design considerations. 2. Realize the importance of proper choice of tribological elements 3. Apply the knowledge of wear and lubricants for different applications.				
Unit I	Engineering Surfaces				
Topography of Engineering Surfaces – Surface parameters- Geometric – Statistical parameters – Measurements - Surface contact - Types of contact – Hert'z theory of elastic contact. Surface modification - Transformation hardening - Thermo-chemical process - Laser - Electron beams and Plasma treatment					
Unit II	Friction and wear				
Friction – Laws of friction - Stick-slip phenomenon- Friction characteristics of metals and non-metals - Adhesion and Ploughing theory of friction- Measurement of friction. Wear - Wear mechanisms – Interfacial wear and Chemical wear-Wear measurements-Ferrograpghy and oil analysis.					
Unit III	Lubricants and Lubrication regimes				
Types of Lubricants - Physical Properties – Viscosity, Viscosity Index - Testing principles - Lubricant additives. Lubrcation regimes- Lamda ratio – Hydrodynamic – Elastohydrodynamic - Hydrostatic - Boundary and Solid lubrication.					
Unit IV	Hydrodynamic Lubrication				
Fluid film in simple shear – Mechanism of pressure development in a convergent film– Pressure induced and velocity induced flows- Reynolds equation for fluid film lubrication – Long bearing and short bearing approximations- Load carrying capacity - Sommerfield Number – Friction -Thermal equilibrium.					
Unit V	Materials and Applications				
Materials for rolling element bearings - Fluid film bearings - Dry bearings. Technological Applications of tribology - Automotive Tribology					
Text Books					
1. Prasanta Sahoo, (2009) Engineering Tribology, PHI Learning Private Limited.					
Reference Books					
1. Bowden, F.P. & Tabor, D.,(2001) Friction and Lubrication of solids, Oxford University press. 2. Neale, M.J., Tribology ,(1999), Hand Book, Butterworth. 3. Fuller D.D., (1999),Theory and practice of Lubrication for engineers, John Wiley sons. 4. Bharat Bhushan, (2002), Introduction to tribology, John Wiley and Sons.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE213	ROBOTICS	3	0	0	3
Prerequisite	-				
Objectives:	1. To introduce the history, constructional features and other basic information on robotics 2. To introduce to the sensors used in robotics 3. To teach robot programming of a typical robot as also the concepts of path planning and applications				
Expected Outcome:	Student will be able to 1. Have an awareness of basics of robotics 2. Do robot programming 3. Appreciate the applications of robotics and be able to apply economic measures to justify advantages of robots in industry.				
Unit I	Introduction				
Definition of a Robot – Basic Concepts –Robot configurations – Types of Robot drives – Basic robot motions – Point to point control – Continuous path control.					
Unit II	Components and Operation				
Basic control system concepts – Control system analysis – Robot actuation and feed back - Manipulators – direct and inverse kinematics - Coordinate transformation – Brief Robot dynamics. Types of Robot and Effectors – Robot/ End – Effector interface.					
Unit III	Sensing and Machine Vision				
Range sensing – Proximity sensing –Touch sensing – Force and Torque sensing. Introduction to Machine vision – Sensing and Digitizing – Image processing and analysis.					
Unit IV	Robot Programming				
Methods – Languages – Capabilities and limitation – Artificial intelligence – Knowledge representation –Search techniques in A I and Robotics.					
Unit V	Industrial Applications				
Application of robots in machining – Welding – Assembly – Material handling –Loading and Unloading – CIM – Hostile and Remote environments.					
Text Books					
Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, (1999), Robotic Engineering : An Integrated Approach, Prentice Hall of India.					
References					
1. Mikell P. Groover, Mitchell Weiss, (1998), Industrial Robotics Technology – Programming and Applications, McGraw Hill International Edition. 2. Yoshikawa, (2004), Foundation of Robotics: Analysis and Control, Prentice Hall of India.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE431	PRODUCT DESIGN	2	1	0	3
Prerequisite	MEE302				
Objectives:	The course is aimed at training students to acquire skills to design and develop products in a structured way that are easier to manufacture, assemble, service and more friendlier to environment, etc.				
Expected Outcome:	Student will be able to have customer-oriented manufacturing approach and life-cycle sensitive approach to product design and development.				
Unit I	New Product development				
Product development – Trends– Best practices– Product development process and organizations – Collaborative product development – Time compression Technologies – risk management – Stages of Product development. Conceptual / Industrial / Engineering design. Design analysis and validation					
Unit II	Conceptual design				
Early design – Customer needs – Requirement Definition and Conceptual design – Optimization using cost and utility metrics – Trade-off analysis- models and parameters-design to cost – Design to Life cycle cost – Design for warranties- problem solving – Benchmarking					
Unit III	Product design Evaluation				
Detailed design – Analysis and modeling – Best practices for detailed design – Design analyses – Prototypes in detailed design – Test and Evaluation – Design review, prototyping – simulation and testing – Manufacturing – Strategies – planning and methodologies.					
Unit IV	Design for Manufacture and assembly				
General design principles for manufacturability – strength and mechanical factors, mechanism selection- process capability – Feature tolerances – Geometric tolerances – Assembly limits – Datum features – Tolerance stacks – Problems on tolerancing – Exposure on DFMA software					
Unit V	Design for X				
Simplification – commonality and preferred methods – Modularity and scalability – part reduction – functional analysis and value engineering – Reliability – Strategies and practices – Testability – Design for test and inspection. Design for people – Ergonomics, Reparability, Maintainability, safety and product liability					
Text Books					
1. Karl T. Ulrich and Steven D. Eppinger. “Product Design and Development” Tata McGraw-Hill Publishing Company Limited, 2003					
References					
1. Stephen C. Armstrong, “Engineering and Product development Management– The Holostic Approach” Cambridge University Press, 2001. 2. IbrahimZeid, “Mastering CAD/CAM” Tata McGraw-Hill, 2005. 3. Corrodo Poli, “Design for Manufacturing: A structured approach”, Butterworth-Heinemann, 2001. 4. John W. Priest and Jose M. Sanchez, “Product development and design for manufacturing- A collaborative approach to Produciability and reliability”, Marcel Dekker Publications, 2001.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE432	TOOL DESIGN	2	1	0	3
Prerequisite	MEE217, MEE302				
Objectives:	1. To teach students the fundamentals of work holding devices. 2. To enable the students design tools, dies, jigs and fixtures. 3. To teach students to analyze and optimize an existing jig and fixture. 4. To expose students to design of dies for press work and forging.				
Expected Outcome:	Student will be able to 1. Identify the importance of work holding device. 2. Design jigs and fixtures. 3. Calculate the required specifications of a press for required operations. 4. Design tools and dies for required operations.				
Unit I	Design of Cutting Tools				
Metal cutting process - Selection of tool materials - Design of single point and multipoint cutting tool - Form tools, Drills, Milling cutters, broaches and chip breakers – Problems on design of single point cutting tools only.					
Unit II	Locating and Clamping Methods				
Basic Principles of Location - Locating methods and devices - Principles of clamping - Mechanical, Pneumatic and Hydraulic actuation - Clamping force analysis - Design problems.					
Unit III	Design of Jigs				
Types of drill jigs - General considerations in the design of drill jigs - Drill bushings - Types, methods of construction - Simple designs of Plate, Channel, Boxes, Post, Angle plate, Turnovers and Pot Jigs.					
Unit IV	Design of Fixtures				
Design principles - Types of fixtures - Fixtures for machine tools: Lathe, Milling, Boring, Broaching and grinding - Assembly fixtures - Inspection and Welding fixtures.					
Unit V	Design of Dies				
Press tools - Fundamentals of die-cutting operations - Cutting action in punch and die operations - Die clearance - Blanking and Piercing Die construction – Pilots - Strippers and Pressure Pads - Press work materials - Strip layout - Design of simple progressive and compound die sets - Forging Die – Flow lines, parting lines, open and close die forging; Materials for die block.					
Text Books					
Donaldson C., Lecain G.H. and Goold V.C. (2007), Tool Design, 3rd edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi.					
References					
1. Joshi P. H., (2004) Jigs and Fixtures, 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi. 2. Edward G. Hoffman (2004) Jigs and Fixtures Design, Thomson - Delmar Learning Series, Singapore. 3. Jeff Lantrip, David A. Smith and John G. Nee, (2003) Fundamentals of Tool Design, 5th Edition, Society of Manufacturing Engineers.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE336	FINITE ELEMENT ANALYSIS	2	1	2	4
Prerequisite	MAT205, MEE214				
Objectives:	1. To enable the students understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics, heat transfer and fluid flow problems. 2. To teach the students the characteristics of various elements and selection of suitable elements for the problems being solved. 3. To make the students derive finite element equations for simple and complex elements.				
Expected Outcome:	Student will be able to 1. Apply the knowledge of Mathematics and Engineering to solve problems in structural, heat transfer and fluid flow by FEM 2. Use commercial FEA packages like ANSYS and modern CAD/CAE tools for solving real life problems				
Unit I	Introduction to Finite Element Method				
General description of Finit Element Method – Historical development – Comparision with classical methods – General procedure of FEM - Applications of FEM – FEA softwares. General field problems, discrete and continuous models, Variational formulation in finite elements – Ritz method - Weighted residual methods – Galerkin – sub domain – method of least squares and collocation method - numerical problems.					
Unit II	Discretization and Interplolation Function				
Discretization: Geometrical approximations – Simplification through symmetry – Element shapes and behaviour – Choice of element types – size and number of elements – Element shape and distortion – Location of nodes – Node and Element numbering. Interpolation Function: Simplex - Complex and Multiplex elements – Selection of interpolation polynomials - Convergence requirements – Natural coordinate systems - Derivation of shape functions for various elements – Isoparametric elements – Numerical Integration.					
Unit III	Applications in structural				
One dimensional elasticity – Castigliano's first theorem – Principle of minimum potential energy - Linear spring - Elastic bar bar with constant and varying cross sections using linear and quadratic elements – Truss structures and Beams.					
Unit IV	Applications in plane elasticity				
Introduction to plane elasticity theory – Plane stress, Plane strain and Axisymmetric problems – Finite Element formulations of plane elasticity problems using CST and four noded quadrilateral elements only.					
Unit V	Applications in Heat Transfer and Fluid Mechanics				
Finite Element formulation of One-dimensional and Two-dimensional steady state heat conduction problems with convection - Simplex elements only. Finite Element formulation of inviscid and incompressible flow – Potential function formulation – Stream function formulation.					
Text Books					
1. Tirupathi R. Chandrupatla and Ashok D. Belugundu, (2011), Introdution to Finite Elements in Engineering, Prentice Hall. 2. David V Hutton, (2009), Fundamentals of Finite Element Analysis, Tata McGraw-Hill Education. 3. Daryl L. Logan, (2011) A First Course in the Finite Element Method, Cengage Learning.					
Reference Books					

1. Bathe Klaus-Jurgen, (2009), Finite element procedures, PHI Learning. 2. Rao S. S., (2011), The Finite Element Method in Engineering, Elsevier. 3. Zienkiewicz O.C., Taylor R.L., Zhu J.Z. (2011), The Finite Element Method: Its basis and fundamentals, Butterworth Heinmann. 4. Madenci Erdogan, Guven Ibrahim (2011), Finite Element Method and Applications In Engineering using ANSYS , Springer.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE336L	**FINITE ELEMENT ANALYSIS LABORATORY**
Experiments:	
1. Introduction to MATLAB: 6 hrs. 2. MATLAB code for analysis of spring systems 3. MATLAB code for One-Dimensional elasticity problems 4. MATLAB code for plane truss analysis 5. MATLAB code for beam analysis 6. MATLAB code for 2-D frame analysis 7. MATLAB code for plane stress analysis using CST element 8. MATLAB code for one-dimensional heat conduction considering convection	
References: Laboratory manual prepared by VIT Faculty	
Mode of Evaluation: Laboratory Report // Mini-Project / Practical Examination	

MEE340	PRODUCT DESIGN FOR MANUFACTURING	2	1	0	3
Prerequisite	MEE217				
Objectives:	1. To expose the students to the basics of product design and manufacturing 2. To introduce students to principles and evaluation methods of various aspects of designing components 3. To teach students about the manufacturability requirements and assembly processes				
Expected Outcome:	Student will be able to 1. Possess customer-oriented, manufacturing and life cycle sensitive approach to product design and development, with product design principles and structured design methodologies 2. Possess methods and approaches for developing, implementing and nurturing an effective DFM process within the firm 3. Demonstrate the knowledge of DFMA software for case studies				
Unit I	Introduction to Product design				
Introduction to Product design: Asimow's Model - Product design practice in Industry - Strength consideration in product design - Design for stiffness and rigidity					
Unit II	Principles and evaluation methods				
Principles and evaluation methods of various aspects of Design for X (machining - sheet metal working - injection molding - environment - service and repair - etc.).					
Unit III	Manufacturability requirements				
Manufacturability requirements - Forging design - Pressed component design - Casting design - Die Casting and special castings.					
Unit IV	Assembly and assembly process				
Assembly and assembly process - principles of Design for assembly and applications (Boothroyd/Dewhurst Method – case studies using DFMA software.)					
Unit V	Other supporting techniques				
Other supporting techniques for new product development processes such as quality function deployment - and quality engineering and Taguchi Method.					
Text Books					
1. Boothroyd, G., (1999), Product Design for Manufacture and Assembly, Marcel Decker.					
References					
1. Bralla, J.G., (1999), Design for Manufacturability Handbook, McGraw-Hill. 2. A.K. Chitale, R.C. Gupta, (1997), Product Design and Manufacturing., Printice –Hall of India. 3. James G. Bralla, (1999), Hand Book of Product Design for Manufacturing, McGraw Hill Company. 4. Swift K.G., (1999), Knowledge based design for manufacture, Kogan Page Ltd.				
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE433	MECHANICAL VIBRATIONS	2	1	0	3
Prerequisite	MEE301				
Objectives:	1. To know the basics of vibration 2. To study the undamped and damped free vibration 3. To study the forced vibrations 4. To study the multi degrees of freedom system 5. To study the vibration measuring instruments.				
Expected Outcome:	Student will be able to 1. Write differential equation of the given vibration model. 2. Know about damping, natural frequency and resonance. 3. Know about response of the vibrating system 4. Know about multi degrees of freedom systems. 5. Know about vibration measurement.				
Unit I	Fundamentals of Vibration				
Review of Single degree freedom systems - Response to arbitrary periodic executions - Duhamel's integral - Impulse response function - Virtual work - Lagrange's equations - Single degree freedom forced vibration with elastically coupled viscous dampers - System identificaton from frequency response - Transient vibration - Laplace transformation formulation.					
Unit II	Two Degree Freedom System				
Free vibration of spring-coupled system - Mass coupled system - Bending variation of two degree freedom system - Forced vibration - Vibration Absorber - Vibration isolation.					
Unit III	Multi Degree Freedom System				
Normal mode of vibration - Flexiblity matrix and stiffness matrix - Eigen value and Eigen vector – Orthogonal properties - Modal matrix - Modal analysis - Forced vibration by matrix inversion - Modal damping in forced vibration - Numerical methods of fundamental frequencies.					
Unit IV	Vibration of Continuous Systems				
Systems governed by wave equations - Vibration of strings - Vibration of rods - Euler 's equation for beams - Effect of Rotary inertia and shear deformation - Vibration of plates.					
Unit V	Experimental Methods in Vibration Analysis				
Vibration instruments - Vibration exciters Measuring Devices - Analysis - Vibration Tests - Free and Forced Vibration tests. Examples of vibration tests - Industrial case studies.					
Text Books					
S.S. Rao, Mechanical Vibrations, 4th Edition, Pearson Education, 2006					
References					
1. Dukkipati RV, Advanced Mechanical Vibrations, Narosa Publications, 2008 2. Kelly SG, Mechanical Vibrations, Mcgraw hill(India) Ltd., 2007					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE 380	SURFACE ENGINEERING	3	0	0	3
Prerequisite	MEE205				
Objectives:	1. To teach students the basic concepts of surface engineering and its development 2. To provide students the knowledge of coatings and the formation of technological surface layers 3. To enable the students understand the basic principles of Laser Technology and Plasma Coating Technology				
Expected Outcome:	1. Student will be able to 2. Develop and apply various surface modifications technologies 3. Find applications of coating processes in industries				
Unit I	Introduction to surface Engineering				
Differences between surface and bulk, Properties of surfaces-wear, corrosion, optical, roughness, electrical and thermal properties, wetability					
Unit II	Concepts of coating				
Coatings- Concepts of coatings , Electroplating and electroplating -Metallic and non metallic coatings- Galvanizing – Thermal Spray ,types of thermals spary and their advantages and disadvantages - conventional verses nanocoatings –					
Unit III	Plasma Coating Technology				
Process parameters, thermal and kinetic history of inflight particle, microstructural features of plasma sprayed coatings, single splat studies, process-structure property relationship-challenges in prepartion,plasma spraying of nanopowders - its microsturcutre – properties –Liquid precurser plasma spray- applications					
Unit IV	Characterization of coatings				
Coatings –thickness-porosity-hardness, fracture toughness=elastic modulus –adhesion-bending strength-fracture strength- tensile strength- wear and corrosion measurement-phase analysis					
Unit V	Hard and soft coatings				
Caser cladding- laser alloying, Electron beam hardening-ion beam implantation- sol –gel coatings –electrophoretic deposition –DLC and diamond coatings, antifriction and antiscratch coatings					
Text Books	Surface Engineering of Metals, Principles, equipments and Technologies-Tadeusz Burakowski, Padeusg and Weirzxhon,CRC press, 1998 Surface coatings for protection against wear edited by BG Miller, Woodhead publishing,-2006				
1. Surface coatings ASM handbook 2. Characterization Techniques ASM Handbook 3. P. Fauchais, A. Vardelle, and B. Dussoubs, "Quo Vadis Thermal Spraying? "Journal of Thermal Spray Technology, Volume 10(1) March2001 4. H. Herman and S. Sampath "Thermal Spray Coatings" Published in 1996 by Chapman and Hall, London. Edited by Kurt H Sien					
Mode of Evaluation	projects ,Assignment/ ,Seminar/Written Examination				

MEE311	NON-DESTRUCTIVE EVALUATION AND TESTING	3	0	0	3
Prerequisite	MEE203, MEE205				
Objectives:	1. To acquire familiarity with different types of NDT techniques 2. To understand the basic principles underlying each NDT technique 3. To know the advantages and limitations of each technique 4. To understand the considerations for selection of appropriate NDT technique(s) for various applications 5. To become familiar with common types of defects arising in different types of manufactured products and the NDT method(s) best suited to evaluate them				
Expected Outcome:	Student will be able to 1. Develop NDT techniques for various products. 2. Acquire skills needed for selection of appropriate NDT technique(s) for new inspection jobs 3. Acquire sound knowledge of established NDE techniques and basic familiarity of emerging NDE techniques. 4. Make use of standards and codes in the area of NDET				
Unit I	Introduction to NDET and Surface NDT Techniques				
Introduction to non-destructive testing and evaluation, visual examination, liquid penetrant testing and magnetic particle testing. Advantages and limitations of each of these techniques.					
Unit II	Radiographic Testing				
Radiography principle, electromagnetic radiation sources, X-ray films, exposure, penetrameter, radiographic imaging, inspection standards and techniques, neutron radiography. Radiography applications, limitations and safety.					
Unit III	Eddy Current Testing and Ultrasonic Testing				
Eddy current principle, depth of penetration, eddy current response, eddy current instrumentation, probe configuration, applications and limitations. Properties of sound beam, ultrasonic transducers, inspection methods, flaw characterization technique, immersion testing.					
Unit V	Special/Emerging Techniques				
Leak testing, Acoustic Emission testing, Holography, Thermography, Magnetic Resonance Imaging, Magnetic Barkhausen Effect. In-situ metallography.					
Unit VI	Defects in materials / products and Selection of NDET Methods				
Study of defects in castings, weldments, forgings, rolled products etc. and defects arising during service. Selection of NDET methods to evaluate them. Standards and codes.					
Text Books					
1. Baldevraj, Jayakumar T., Thavasimuthu M., (2008) "Practical Non-Destructive Testing", 3rd edition, Narosa Publishers.					
Reference Books					
1. American Society for Metals, "Non-Destructive Evaluation and Quality Control": Metals Hand Book: 1992, Vol. 17, 9th Ed, Metals Park, OH. 2. Paul E Mix, "Introduction to nondestructive testing: a training guide", Wiley, 2nd edition New Jersey, 2005. 3. Ravi Prakash, "Nondestructive Testing Techniques", New Age International Publishers, 1st rev. edition, 2010.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE341	METAL CASTING TECHNOLOGY	3	0	0	3
Prerequisite	MEE205				
Objectives:	1.To understand the basic principles of metal casting 2. To know the various types of melting practices 3. To broaden the understanding of casting design principles 4. To know about casting defects and remedial measures				
Expected Outcome:	Student will be able to 1. Design of gates and risers in castings 2. Develop various alloys for different applications 3. Develop suitable casting techniques for specific applications				
Unit I	Molding practices				
Introduction to casting and foundry industry; basic principles of casting processes; sequence in foundry operations; patterns; molding practice; ingredients of molding sand and core sand, sand testing; different molding processes					
Unit II	Melting furnaces				
Types of furnaces used in foundry; furnaces for melting; melting practice for steel, cast iron, aluminum alloys, copper alloys and magnesium alloys; safety considerations; fluxing, degassing and inoculation.					
Unit III	Special Casting techniques				
Investment casting , Shell molding ,die casting, centrifugal casting, plaster mould casting, magnetic casting, squeeze casting, full mould process, strip casting, CO_2 molding					
Unit IV	Gating and risering				
Concept of solidification, directional solidification, role of chilling, principles of gating and risering systems: types and design calculations.					
Unit V	Foundry Defects				
Defects in castings and its remedies. Energy saving and quality control in foundries.					
Text Books					
Heine R. W., Loper C. R., Rosenthal P. C., Principles of Metal Casting,2nd Edition, Tata McGraw Hill Publishers, 1996.					
References					
1. Wulff B., Taylor H. F., Fleming M. C., Foundry Engineering, Wiley Eastern, 1999, 2. Jain P. L., Principles of Foundry Technology, 3rd Edition, Tata McGraw Hill, 2000 3. Srinivasan N. K., Foundry Technology, Khanna Publications, 2001.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE342	WELDING ENGINEERING	3	0	0	3
Prerequisite	MEE205				
Objectives:	1. To understand the basic principles of welding 2. To know the various types of advanced joining processes 3. To know about welding defects and remedial measures for it				
Expected Outcome:	Student will be able to 1. Develop welding techniques for various alloys 2. Develop welding application concepts 3. Develop mechanized welding techniques 4. Develop welding electrodes				
Unit I	Power sources				
Classification of welding processes - heat sources, power sources, arc characteristics, V-I relationship, different types of electrodes, ingredients and function of electrode coverings, types of weld joints.					
Unit II	Fusion welding processes				
Shielded metal arc welding, gas welding, TIG welding, MIG welding, Submerged arc welding processes					
Unit III	Solid state welding processes				
Resistance, friction, friction stir, ultrasonic, induction pressure, diffusion welding processes, explosive welding .					
Unit IV	Special welding processes				
Electron beam, laser beam welding, plasma arc processes; advantages, limitations, Introduction to Robotic welding, underwater welding.					
Unit V	Welding metallurgy				
Weld thermal cycles and their effects, effects of pre and post weld heat treatments, concept of HAZ, concept of weldability and its assessment. Welding of different materials, defects in welds, their causes and remedies.					
Text Books					
Cornu. J.,(2004)"Advanced Welding Systems"-Volumes I, II and III, JAICO Publishers.					
References					
1. Lancaster L.F, (1996) 'The Physics of Welding', Pergamon Press. 2. Welding Handbook (Section I) American Welding Society1999 3. Parmer R.S, (2005) "Welding processes", Khanna publishers. 4. Srinivasan N.K, (2004) "Welding Engineering", Khanna publishers. 5. Rao P.N – (1998)"Manufacturing Technology (Foundry, Forming and Welding) II Edition", Tata McGraw Hill Pub. Co. Ltd,. New Delhi.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE434	PRODUCTION PLANNING AND CONTROL	2	1	0	3
Prerequisite	MEE308				
Objectives:	1. To get clear idea about various types of production like job, batch and continuous. 2. To find out the sales forecasting, various types of demands and different methods 3. To acquire knowledge in product planning and process planning, value analysis and value engineering and bread even analysis. 4. To learn about various types of controls toward inventory planning. 5. To be familiar in operation scheduling, ie loading, scheduling and routing etc.				
Expected Outcome:	Student will be able to 1. Identify and suggest correct type of production planning technique. 2. Analyse the concepts of production planning and Control and implement in crucial areas of the industry.				
Unit I	PPC performance				
PPC – Requirements, Benefits, Factors influencing PPC performance, 3 types of decisions – 3 Phases of PPC – Aggregate and Disaggregate Planning – Master Production Schedule (MPS) – Techniques & Hour Glass Principle – Bill of Material (BOM) structuring					
Unit II	MRP				
Material Requirements Planning (MRP) System – Inputs, Outputs, Benefits, Technical issues – MRP system nervousness – Manufacturing Resources Planning (MRP II) – Resource Planning - Final assembly scheduling					
Unit III	Capacity management				
Capacity Planning using overall factors (CPOF) – Capacity Bills – Resource Profiles – Capacity requirements planning (CRP) – I/O Control - Shop floor control – Basic concepts, Gantt Chart, Priority sequencing rules and Finite Loading – Inventory models.					
Unit IV	Shop floor control				
Shop floor control – Just in time (JIT) – Key elements, techniques – JIT & PPC – Pull & Push Systems – Kanban system – Types, number of kanban calculations, Design, advantages and disadvantages					
Unit V	ERP System				
ERP systems – Components, Modules, Implementation, advantages and disadvantages - Technical aspects of SAP - Supply Chain Management (SCM) – Components, stages, Decision phases – Supply chain macro processes in a firm					
Text Books					
1. Vollmann, T.E., Berry, W.L., Whybark, D.C., and Jacobs, F.R., (2005), 'Manufacturing Planning and Control for Supply Chain Management' (5th ed.), Irwin.					
Reference Books					
1. Curran, T. and Keller, G.,(2009), 'SAP R/3 Business Blueprint' Prentice-Hall. 2. Sipper, D., Bulfin, R.L., (2007), 'Production Planning, Control, and Integration, McGraw Hill. 3. S.K. Mukhopadhyay (2009), Production planning and control – Text and Cases, PHI Ltd					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE435	LEAN ENTERPRISES AND NEW MANUFACTURING TECHNOLOGY	3	0	0	3
Prerequisite	MEE308				
Objectives:	1. To provide the students an overall view of new methods of manufacturing and operations management. 2. To introduce students to lean manufacturing and principles. 3. To teach students about strategic issues and process mapping. 4. To introduce students to cellular manufacturing and Group Technology.				
Expected Outcome:	Student will be able to 1. Apply lean concepts in an organization. 2. Possess the knowledge of cellular manufacturing. 3. Demonstrate the understanding of Group Technology.				
Unit I	Introduction to Lean manufacturing				
General - Brief history of lean manufacturing – Just in time – Toyota systems – Pioneers of lean manufacturing – Ohno and Shingo – Benefits of lean manufacturing – Theory of constraints – Reduction of wastes					
Unit II	Lean Manufacturing Principles				
Lean manufacturing: - Principles - Basic tools - Techniques - Definition - Assessment tools - Implementing lean manufacturing – Science behind lean manufacturing – Capacity utilization - Variability - Delivery					
Unit III	Strategic Issues				
Strategic issues: - Actions - Issues - Focus - Leadership - Management of teams – Training. Lean accounting: Activity based costing - Product costing - Volume adjusted costing – Focused factory concept – Building strategic advantage through enterprise wide.					
Unit IV	Process Mapping				
Value stream and process mapping: - Overview - Where to use - Step by step approach – How to use – Reduce stream mapping – Present and future states - VSM symbols - Process mapping - Detailed instructions - limits - facilitation					
Unit V	Cellular Manufacturing				
Cellular manufacturing: - Work cell – Cell design - Facility planning – Plant layout – Balancing the work in work cells – Tact time – Defining - Benefits - Uses - Limitations – Facilities planning tools. Group technology coding classification - Productivity Improvement Aids - Kaizen – Kanban - 5S - TPM - Automation - Jidoka – Mistake proofing – Yoko poko Design Root cause analysis - Failure models and effects.					
Text Books					
Taiichi Ohno, (1988), The Toyota Production System (Beyond Large Scale production), Portland, Oregon Productivity Press.					
References					
1. Kigoshi Suzaki, (1988), The New Manufacturing Challenge, Free Press, New York. 2. Shigeo Shing, (1989), Study of Toyota Production System, Portland, Oregon Productivity Press.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE343	METAL FORMING THEORY AND PRACTICE	3	0	0	3
Prerequisite	MEE203, MEE205				
Objectives:	1. To understand the basic principles of Metal Forming Theory 2. To know the various types of forming processes 3. To know about advanced metal forming methods				
Expected Outcome:	Student will be able to 1. Choose forming techniques for various applications 2. Estimate power requirement for forming processes 3. Calculate the forming limit for various processes				
Unit I	Theory of Plasticity				
Theory of Plasticity - stress tensor – hydrostatic & deviator components of stress – flow curve – true stress strain – yielding criteria – yield locus – octahedral shear stress and shear strains – invariants of stress strain – slip line field theory plastic deformations of crystals.					
Unit II	Plastic Forming of Metals-Forging				
Basics of plastic forming & forging- mechanics of metal working – temperature in metal working – strain rate effects – friction and lubrication – deformation zone geometry. Forging process – classification – equipment – calculation of forging loads – forging defects – residual stresses.					
Unit III	Plastic Forming of Metals-Rolling and Extrusion				
Rolling and Extrusion – classification -rolling mills - rolling of bars & shapes – rolling forces – analysis of rolling – defects in rolling- theories of hot & cold rolling – torque power estimation. Extrusion: classification-equipment – deformation lubrication and defects – analysis – hydrostatic extrusion – tube extrusion.					
Unit IV	Plastic Forming of Metals- Drawing and Sheet metal forming				
Drawing & Sheet Metal Forming- rod & wire drawing equipment – analysis – deep drawing – tube drawing – analysis, residual stresses sheet metal forming – methods – shearing and blanking – bending – stretch forming – deep drawing – forming limit criteria – defects - Stretch forming – press brake forming – explosive forming.					
Unit V	Unconventional Forming Methods				
Electro hydraulic forming – magnetic pulse forming – super plastic forming – electro forming – fine blanking – P/M forging-Isothermal forging – HERF.					
Text Books					
George E Dieter, Mechanical Metallurgy, Tata McGraw Hill, 2007					
References					
1. B L Juneja, Fundamentals of Metal Forming Processes, New Age International. 2. John A Schey, Introduction to Manufacturing Process, Allied, ND. 3. ASM, Hand book: Forming and Forging.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE344	MODELING AND SIMULATION OF MANUFACTURING SYSTEMS	3	0	0	3
Prerequisite	MAT104				
Objectives:	1. To introduce modeling, optimization and simulation, as it applies to the study and analysis of manufacturing systems for decision support. 2. To expose students to a wide range of applications for simulation methods and models, and to integrate them with their introduction to operations management.				
Expected Outcome:	Student will be able to 1. Develop the practical skills necessary to design, implement and analyze discrete-event simulation systems; 2. Cover the basic theory underlying discrete-event simulation methodologies, in order to enable a critical understanding of simulation output in managerial environments and build the foundations necessary to quickly adapt to future advances in simulation technology.				
Unit I	Introduction to System Simulation				
Introduction to system simulation – Applications – Discrete and Continuous simulation – Simulation models – Simulation procedure – Simulation Examples – General Principles - Simulation software.					
Unit II	Mathematical and Statistical Models				
Review of basic probability and Statistics – Statistical models in simulation - Selecting input probability distributions					
Unit III	Random Numbers				
Random number generation-Testing of Random numbers – Techniques for generating random numbers- Random Variate Generation – Inverse transform techniques-Acceptance-Rejection techniques- Special properties					
Unit IV	Analysis of Simulation Data				
Input modeling – Data collection – Identifying the distribution with data- Parameter estimation - Goodness of fit tests – Fitting a non-stationery Poisson`s process- Selecting input models without data-Multi Variate and Time Series Input Models- Model Building – Verification, Validation and Calibration of Simulation Models – Output analysis – Comparison and Evaluation of Alternative System designs					
Unit V	Applications				
Simulation of Manufacturing and Material Handling systems – Simulation of Computer Systems – Simulation of Computer Networks					
Text Books					
Jerry banks, John S Carson, Barry L Nelson and David M Nicol, Discrete Event System Simulation, 4th edition, Pearson Education Asia, 2006.					
References					
1. Averill M. Law and W David Kelton, Simulation Modeling and Analysis, 3rd Edition, McGraw Hill, 2000. 2. W David Kelton, Randoll P Sadowski and Debroah A Sasowski, Simulation with ARENA, McGraw Hill, 2002.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE345	GAS DYNAMICS AND JET PROPULSION	2	1	0	3
Prerequisite	MEE204, MEE206				
Objectives:	1. To provide students with an insight into the applications of compressible flows and the fundamentals of jet propulsion system 2. To enable the students formulate and solve problems in one -dimensional steady compressible flow including isentropic nozzle flow, constant area flow with friction (Fanno flow) and constant area flow with heat transfer (Rayliegh flow) 3. To teach students how to derive the conditions for change in pressure, density and temperature for flows through normal and oblique shocks 4. To enhance the knowledge of students in determining the change in flow conditions through Prandtl-Meyer expansion wave and characteristic methods to solve problems in two-dimensional compressible flows				
Expected Outcome:	Student will be able to 1. Demonstrate the knowledge of major elements in a jet engine and calculate the overall performance of a jet engine, given a few critical parameters 2. Apply the concepts of Gas Dynamics for applications related to compressible flows and jet propulsion 3. Possess the knowledge of jet engines and aircraft propulsion theories				
Unit I	Gas Dynamics				
Conservation laws for mass - Momentum and energy in steady flow - Velocity of sound - Bulk modulus of elasticity - Coefficient of Compressibility - Stagnation state - Critical state - Various regions of flow - Physical significance of Mach number - Crocco Number - Characteristic Mach number - Critical Mach number - Mach cone - Von – Karma's rules for supersonic flow - Differences between Incompressible and Compressible flows. Properties of atmosphere - Effect of Mach number on compressibility: T-S and H-S diagrams showing Nozzle and Diffuser process.					
Unit II	Isentropic Flow				
Isentropic flow through a constant area duct – Absence of any of the factors which can trigger a change in fluid flow behavior like area change - Heat transfer - Friction and work transfer – Non variation of properties. Isentropic flow through a variable area duct – Mach number variation - Area ratio as a function of mach number - Impulse function - Mass flow rate through nozzles and diffusers. Phenomenon of choking – subsonic and supersonic designs - Pressure values for nozzles - Diffusers.					
Unit III	Flow through constant area ducts				
Fanno flow - Fanno curves - Equation and its solution - Variation of flow properties with duct length - Applications. Isothermal flow with friction – Variation of flow properties – Applications Rayleigh flow - Rayleigh flow equation - Rayleigh line - Variation of flow properties - Maximum heat transfer – Applications. Non Isothermal flow with heat transfer and friction - Basic formulation – Elementary treatment only					
Unit IV	Normal Shock Gas Dynamics				
Flow with normal shock waves - Governing equations - Prandtl–Meyer equation - Impossibility of rarefaction shock - Mach number down stream of shock - Property variation across shock - Strength of shock wave - entropy change. Characteristics of flow through a C-D nozzle at various back pressures. Normal shocks in Fanno and Rayligh flow.					

Flow with oblique shock waves (Qualitative treatment)		
Unit V	Jet Propulsion	
Air craft propulsion – Types of jet engines - Energy flow through jet engines - Thrust - Thrust power and Propulsive efficiency - Turbojet components - Diffuser compressor - Combustion chamber - Turbines - Exhaust system - Performance of jet engines – Thrust augmentation - Pulse jet and Ram jet engines. Rocket propulsion – Rocket engines - Basic theory of equation - Thrust effective jet velocity - Specific impulse - Rocket engine performance - Solid and Liquid propellant rockets - Comparison of various propulsion systems - Principle and Working of Helicopter.		
Text Books		
S.M.Yahya, (2001), 2nd edition, Fundamentals of compressible flow with Aircraft and Rocket propulsion, Wiley Eastern.		
References		
1. P.H.Oosthaizen, W.E. Carscallen (1999), Compressible Fluid Flow, McGraw-Hill ISE. 2. A.H.Shapiro, (1995), The Dynamics and Thermodynamics of Compressible Fluid flow, Vol I and II, the Ronald Press NY. 3. J.D.Anderson, Jr, (1999), Introduction to Flight, 3rd edition, McGraw-Hill ISE.		
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination	

MEE322	FUELS AND COMBUSTION	3	0	0	3
Prerequisite	MEE204				
Objectives:	1. To give introduction to students about various types of fuels, their composition and properties 2. To provide in depth knowledge of solid, liquid and gaseous fuels 3. To enable the students to understand the thermodynamics of combustion 4. To introduce students to the types of pollution and its control				
Expected Outcome:	Student will be able to 1. Analyze the composition of various types of fuels and their properties 2. Estimate the possible pollution of fossil fuels and its control 3. Demonstrate the knowledge of combustion thermodynamics				
Unit I	Fuel Characteristics				
Fuels – Types and Characteristics of Fuels – Determination of Properties of Fuels - Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination – Calorific Value - Gross and Net Calorific Values - Calorimetry - DuLong's Formula for CV Estimation - Flue gas Analysis - Orsat Apparatus - Fuel and Ash Storage and Handling – Spontaneous Ignition Temperatures.					
Unit II	Solid and Liquid Fuels				
Solid Fuels: Wood and Wood charcoal-Origin of coal-Composition of coal –Analysis and properties of different grades of coal-preparation and storage of coal-coal washing – Briquetting. Liquid coals: Origin of petroleum fuels-Production –Composition-Petroleum refining-Various grades of petro-Products-Properties and testing –Alcohol shale oil-Gasification of liquid fuels –Synthetic fuels -Storage and handling of liquid fuels.					
Unit III	Gaseous Fuels				
Classification - Composition and Properties – Estimation of Calorific Value - Gas Calorimeter. Rich and Lean Gas - Wobbe Index - Natural Gas - Dry and Wet Natural Gas - Stripped NG - Foul and Sweet NG - LPG - LNG - CNG - Methane - Producer Gas - Gasifiers - Water Gas – Town Gas - Coal Gasification – Gasification Efficiency - Non - Thermal Route - Biogas - Digesters - Reactions – Viability - Economics.					
Unit IV	Combustion: Stoichiometry and Kinetics				
Stoichiometry - Mass Basis and Volume Basis – Excess Air Calculation - Fuel and Flue Gas Compositions – Calculations - Rapid Methods - Combustion Processes - Stationary Flame – Surface or Flameless Combustion – Submerged Combustion - Pulsating and Slow Combustion Explosive Combustion. Mechanism of Combustion – Ignition and Ignition Energy - Spontaneous Combustion - Flame Propagation - Solid - Liquid and Gaseous Fuels Combustion - Flame Temperature - Theoretical - Adiabatic and Actual - Ignition Limits – Limits of Inflammability.					
Unit V	Air Pollution				
Types of pollution - Combustion-Generated air pollution - Effects of air pollution - Pollution of fossil fuels and its control - Pollution from automobiles and its control.					
Text Books					
Sharma.S.P., Cahandramohan., (1999), Fuels and combustion., Tata McGraw-Hill.					
References					
1. Civil Davies., (1999), Calculation in furnace Technology, Pergamon Press. 2. Samir sarkar., (2000), Fuels and combustion., Orient longman. 3. Obrert Edward, (2000), I.C Engines and Air pollution, Harper and Row publishers. 4. Blokh AG, (2000), Heat Transfer in Steam Boiler Furnace, Hemisphere Publishing					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE309	INTERNAL COMBUSTION ENGINES	3	0	0	3
Prerequisite	MEE216				
Objectives:	1. To introduce students to the working of spark ignition and compression ignition engines. 2. To teach students about the usage of alternate fuels for IC engines. 3. To enhance the understanding of students in engine emissions, pollution and their control. 4. To introduce students to the recent trends in IC Engines like stratification, multi point injection, plasma ignition etc				
Expected Outcome:	Student will be able to 1. Determine performance and combustion characteristics of SI and CI engines. 2. Identify the usage of alternate fuels and power plants for automobiles. 3. Determine emissions from SI and CI engines. 4. Demonstrate the ability to enhance the efficiency and performance of IC engines.				
Unit I	Spark Ignition Engines				
Spark ignition Engine mixture requirements - Feedback Control Carburetors –Properties of Fuel - Injection systems -Monopoint and Multipoint injection – Gasoline Direct Injection – Ignition Systems-Stages of combustion - Normal and Abnormal combustion-Factors affecting knock - Combustion Chambers.					
Unit II	Compression Ignition Engines				
States of combustion in C.I. Engine - Direct and indirect injection systems – Combustion chambers - Properties of Fuel -Fuel spray behavior - spray structure - spray penetration and evaporation – Air motion - Turbocharging – Cooling and Lubriction Systems.					
Unit III	Engine emissions and their control				
Pollutant - Sources and types - formation of NOx - Hydrocarbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions - Methods of controlling Emissions-Catalytic converters and Particulate Traps-Selective Catalytic Reduction(SCR)-Diesel Oxidation Catalyst(DOC)-Methods of measurements – Emission Norms and Driving cycles.					
Unit IV	Alternate Fuels				
Alcohol - Hydrogen - Natural Gas and Liquefied Petroleum Gas – Biodiesel- Biogas-Properties - Suitability - Engine Modifications - Merits and Demerits as fuels.					
Unit V	Recent trends in IC engines				
LHR Engines-Learn Burn Engines - Stratified charge spark ignition engine – Homogeneous charge compression Ignition - Plasma Ignition – Electric/Hybrid Vehicles-Electronic Engine Management - Fuel cell vehicles.					
Text Books					
R.B.Mathur and R.P.Sharma, (2002), Internal Combustion Engines., Dhanpat Rai & Sons					
References					
1. Colin R.Feriguson, and Allan.T.Kirkpatrik, (2000), I.C.engines Applied Thermosciences 2. Ganesan V., (1999), Internal Combustion Engines, Tata McGraw Hill. 3. John B. Heywood, (2000), Internal Combustion Engine Fundamentals, McGraw Hill. 4. Rowland S.Benson and N.D.Whitehouse, (2000) Internal combustion Engines, Vol. I and II, Pergamon Press. 5. Richard.L.Bechfold, Alternative Fuels Guide Book, SAEInternational Warrendale,1997. 6. “Alcohols as motor fuels progress in technology” - Series No.19 - SAE Publication					

USE - 1980. 7. Heisler Heinz, Advanced Engine Technology, Hodder & Stoughton Ltd	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE346	FLUID POWER SYSTEMS	3	0	0	3
Prerequisite	MEE206				
Objectives:	1. To enable the students understand the basics of hydraulics and pneumatics 2. Improve students' knowledge on hydraulic pumps and various power supply sources 3. To teach students about the utilization of cylinders, accumulators, valves and various control components 4. Introduce students to fluid power maintenance and troubleshooting				
Expected Outcome:	Student will be able to 1. Find the importance of fluid power technology in industries. 2. Obtain knowledge on hydraulic and pneumatic components 3. Get exposure to the basics of fluid flow including the physical laws affecting fluid standards and symbols used in industrial applications 4. Gain knowledge of the various components in fluid power industry and solve problems related to pumps 5. Select and develop hydraulic and pneumatic systems for certain industrial applications 6. Demonstrate the ability to select appropriate controlling devices based on application 7. Get familiarity in fluid power maintenance and understand the importance of it 8. Involve in the troubleshooting of fluid power systems in industry according to the requirement				
Unit I	Introduction to Fluid Power				
Definition- Hydraulics Vs Pneumatics – Standards- Application – Basic Principle of Hydraulics-Pascal's Law-Transmission and multiplication of force-Basic properties of hydraulic fluids- liquid flow- static head pressure-pressure loss – Power-Basic principle of pneumatics: absolute pressure and Temperature- gas laws- vacuum					
Unit II	Hydraulic and Pneumatic Power Supply Source				
Hydraulic Pump- graphic symbol- pump types -pump flow and pressure- pump drive torque and Power- pump efficiency –air compressor- graphic symbol-compressor types-compressor sizing- vacuum pumps					
Unit III	Hydraulic and Pneumatic Control Components				
Cylinders-accumulators –FRL-Directional control Valves- Pressure control valves-Flow control Valves-electronic control components- symbols					
Unit IV	Basic Circuits				
DCV controlling single acting, double acting cylinder-counter balance circuit-Fail safe circuit-AND and OR valve circuit-regenerative circuit-meter in and meter out circuit for extended and retracted stroke-pressure intensifier circuit-accumulator circuits					
Unit V	Fluid Power System Maintenance				
Introduction, Sealing Devices - Reservoir System - Filters and Strainers - Beta Ratio of Filters - Wear of Moving Parts - Gases in Hydraulic Fluids - Temperature Control - Troubleshooting					
Text Books					
Antony Esposito, (1998), Fluid Power System and Control, 6th Edition, Prentice Hall of India.					

References	
1. James L.Johnson, (2003), Introduction to Fluid power, Delmar Thomson Learning Inc. 2. Hydraulic systems Hand book, (1998), Utility Publications Ltd., Secunderabad.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE 405	COMPUTATIONAL FLUID DYNAMICS	2	1	2	4
Prerequisite	MAT205, MEE206 (or) MEE 240, MEE303				
Objectives:	1. To provide the students with sufficient background to understand the mathematical representation of the governing equations of fluid flow and heat transfer. 2. To enable the students to solve one and two-dimensional ordinary and partial differential equations using traditional CFD tools. 3. To teach students how to express derivatives and differential equations through discretization techniques. 4. To help the students to understand the general transformation equations for grid generation. 5. To teach students how to apply explicit, implicit and semi-implicit methods of finite differencing. 6. To help the students solve fluid flow field using some popular CFD techniques.				
Expected Outcome:	Student will be able to 1. Possess the knowledge of CFD techniques, basic aspects of discretization and grid generation. 2. Solve fluid flow fields using CFD methods. 3. Model fluid flow problems and heat transfer.				
Unit I	Introduction and Governing Equations				
Introduction - Impact and applications of CFD in diverse fields - Governing equations of fluid dynamics – Continuity - Momentum and energy - Generic integral form for governing equations - Initial and Boundary conditions - Governing equations for boundry layers - Classification of partial differential equations – Hyperbolic - Parabolic - Elliptic and Mixed types - Applications and relevance.					
Unit II	Discretization				
Basic aspects of discretization - Discretization techniques – Finite difference - Finite volume and Finite Element Method– Comparison of discretization by the three methods - Introduction to Finite differences - Transient one-dimensional and two-dimensional conduction – Explicit - Implicit - Crank-Nicolson - ADI scheme – Stability criterion. Difference equations - Numerical errors - Grid independence test - Optimum step size.					
Unit III	Grid Generation				
Grid generation – General transformation of the equations - Form of the governing equations suitable for CFD – Boundary fitted co-ordinate systems – Elliptic grid generation - Adaptive grids - Modern developments in grid generation.					
Unit IV	Convection – Diffusion				
Steady one-dimensional convection and diffusion - Central difference, upwind, quick, exponential, false diffusion, hybrid and power law schemes. Transient one dimensional heat conduction equation.					
Unit V	Calculation of Flow Field				
Representation of the pressure - Gradient term and continuity equation – Staggered grid - Momentum equations - Pressure and velocity corrections - Pressure Correction equation - Numerical procedure for SIMPLE algorithm - Boundary conditions for the pressure correction method. Stream function – Vorticity method - Discussion of case studies.					
Text Books					
1. K.A. Hoffman, (2000), Computational Fluid Dynamics for Engineering, Vol I - III Engineering Education System, Austin, Texas.					
Reference Books					

1. J.D. Anderson, Jr., (2000), Computational Fluid Dynamics – The basics with applications, McGraw-Hill, Incs. 2. K. Muralidhar, T. Sundarajan, (2001), Computatioanl Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi. 3. S.V. Patankar, (1999), Numerical Heat Transfer and Fluid Flow, Hemisphere, New York. 4. V.V. Ranade, (2002), Computational Flow Modeling for Chemical Reactor Engineering, Academic Press	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE312	REFRIGERATION AND AIR-CONDITIONING	2	1	0	3
Prerequisite	MEE216				
Objectives:	1. To enable the students to understand the principles of refrigeration and air conditioning 2. To teach the students how to calculate the cooling load for different applications of Refrigeration and Air-conditioning 3. To expose the students to cyclic controls and system balancing 4. To teach students the principles of psychrometry 5. To develop the knowledge of students in selecting the right equipment for a particular application of Refrigeration and Air-conditioning				
Expected Outcome:	Student will be able to 1. Possess the knowledge of system components of refrigeration and air conditioning 2. Design and implement refrigeration and air conditioning systems using standards 3. Apply the knowledge of psychrometry in calculating cooling load and heating load calculations				
Unit I	Refrigeration Cycles and Refrigerants				
Vapour compression refrigeration cycles-Air refrigeration cycles-Simple saturated vapour compression refrigeration cycle-P-H charts - Multi stage compression –Multi evaporator system-cascade system-Vapour absorption systems.					
Unit II	System Components				
Refrigeration classification –Designation-Alternate refrigerants –Global warming and Ozone depleting aspects. Refrigerant compressors Reciprocating –Rotary - Condensers - Evaporators - Expansion devices - Cooling towers.					
Unit III	Cycling Controls and System Balancing				
Pressure temperature control range and different settings - Selection and balancing of system components - Graphical method.					
Unit IV	Psychrometry				
Moist air properties - Psychrometric chart - Different Psychrometric process analysis.					
Unit V	Air Conditioning				
Air conditioning systems – classification - Cooling load calculations - different types of loads - GRSHF - ERSHF - Estimation Of total load - Air distribution patterns - Dynamic and frictional losses in air ducts - Equal friction method - Fan characteristics of duct system.					
Text Books					
W. F. Stocker and J. W. Jones, (2002), Refrigeration and Air conditioning, McGraw Hill.					
References					
1. Manohar Prasad, (1998), Refrigeration and Air conditioning, Wiley Eastern Ltd. 2. Arora, C. P., (2007), Refrigeration and Air Conditioning, Tata McGraw-Hill Publishing Company Ltd. 3. S. C. Arora and Dumkundwar, (1996), Refrigeration and Air-Conditioning, Dhanpathrai Publishers.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE416	SOLAR THERMAL POWER ENGINEERING	3	0	0	3
Prerequisite	MEE303				
Objectives:	1. To enable the students understand solar radiation received on the earth and fundamentals of solar thermal engineering. 2. To enable students know about solar thermal devices like cookers, pumps, ponds etc. 3. To introduce students to solar flat plates and solar concentrators. 4. To teach students about solar power generation.				
Expected Outcome:	Student will be able to 1. Estimate solar radiation received on a surface. 2. Predict and analyse the performance of solar devices. 3. Identify and integrate solar thermal devices in various applications.				
Unit I	Solar Radiation				
Sun Earth relationship – Solar radiation components – Measurement – Estimation of radiation at a given place.					
Unit II	Solar Flat Plate Collectors				
Theory of Flat Plate Collectors – Performance Evaluation – Collector Testing – Natural and Forced Circulation – System Configurations – Applications.					
Unit III	Solar Thermal Devices – I				
Solar Air Heaters: Theory and Applications – Solar drying: Theory, design, performance analysis and types – Solar Desalination: Theory and Performance analysis.					
Unit IV	Solar Thermal Devices – II				
Solar Cooking Devices – Solar cooling: Absorption, adsorption and passive systems – Solar Thermal Pumps – Energy Storage – Solar Ponds.					
Unit V	Solar Concentrators and Power Generation				
Solar concentrator types – Optics – Performance analysis – Design considerations – Tracking – Solar Electric Power Generation Systems – Economics of Solar thermal systems & devices.					
Text Books					
1. Y. Goswami, F. Kreith and J. F. Kreider, (2001), Principles of Solar Engineering, Mc Graw Hill. 2. S.P.Sukhatme, Solar Energy, (2004), Tata McGraw Hill, Second Edition.					
References					
1. J. A. Duffie, and W. A. Beckman, (1991), Solar Engineering of Thermal Processes, Wiley-Interscience. 2. J. Gordon, (2001) State of Art Papers on Solar Energy, International Solar Energy Society. 3. ASHRAE Standard 93-77, (1977) Methods of Testing to Determine the Thermal Performance of Solar Collectors, ASHRAE. 4. R. C. Neville, (1995) Solar Energy Conversion, Elsevier.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE348	CRYOGENIC ENGINEERING	2	1	0	3
Prerequisite	MEE216				
Objectives:	1. To introduce students to low temperature engineering and behaviour of materials. 2. To develop students' skills to perform the analysis and design of cryogenic systems and cryovessels. 3. To enable the students study the principles of cryogenic instrumentation. 4. To introduce students to cryogenic applications.				
Expected Outcome:	Student will be able to 1. Possess basic knowledge of cryogenics. 2. Design cryogenic systems and cryovessels. 3. Find applications of cryogenics 4. Demonstrate the knowledge of cryogenic instrumentation				
Unit I	Introduction to Low Temperature Engineering				
Cryogenics – Principles of cryogenics – Methods of production of low temperature – Cryogenic fluids – Superconductivity and its applications – Super fluidity – Low temperature properties of structural materials – Applications of Cryogenics.					
Unit II	Cryogenic Systems				
Liquefaction of gases – Linde Hampson system – Claude system – Heylandt system – Critical components of liquefiers, Gas separation and Purification – Cryocoolers – Stirling Cryocooler – Gifford – McMahon cryocooler – Pulse tube cryocooler – Thermodynamic analysis of above systems – McMahon.					
Unit III	Separation and Purification Systems				
Properties of mixtures – Principles of gas separation, Air, Hydrogen and Helium separation systems – Gas purification methods.					
Unit IV	Storage and Transfer Systems				
Design of cryovessels – Concept of vapour coated shields – Cryogenic insulation – Vacuum, powder, multilayer insulation, Micro-sphere insulation – Transfer lines.					
Unit V	Cryogenic Instrumentation				
Temperature, pressure, flow, level, measurement – Cryostats – Cold electronics.					
Text Books					
Randall F. Barron, (1999), Cryogenic Systems, Oxford University Press, New York.					
References					
Haselden, G.G. (1999), Cryogenic Fundamentals, Academic Press Inc., London					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE420	NUCLEAR POWER ENGINEERING	3	0	0	3
Prerequisite	-				
Objectives:	The student will be exposed to the basic physics of nuclear reactions, operation of nuclear reactors, its types, power generation methods, safety and environmental aspects.				
Expected Outcome:	Student will be able to 1. Know the nuclear fission and fusion processes 2. Understand the working of a nuclear reactors 3. Understand power generation and safety aspects				
Unit I	Nuclear Reactors				
Mechanism of nuclear fission – Nuclides - Radioactivity – Decay chains - Neutron reactions - Fission process – Reactors - Types of reactors – Design and construction of nuclear reactors - Heat transfer techniques in nuclear reactors - Reactor shielding					
Unit II	Reactor Materials				
Nuclear fuel cycles – Characteristics of nuclear fuels – Uranium – Production and purification of uranium – Conversion to UF4 and UF6 – Other fuels like Zirconium, Thorium, Berylium					
Unit III	Reprocessing				
Nuclear fuel cycles - Spent fuel characteristics - Role of solvent extraction in reprocessing - Solvent extraction equipment					
Unit IV	Separation of Reactor Products				
Processes to be considered - Fuel element dissolution - Precipitation process – Ion exchange - Redox - Purex - TTA – Chelation -U235 -Hexone - TBP and Thorax processes - Oxidative slagging and electro-refining - Isotopes – Principles of isotope separation					
Unit V	Waste Disposal and Radiation Protection				
Types of nuclear wastes – Safety control and pollution control and abatement - International convention on safety aspects – Radiation hazards prevention					
Text Books					
1. S. Glasstone and A. Sesonske (1981), Nuclear Reactor Engineering, 3rd Edition, Von Nostrand. 2. M.M. El-Wakil (1962), Nuclear Power Engineering, McGraw-Hill.					
References					
1. J.R. Lamarsh (1966), Introduction to Nuclear Reactor Theory, Wesley. 2. J.J. Duderstadt and L.J. Hamiition (1976), Nuclear Reactor Analysis, John Wiley 3. A.E. Walter and A.B. Reynolds (1981), Fast Breeder Reactor, Pergamon Press. 4. R.H.S. Winterton (1981), Thermal Design of Nuclear Reactors, Pergamon Press. 5. M.M. El-Wakil (1971), Nuclear Energy Conversion, Intext Educational Publish.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE428	AUTOMOBILE ENGINEERING	3	0	0	3
Prerequisite	MEE301, MEE302				
Objectives:	1. To broaden the understanding of students in the structure of vehicle chassis and engines. 2. To introduce students to steering, suspension, braking and transmission systems. 3. To introduce students to engine auxiliary systems like heating, ventilation and air-conditioning. 4. To teach students about the importance of alternate fuels and modifying the engine suitably.				
Expected Outcome:	Student will be able to 1. Develop chassis and identify suitable engine for different applications 2. Formulate steering, braking and suspension systems 3. Select a suitable conventional and automatic transmission system 4. Identify the usage of Electrical vehicles / Hybrid vehicles and power plants				
Unit I	Introduction to Vehicle Structure and Engine components				
Vehicle construction - Chassis and body - Specifications - Engine - Types - Construction - Location of engine - Cylinder arrangement - Construction details - Cylinder block - Cylinder head - Cylinder liners - Piston – piston rings - Piston pin - Connecting rod - Crankshaft - Valves. Lubrication system - Types - Oil pumps - Filters - Cooling system - Types - Water pumps - Radiators - Thermostats - Anti-freezing compounds.					
Unit II	Ignition, Fuel Supply and Emission Control System				
Ignition system - Coil and Magneto - Spark plug - Distributor – Electronic ignition system - Fuel system - Carburetor - Fuel pumps - Fuel injection systems - Mono point and Multi point – Unit injector – Nozzle types - Electronic Fuel Injection system (EFI) – GDI, MPFI, DTSI-Automobile Emissions - Source of formation – Effects on human health and environment - Control techniques - Exhaust Gas Recirculation (EGR) - Catalytic converter - Emission tests and standards (Indian and Europe)					
Unit III	Transmission System				
Clutches - Function - Types - Single plate, Multiple plate and Diaphragm Clutch - Fluid coupling - Gearbox - Manual - Sliding - Constant - Synchromesh - Overdrive - Automatic transmission - Torque converter - Epicylic and Hydromatic transmission - Continuously variable transmission - Universal joint - Propeller shaft - Hotchkiss drive – Final drive - Rear axle assembly - Types -Differential - Need - Construction – Non-slip differential – Differential locks - Four wheel drive.					
Unit IV	Steering, Suspension and Braking System				
Principle of steering - Steering Geometry and wheel alignment - Steering linkages – Steering gearboxes - Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers - Wheels and Tires - Construction - Type and specification - Tire wear and causes - Brakes - Needs – Classification –Drum and Disc Mechanical - Hydraulic and pneumatic - Vacuum assist – Retarders – Anti-lock Braking System(ABS)					
Unit V	Automobile Electrical systems, Instrumentation and Advances in Automobile Engineering				

Battery-General electrical circuits-Dash board instrumentation - Passenger comfort - Safety and security - HVAC - Seat belts - Air bags - Automotive Electronics - Electronic Control Unit (ECU) - Variable Valve Timing (VVT) - Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program(ESP) Traction Control System (TCS) - Global Positioning System (GPS) - X-by-wire - Electric - Hybrid vehicle.	
Text Books	
1. William.H.Crouse, (2006), Automotive Mechanics, 10th Edition, McGraw-Hill.	
Reference Books	
1. David A. Corolla, (2009), Automotive Engineering: Powertrain, Chassis System and Vehicle Body, Butterworth-Heinemann Publishing Ltd. 2. Richard Stone, Jeffrey K. Ball, (2004), Automotive Engineering Fundamentals" SAE International 3. Bosch Automotive Hand Book, (2007), 6th Edition, SAE Publications. 4. K. Newton and W. Steeds, The motor vehicle, 13th Edition, Butterworth-Heinemann Publishing Ltd. 5. Kirpal Singh, Automobile Engineering, Vol.1&2, Standard Publications.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE347	ADVANCED MACHINING PROCESSES	2	1	0	3
Prerequisite	MEE217				
Objectives:	1. To teach the principles of material removal mechanism of advanced machining processes such as mechanical, electro-chemical and thermal. 2. 2. 2. To provide in depth knowledge in selection of advanced machining process to fabricate intricate and complex shapes in difficult to machine material. 3. To provide awareness of advanced finishing processes to achieve submicron/nano surface finish.				
Expected Outcome:	Student will be able to 1. Identify and suggest the suitable manufacturing process for advanced materials and critical finishing. 2. Deal with sophisticated and advanced equipment such as IBM, EBM, PAM etc.,				
Unit I	Mechanical Advanced Machining Processes				
Need and classification of nontraditional machining processes – Material removal in traditional and nontraditional machining processes - considerations in process selection. Ultrasonic machining – Working principle, mechanism of metal removal – Theory of Shaw, elements of the processes, tool feed mechanism, effect of parameters, applications and numerical. Abrasive jet machining, Water jet machining and abrasive water jet machine - Basic principles, equipments, process variables, mechanics of metal removal, MRR, application and limitations.					
Unit II	Electro – Chemical Processes				
Principle of ECM process, chemistry of the ECM processes, Parameters of the process, determination of the metal removal rate, dynamics of ECM process, polarization, tool design, advantages and disadvantages, application, electrochemical grinding, electrochemical honing, electrochemical deburring, Application of ECM for deep hole drilling - electrostream drilling and shaped tube electrolytic machining. Chemical machining - Fundamental principle, types of chemical machining, maskants, etchants, advantages, disadvantages, applications					
Unit III	Electric Discharge Machining				
Working principle of EDM, Power circuits for EDM - RC pulse generator and controlled pulse generator– Analysis of R-C Circuits – Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy, characteristics of spark eroded surface and recent development in EDM. Wire EDM – Working principle, process variables, process characteristics and applications. Electric discharge grinding and electric discharge diamond grinding - working principle, process capabilities and applications.					
Unit IV	Laser, Electron Beam, Ion Beam and Plasma Arc Machining				
General working principle of laser beam machining – Generation of Laser, types of Lasers, process characteristics and applications. Electron Beam Machining - Equipment for production of Electron Beam, theory of EBM, thermal and non-thermal type, process characteristics and applications. Ion Beam Machining - Mechanism of metal removal and associated equipments, process					

characteristics and applications. Plasma Arc Machining - Metal removal mechanism, process parameters, process characteristics, types of torches, applications.		
Unit V	Advanced Finishing Processes	
Abrasive flow Machining (AFM) - working principle, AFM system, process variables, process performance and applications. Magnetic abrasive finishing (MAF) - working principle, MAF system, material removal and surface finish, process variables and applications. Chemomechanical polishing, working principle, material removal and surface finish and applications.		
Text Books		
V.K. Jain, Advanced Machining Processes, Allied Publishers Pvt. Ltd. 2002		
References		
1. H. El-Hofy, Advanced Machining Processes, McGraw-Hill, New York, 2005. 2. G.F. Benedict, Nontraditional Machining Processes, Marcel Dekker Inc., New York, 1987. 3. J.A. McGeough, Advanced Machining Methods, Chapman and Hakk, London, 1988. 4. M. Adithan, Modern Machining Methods, Khanna Publishers, New Delhi, 2008. 5. P.K. Mishra, Nonconventional Machining, The Institution of Engineers (India) Text Book Series, Narosa Publishing House, New Delhi, 1997. 6. P.C. Pandy and H.S. Shan, Modern Machining Processes, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1980.		
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination	

MEE244	INDUSTRIAL AUTOMATION CONTROLLERS	**2**	**1**	**2**	**4**
Prerequisite	EEE101				
Objectives:	1. To introduce hardware of programmable logic and automation controllers (PLC/PAC). 2. To enable the students to program PLC with timers, counters and data manipulation. 3. To initiate the design and development of a PLC control systems.				
Expected Outcome:	1. Student will be able to 2. Identify the applications of PLC's to industrial processes. 3. Design PLC programs to solve industrial control problems. 4. Interface Programmable Logic Controller with field devices. 5. Install and troubleshoot PLC.				
Unit I	Programmable Controllers in Automation				
Automation - Programmable Controllers – Microprocessor controlled System - Microcontroller controlled System – Programmable Logic Controllers – Programmable Automation Controllers.					
Unit II	Programmable Logic Controllers Hardware				
Basic architecture - I/O Modules - Programming Devices - Field devices - Program scan - Modes of operation - PLC Enclosures – Grounding - Monitoring –Maintenance.					
Unit III	PLC Ladder Logic Programming				
Programming methods - Basic Instructions – Instruction Addressing – Branch instructions – Latches, Timers and counters - Math Instructions – Master control instructions – Subroutines - Data transfer and compare instructions – Data Manipulation Programs – PID control functions.					
Unit IV	Human/Man Machine Interface (HMI/MMI)				
User interfaces in automation – Human- Machine Interfaces- Types- HMI design - interfacing HMI and MMI with PLC – design cases.					
Unit V	PLC Control Case Studies				
Supervisory and distributed control systems – Temperature Control - Valve Sequencing – Robot control - Conveyor belt control- Control of a Process - Demonstration of PLC control system design.					
Text Books					
John W. Webb, (2005), Programmable Logic Controllers: Principals and Applications, Fifth Edition. Prentice Hall of India.					
References					
1. W. Bolton, Programmable Logic Controllers, Third Edition, Newnes. 2. Stenerson, (2005), Fundamentals of Programmable Logic Controllers, Sensors and Communication, Third Edition, Pearson Education. 3. John R. Hackworth, (2003), Programmable Logical Controllers, Pearson Education.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE244 L	INDUSTRIAL AUTOMATION CONTROLLERS LABORATORY
Objectives:	1. To introduce logic and sequential design principles for automation. 2. To design and develope of PLC controlled systems. 3. To be trained in automation sofwares.
Expected Outcome:	1. Student will be able to 2. apply the fundamental principles of programmable controllers to the solution of practical problems in industrial automation. 3. demonstrate a fundamental knowledge of field devices and associated control with PLCs. 4. interface appropriate field devices and programming controller in automating the systems.

Experiments:

1. Ladder logic programming for simple control applications with logic, timers, counters, data manipulation and math instructions.
2. Interfacing input and output field devices with PLC systems.
3. Interfacing HMI and MMI devices with PLC.
4. PLC based analog and digital control of electrical actuators.
5. PLC control of electro-pneumatic and electro-hydraulic systems.
6. PLC control of modular automation systems.
7. Design and analysis of PLC control systems with Automation Studio software.
8. Study and demonstration of SCADA and PAC systems.

References: Laboratory manual prepared by VIT Faculty

Mode of Evaluation: Laboratory Report / / Mini-Project / Practical Examination

MEE401	TOTAL QUALITY MANAGEMENT AND RELIABILITY	3	0	0	3
Prerequisite	MEE308				
Objectives:	1. To enable the students understand the principles of Quality Management 2. To provide students details of quality planning and TQM techniques 3. To provide in depth knowledge of reliability and maintainability				
Expected Outcome:	Student will be able to 1. Implement TQM in industries 2. Possess the knowledge of quality planning and TQM techniques 3. Design systems with reliability and maintainability				
Unit I	Principle of Quality Management				
Definition of quality – Deming, Miller – Crosby Theories – Service and Product quality – Customer orientation. Evaluation of Total quality Management – Inspection – Quality Control – TQM System – Human component, Introduction to Six Sigma concepts.					
Unit II	Quality Planning				
Planning – SMART Goal setting – Designing for Quality – Manufacturing for Quality – Process control – CPK – Process capability. Scientific Approach to TQM – Data based approach – Quantification – Statistical tools – Quality control tools – New 7 tools, Sampling and Control Charts.					
Unit III	TQM Techniques				
Benchmarking – Definition – Types – Steps – Metrics – Case studies – Quality Function Deployment – Definition – steps – Case studies – Corrective Techniques – Preventive techniques – Failure Mode and Effect Analysis – 5S. Continuous Improvement Techniques – Different techniques such as POKA YOKE etc. – Deming wheel – Case studies					
Unit IV	Reliability				
Definition – Mean fracture rate – Mean time to failure – Mean time between failure – Hazard rate – Hazard models – Constant hazard – Linearly increasing hazard – Weibull model – System reliability – Series – Parallel and Mixed configuration – Simple problems					
Unit V	Maintainability				
Reliability improvement – Redundancy – Element – Unit and stand by redundancy – Reliability allocation for a series system – Maintainability and availability – System downtime – Reliability and Maintainability trade off – Simple problems					
Text Books					
1. Dale H Besterfield, (2008), Total Quality Management, Pearson Education 2. L.S. Srinath, (2005) Reliability Engineering, Affiliated East West Press, New Delhi.					
Reference Books					
1. Samuel K Ho, (1996), TQM – An Integrated Approach, II Edition, Kogan Page Ltd., USA. 2. Joel E. Rose, (1993), Total Quality Management, II Edition, Kogan Page Ltd., USA.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE349	NEW VENTURE PLANNING AND MANAGEMENT	2	1	0	3
Prerequisite	-				
Objectives:	1. To enable the students have an overall view of new venture initiation 2. To provide students with intricacies of new venture management 3. To teach students about details of financing how to get governmental assistance 4. To introduce students to the legal aspects of business				
Expected Outcome:	Student will be able to 1. Possess detailed knowledge of starting a new venture 2. Plan to start a new venture				
Unit I	Business Concepts				
Entrepreneurship – Meaning – Types – Qualities of an Entrepreneur, Factors influencing Entrepreneurship. Entrepreneurship as a career. Business Concept – Statement of concept of business – Who is the potential customer – Concept development —Where the money is – Appropriate trend analysis (trend identification) – Micro\ Macro level factors - Social - political - environmental - demographic - international factors – Tap customer's hidden requirements – Competitor effect .					
Unit II	Business Plan				
Contents of Business plan- Introduction, Project details, Project projections Characteristics of project- General and Technical, Project cost, Production cost, Financial details, Break even Analysis, Profitability. Sample plan. Sales and marketing- Market Survey, market research, Marketing approach, channels of distribution. Pricing for profitability.					
Unit III	Financing				
Financing your business – Estimating your financial requirements – Pre-operative expenses - Fixed - Working capital - Sources of fund – Promoter's capital - Debt Equity ratio – Margin Money - Venture Capital – Shares and related issues – Governmental organization – Marketing expenses - Office expenses – Cash flow statement – Break even – Profit planning – Project preparation.					
Unit IV	Legal aspects of business				
Legal aspects of business: - Relating to Registration, labour – Licenses – clearances. Intellectual property rights - Advertising issues – Business insurance. Employee welfare measures – PF - ESI - Medical compensation - Risk coverage – Accounting practices – Income Tax – VAT – TDS.					
Unit V	Governmental Assistance				
Governmental Assistance – Local – DIC –Government subsidies Grants and schemes for entrepreneurship development, Entrepreneurial Development Agencies. Environmental aspects and Safety.					
Text Books					
1. Hand Book for New Entrepreneurs, (2008), P.C Jain Entrepreneurship Institute of India, Ahemedabad, India					
Reference Books					
1. Harold. P. Welsch, (2003) The Entrepreneurship: The way ahead. 2. David. F. Summen, (2000), Forming Entrepreneurial Institution. 3. Sramana Mitra (2008) Entrepreneur Journeys.					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE350	FACILITIES AND PROCESS PLANNING	2	1	0	3
Prerequisite	MEE308				
Objectives:	1. To teach students about factors affecting plant location, site selection and space requirements. 2. To introduce students to the types of layouts, processes, tools and techniques for developing layouts. 3. To enable the students program the procedure of heuristics like CORELAP, ALDAP, CRAFT and Facility design. 4. To teach students the types of material handling system, unit load concept and the relationship between material handling and plant layout.				
Expected Outcome:	Student will be able to 1. Demonstrate the knowledge of facilities planning, layout capacity, serviceability, flexibility, labour requirements and selection. 2. Possess the knowledge of various types of layout, tools and techniques for developing a layout. 3. Understand the principles and objectives of mechanization, material handling system design, AGVS in material handling. 4. Analyze the evaluation and implementation of layouts.				
Unit I	Plant Location				
Basic Factors to be considered – Plant location and site selection – Facilities Design Procedure – Plant capacity – Serviceability and flexibility – Selection of Equipment – Factors affecting & Analysis – Space requirement – Labour Requirement and selection.					
Unit II	Layout Planning				
Layout – Types, Factors influencing, design procedure, Tools and Techniques for developing - Developing and Analysis of plant Layout – Presenting the Layout – Office Layout - Plot planning - Evaluation and Improvement of Layout – Efficiency Indices – Cost Evaluation of Layout – Implementation process					
Unit III	Computer Aided Plant Layout				
Data requirements – Mathematical programming – Heuristics – CORE LAP - PLANET - MAT - CRAFT- Probabilistic Approach - Random selection (ALDEP) - Biased sampling – Simulation, Graph Theory–Scale effect–Criticism of Computer Aided Plant Layout.					
Unit IV	Material Handling				
Objectives – Principles – Types – Degree of mechanization – Unit load concept – Material Handling cost – Relationship between Material Handling and Plant Layout – Material Handling system Design - Specification of the Design – Analyzing an existing material Handling system - Basics of material handling equipment selection – AGVS in material Handling – Packaging.					
Unit V	Case Studies				
Case studies in Plant Layout design, Equipment Selection, Plot plan and Office layout					
Text Books					
1. James M. Apple , (2007), Plant Layout and Material Handling, The Ronald press Co.					
Reference Books					
1. Dileep R. Sule , (2009), Manufacturing Facilities, PWS Publishing Company 2. John R. Immer, (2008), Layout planning Techniques, McGraw-Hill Book Company. 3. Richard L Francis (2009), Facility layout and Location, PHI Limited					
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination				

MEE351	RAPID MANUFACTURING TECHNOLOGIES	3	0	0	3
Prerequisite	MEE205				
Objectives:	1. To introduce students the basics of rapid prototyping/manufacturing technologies and systems and its applications in various fields, reverse engineering techniques, CAD modeling techniques such as surface and solid models, and their use in rapid prototyping applications. 2. To familiarize students how commercial rapid prototyping systems use these models to perform activities such as part building, materials used etc. 3. To teach students about mechanical properties and geometric issues relating to specific rapid prototyping applications.				
Expected Outcome:	1.Demonstrate the knowledge of Rapid Prototyping/Manufacturing technologies. 2. Get exposed to commercial Rapid Prototyping systems. 3. Possess the knowledge of Rapid Prototyping software. 4. Model and manufacture RP components.				
Unit I	Introduction				
Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping on Product Development –Digital prototyping - Virtual prototyping- Rapid Tooling - Benefits-Applications.					
Unit II	Reverse Engineering and CAD Modeling				
Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.					
Unit III	Liquid Based and Solid Based Rapid Prototyping Systems				
Stereolithography (SLA): Apparatus: Principle, per-build process, part-building, post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. laminated object manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.					
Unit IV	Powder Based Rapid Prototyping Systems				
Selective Laser Sintering(SLS): Principle, process, Indirect and direct SLS- powder structures, modeling of SLS, materials, post processing, post curing, surface deviation and accuracy, Applications. Three dimensional printing - types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies.					
Unit V	Rapid Tooling				
Direct tooling methods -Direct tooling using stereo lithography - SLS Rapid Steel - Copper Polyamide Tooling - Direct Metal Laser Sintering - Laminated Tooling - Laser Engineered Net Shaping (LENS) - Controlled Metal Build-up (CMB) – Prometal, Shape deposition manufacturing, Selective Laser melting, Electron beam melting.Indirect Tooling methods - RTV Silicone Rubber Molds – Epoxy tooling - Vacuum Casting – RIM - Wax Injection Molding - Spin Casting - Cast Resin Tooling - Spray Metal Tooling - Sprayed Steel Rapid Solidification Process - Plaster Molds -Electroforming - Cast Aluminum and Zinc Kirksite					

Tooling - Investment Cast Tooling	
Text Books	
1. Noorani, R. (2006), Rapid Prototyping: Principles and Applications, John Wiley & Sons, Inc., New Jersey. 2. Ali K. Kamrani, Emad Abouel Nasr, (2006), Rapid Prototyping: Theory and Practice, Springer.	
Reference Books	
1. Hopkinson, N., Hague, R.J.M. and Dickens, P.M., Rapid Manufacturing and Industrial Revolution for the Digital Age, John Wiley and Sons Ltd, Chichester, 2005 2. Gibson, I., Software Solutions for Rapid Prototyping, Professional Engineering Publication Ltd., 2002. 3. Patri, K. V., and Weiyin, Ma, Rapid Prototyping - Laser-based and Other Technologies, Kluwer Academic Publishers, U.S.A., 2003. 4. Chua, C.K., Leong, K.F., Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley and Sons Inc., 2000.	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE389	MICRO AND NANO MACHINING	3	0	0	3
Pre requisite	MEE247 / MEE217				
Objectives	1. To teach students fundamental as well as advanced knowledge of Micro Nano machining technology 2. To teach students the basic principles and mechanism of Traditional Micro Nano machining and its applications 3. To teach students the basic principles and applications of Advanced Micro Nano Machining 4. To teach students the basic principles and applications of different Abrasive based Micro Nano Machining 5. To teach students fundaments of MEMS and its techniques .				
Expected Outcomes	Student will be able to 1. Understand the basic need of Micro Nano Machining in different industries 2. Demonstrate and understand the Traditional Micro Nano machining techniques 3. Demonstrate and Understand different mechanisms in Advanced Micro Nano maching 4. Understand the importance of Abrasives in Micro Nano Machining 5. Understand the need of MEMS in Micro Nano Machining 6. To develop and exploit µ-/Nano machining capabilities in order to diversify and improve manufacturing technology in the region.				
Unit I	Introduction to Micro Nano Machining				
Need-evolution- fundamentals and trends in micro and nano technologies-Consequences of the technology and society-challenges to manufacturing technology-evolution of precision in manufacturing, tooling and current scenario- Micro Nano materials, fabrication tools, requirements and applications					
Unit II	Traditional Micro Nano machining				
Theory of micromachining – Chip formation – Size effect in micromachining – microturning-micromilling, microdrilling - Micromachining tool design – Precision Grinding – Partial ductile mode grinding – Ultraprecision grinding					
Unit III	Advanced Micro Nano machining				
Introduction-Classification- Mechanical Micromachining (AJM, USM)- Thermal Micromachining (EDM, LBM, EBM)-Electrochemical and Chemical Micromachining, Ion Beam Machining, Photochemical Etching					
Unit IV	Abrasive based Micro Nano machining				
Abrasive Flow Finishing (AFF), Magnetic Abrasive Finishing (MAF), Magnetorheological Finishing, Magnetorheological Abrasive Flow Finishing, Elastic Emission Machining (EEM) and Magnetic Float Polishing					
Unit V	MEMS				
Introduction to MEMS, Definitions and classifications-History-applications-MEMS Market-Bulk Micromachining- Wet and Dry Etching-Surface Micromachining-Chemical-Vapor Deposition-Lithography-Wafer Bonding					
Text Books					
V.K.Jain, Introduction to Micromachining, Narosa publishing House, New Delhi					

References	
1. J. Paulo Davim, Mark J. Jackson (2009) Nano and Micromachining, John Wiley & Sons 2. V. K. Jain (2012), Micromanufacturing Processes, CRC Press 3. Mohamed Gad-el-Hak (2010) MEMS Introduction and Fundamentals, CRC Press	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE241	AUTOMOTIVE ELECTRONIC AND INSTRUMENTATION SYSTEMS	LTPC	3	0	0	3
Prerequisite	-					
Objectives:	To understand the use of electronics in the automobile To appreciate the various electronic and the instrumentation systems used in automobile					
Expected Outcome:	On completion of this course, the students will be able to Tell the functions of the electronic components and the way they work.					
Unit 1	Introduction to microcomputer					
Microcomputer: Buses, memory, timing, CPU registers; Microprocessor architecture: Initialization, operation codes, program counter, branch and jump instructions, subroutine. Analog to digital converters and Digital to analog converters, sampling, polling and interrupts, digital filters, lookup table.						
Unit 2	Sensors and actuators					
Speed sensors, Pressure sensors: Manifold Absolute Pressure sensor, knock sensor, Temperature sensors: Coolant and Exhaust gas temperature, Exhaust Oxygen level sensor, Position sensors: Throttle position sensor, accelerator pedal position sensor and crankshaft position sensor, Air mass flow sensor. Solenoids, stepper motors and relays						
Unit 3	Electronic engine management system					
Electronic engine control: Input, output and control strategies, electronic fuel control system, fuel control modes: open loop and closed loop control at various modes, EGR control, Electronic ignition systems – Spark advance correction schemes, fuel injection timing control.						
Unit 4	Electronic vehicle management system					
Cruise control system, Antilock braking system, electronic suspension system, electronic steering control, traction control system, Transmission control, Safety: Airbags, collision avoiding system, low tire pressure warning system						
Unit 5	Automotive instrumentation system					
Input and output signal conversion, multiplexing, fuel quantity measurement, coolant temperature and oil pressure measurement, display devices- LED, LCD, VFD and CRT, Onboard diagnostics(OBD), OBD-II, off board diagnostics						
Text Books						
1. Understanding Automotive Electronics, William B Ribbens, Newne Butterworth-Heinermann, 6th edition 2003.						
References						
1. Bechhold “Understanding Automotive Electronics”, SAE, 1998. 2. Robert Bosch “Automotive Hand Book”, SAE (5th Edition), 2000. 3. Tom Denton,”Automobile Electrical and Electronic Systems” 3rd edition- Edward Arnold, London - 2004. 4. Eric Chowanietz - ‘Automotive Electronics’ - SAE International USA – 1995						
Mode of Evaluation	Quiz/ Seminar/ Class test					

MEE333	HYDROGEN AND FUEL CELLS	3	0	0	3
Prerequisite	MEE204				
Objectives:	1. To provide thorough understanding of performance characteristics of fuel cell power plant and its components 2. Outline the performance and design characteristics and operating issues for various Fuel cells. 3. Discuss the design philosophy and challenges to make this power plant economically feasible 4. At the end of the course, the students will have sufficient knowledge for working in a fuel cell industry or R&D organization				
Expected Outcome:	The student will be able to 1. Understand the various methods of hydrogen generation and storage. 2. Apply knowledge of thermodynamics, electrochemistry, heat transfer, and fluid Mechanics principles to design and analysis of this emerging technology. 3.Have thorough understanding of performance behavior, operational issues and challenges for all major types of fuel cells. 4. Understand the impact of this technology in a global and societal context. 5. Begin a career as an engineer in an organization developing fuel cell components and systems.				
Unit 1	Hydrogen production technologies				
Hydrogen as a future energy carrier, Properties, Chemical production of hydrogen, steam reforming of methanol, natural gas, coal gas etc, shift conversion and thermal decomposition, purification (removal of CO and CO2), desulphurisation, Electrolytic hydrogen production, Electrolyser Configurations					
Unit 2	Hydrogen storage technologies: Basic principles				
Compressed gas storage, Cryogenic liquid storage, Solid state Storage, Adsorption in compounds and metal hydrides, hydride heat pumps and compressors					
Unit 3	Overview and fundamentals				
Fundamentals of electrochemical energy conversion, Basic operation principles and Overview. Advantages and applications, Fuel cell thermodynamics; open circuit voltage; efficiency. Heat released, reasons for losses in voltage, Electrode kinetics, porous electrodes, characteristics, fabrication of electrodes, assembly of fuel cells, testing, Classification of fuel cells based on nature of electrolyte, operating temperature etc					
Unit 4	Characteristics and status of various types of fuel cells				
Alkaline Fuel cells (AFC), Phosphoric Acid Fuel cells (PAFC), Polymer Electrolyte Membrane Fuel cells (PEMFC), Direct Methanol Fuel cells (DMFC), Molten Carbonate Fuel cells(DMFC), Solid Oxide Fuel cells (SOFC), Regenerative Fuel Cells (RFC), Specific characteristics, advantages and applications.					
Unit 5	Fuel cell power plants and applications				
Fuel cell plants and sub systems, efficiency of systems, performance; emissions, Heat balance, Environmental benefits. Heat rate of various Fuel Cell plants, Direct Fuel cells, Natural gas and coal based Fuel cell power plant concepts, Cogeneration and CHP, Fuel cell Hybrids, Fuel cell systems for portable, automotive, stationary applications, Future challenges					
Textbook					
1. B.Viswanathan and Aulice Scibioh, (2006), Fuel Cells Principles and Applications, Universities Press, Hyderabad. 2. J. Larminie & A. Dicks, (2003), Fuel Cell Systems Explained, Wiley, ISBN#0-471-49026-1					
References					
1. Fuel Cell Handbook-7th Edition, US Department of Energy, (2004).					

2. M. M. Mench, (2008) Fuel Cell Engines, Wiley, (ISBN: 978-0-471-68958-4) 3. X. Li, (2005) Principles of Fuel Cells, Taylor & Francis. 4. Gregor Hoogers, (2003), Fuel Cell Technology Handbook (FCTH), CRC Press, Current Edition. ISBN # 0-8493-0877-1 5. N. Sammes, (2006),Fuel Cell Technology - Reaching Towards Commercialization by ISBN-10: 1852339748-Springer 6. S. Srinivasan, (2006), Fuel Cells: From Fundamentals and Applications, Springer.	
Mode of Evaluation	Written Examination, Assignment and Seminar

MEE410	PETROLEUM TECHNOLOGY	3	0	0	3
Prerequisite	-				
Objectives:	The objective of the course is to impart the knowledge about the crude oils and atmospheric distillation products, vaccum distillation products and properties of petroleum products.				
Expected Outcome:	At the end of this course students would have been introduced to various unit operations processes of the petroleum industry.				
Unit 1	General Characterization				
Classification of Crude Oil – Atmospheric Pressure Distillation Products – Distillation Practice.					
Unit 2	Refining				
Refining by Physical and Chemical Methods. Process for Kerosene, AIR, Diesel and Heating Oil, Hydrodesulphurization.					
Unit 3	Cracking				
Catalytic and Thermal Cracking Process Details and Product Pattern – Catalytic Reforming of Naphtha and its Products.					
Unit 4	Gasoline Production				
Enhancement of Gasoline Production – Alkylation – Polymer Gasoline – Isomerisation.					
Unit 5	By Product Recovery				
Vaccum Distillation of Residue – Production of Lube Oil Stock – Wax and Asphalt.					
References					
1. Petroleum Refinery Engineering, Nelson, Mc. Graw Hill. 2. Modern Petroleum Technology, GD Hobson and W. Rohl Applied Science, 1994					
Mode of Evaluation	Written Examination, Assignment and Seminar				

MEE364	AUTOMOTIVE AERODYNAMICS	2	1	0	3
Pre-requisite	-				
Objectives:	1. To broaden the understanding of vehicle aerodynamics 2. To analyze the stability, safety and comfort of the vehicles 3. To understand wind tunnels and testing techniques 4. To apply CFD for aerodynamic design of vehicle				
Expected Outcome:	Upon completion of this course the student will be able to: 1. Understand vehicle aerodynamics 2. Analyze stability, safety and comfort of vehicles 3. Understand wind tunnels and testing techniques 4. Apply CFD for aerodynamic design of vehicle				
Unit 1	Fundamentals of Aerodynamics				
Scope – Development trends – Flow phenomena related to vehicles – External and Internal flow problems – Performance of cars and light vans – Resistance to vehicle motion – Drag – Types of drag – Flow field around car – Aerodynamic development of cars – Optimization of car bodies for low drag.					
Unit 2	Stability, Safety and Comfort				
The origin of forces and moments – effects – vehicle dynamics under side wind – Force and Moment coefficients – Safety limit – dirt accumulation on vehicle – wind noise – Air flow around individual components – High performance vehicles – Very log drag cars – Design alternatives – High efficiency radiator arrangement – Development and simulation methods.					
Unit 3	Wind Tunnels and Test Techniques				
Principles of wind technology – Limitations of simulation – Scale models – Existing automobile wind tunnels – Climatic tunnels – Measuring equipment and transducers. Pressure measurement – velocity measurements – Flow visualization techniques – Road testing methods – Wind noise measurements.					
Unit 4	Application of CFD				
Methods to solve Navier–Stokes equation – Forces acting in a fluid element – Compressibility effects in a flow field – Inviscid flow – Governing equations – Irrotation flow field and consequences – Potential flows – Boundary layer methods – Numerical 107odeling of fluid flow around vehicle body.					
Unit 5	Aerodynamic Design				
Development and simulation methods –cars, buses, trucks					
Text Books					
References 1. W.H. Hucho, ‘Aerodynamics of Road Vehicles’, Butterworth and Co., 1987. 2. Schlichting, H. ‘Boundary Layer Theory’, McGraw Hill, New York, 1999. 3. Pope, A., Low speed Wind Tunnel Testing, John Wiley and Sons, New York, 1999. 4. Vehicle aerodynamics, SAE, !996.					
Mode of Evaluation	Assignments / Quiz / Continuous Assessment Test / Term end Examinations.				

MEE353	VEHICLE TECHNOLOGY (Automotive Chassis & Body Engineering)	2	1	0	3
Prerequisite	-				
Objectives:	To broaden the understanding of details of car body aspects. To introduce car body and bus body details used. To broaden the understanding of students in the structure of vehicle chassis. To introduce students to steering, suspension and braking systems.				
Expected Outcome:	Student will be able to 1. Carryout construction of different car bodies and designing of car for safety 2. Develop chassis and identify suitable engine for different applications 3. Formulate steering, braking and suspension systems				
Unit 1	Introduction				
General consideration relating to chassis layout, power plant location, types of automobiles, layout of an automobile with reference to power plant, weight distribution, stability, Terms used in body building construction, Angle of approach, Angle of departure, Ground clearance, Cross bearers, Floor longitudes, posts, seat rail, waist rail, cant rail, Roof stick, Roof longitude, Rub rail, skirt rail, truss panel, wheel arch structure, wheel arch, post diagonals, gussets					
Unit 2	Vehicle Body				
Car Body: Types, Regulations, drivers visibility, tests for visibility, methods for improving visibility and space in cars, safety design, safety requirements for car, car body construction. Bus Body Details: Types, Mini bus, single decker, double decker, two level, split level and articulated bus, bus body layout, floor height, engine location, entrance and exit locations, seating dimensions, constructional details, frame construction, double skin construction, types of metal sections used, regulations, conventional and integral type construction.					
Unit 3	Front Axle and Steering Systems				
Axle parts and materials, loads and stresses, centre sections, section near steering head, spring pads, front axle loads, steering heads, factors of wheel alignment, wheel balancing, centre point steering, correct steering angle, steering mechanisms, cornering force, self righting torque, under steer and over steer, Steering linkages, steering gears, special steering columns, power steering, trouble shooting, Numerical problems					
Unit 4	Brakes				
Necessity, stopping distance and time, brake efficiency, weight transfer, brake shoe theory, determination of braking torque, classification of brakes, types, construction, function, operation, braking systems - mechanical, hydraulic, disc, drum, details of hydraulic system, mechanical system and components, types of master & wheel cylinders, bleeding of brakes, brake drums, brake linings, brake fluid, factors influencing operation of brakes such as operating temperature, lining, brake clearance, pedal pressure, linkages etc, Numerical problems.Brake compensation, Parking and emergency brakes, hill holder, automatic adjustment, servo brakes, Power brakes-Air brakes, wagner air brake, vacuum brakes and electric brakes and components brake valve, unloader valve, diaphragm, air-hydraulic brakes, vacuum boosted hydraulic brakes, trouble shooting, Numerical problems.					
Unit 5	Suspension & Wheels And Tyres				
Objects, basic considerations, Types of suspension springs, construction , operation & materials, leaf springs, coil springs, torsion bar, rubber springs, plastic springs, air bellows or pneumatic suspension, hydraulic suspension, constructional details of telescopic shock absorbers, independent suspension, front wheel independent suspension, rear wheel independent suspension, types, stabilizer, trouble shooting, Numerical problems. WHEELS AND TYRES: Types of wheels, construction, structure and function, wheel					

dimensions, structure and function of tyres, static and dynamic properties of pneumatic tyres, types of tyres, materials, tyre section & designation, factors affecting tyre life, quick change wheels, special wheels, trouble shooting'	
Text Books	
Automotive Chassis – P.M. Heldt, Chilton & Co. Automotive Mechanics – N.K. Giri , Khanna Publications, New Delhi, 2004	
References	
Automotive chassis and body – P.L. Kohli, TMH Automobile Engineering Vol. I - Kirpal Singh, Standard publications, New Delhi, 2004. Introduction to automobile engineering – N.R. Khatawate, Khanna pub. New Delhi Automotive mechanics – Joseph I Heintner, Affiliated East West Press, New Delhi/Madras,1967 Automobile engineering – G.B.S. Narang, Khanna Publications, New Delhi, 1982 Automobile Engineering – T.R. Banga & Nathu Singh, Khanna Publications, 1993	
Mode of Evaluation	Quiz/Assignment/ Seminar/Written Examination

MEE227	SAFETY AND HAZARD ANALYSIS	2	1	0	3
Prerequisite	-				
Objectives:	1. Critically understand the importance of safety in process industries 2. Assess & identify the potential hazards in process industries. 3. Appreciate and apply safety procedures in a process industries. 4. Identify and evaluate the causes of accident in a chemical industry. 5. Understand safety systems, artificial intellegence and expert systems in process industry to carry out HAZOP and risk analysis.				
Expected Outcome:	At the end of this course students would have realized the importance of safety and hazard analysis in chemical industries.				
Unit 1	Introduction				
Importance and need for Development of safety Consciousness in Chemical Industries: Psychological attitude towards Safety Program; Effective Realization; Economic and Social Benefits from Safety Program; Effective communication Training at various levels of Production and Operation.					
Unit 2	Toxic Chemicals and its Handling				
Potential Hazards in Chemical Process Industries; Chemical and Physical job Safety Analysis; High pressure and Temperature Operation; Dangerous and Toxic Chemicals; Routes of entry, Effects toxicants and its elimination. Toxic release and dispersion models. Ratio Active materials; safe Handling and Operation of materials and Machinery					
Unit 3	Safety and Risk				
Effective steps to Implement Safety Procedures; Periodic Advice and checking to follow Safety Procedures & Rules; Proper selection and replacement of Handling Equipment; plant layout Personnel Safety and Protective Equipments; Occupational health and safety					
Unit 4	Safety measures				
Identification of Accident Spots in Chemical industries; Identification and Analysis of Causes of Injury to Men and Machines; Accident Cost; Economics and Insurance; Fire Prevention and Fire Protection					
Unit 5	Planning				
Hazard Identification and Assessment; Involvement of Human factors and Errors-Hazard Qualifications-disaster management ; Occupational and Industrial Health Hazards; Safety Systems; computer aids in Overall Chemical Plant Safety; Artificial Intelligence and Expert Systems					
References					
1. Industrial Safety Handbook, Editor, William Handley, McGraw Hill, New York 91975) 2. Safety and Accident Prevention in Chemical Operations, Editors HH Fawatt and WS Wood, Interscience (Wiley) New York (1965) 3. Industrial Safety, R.B. Blake, Prentice Hall 5. Anton Tj. Occupational Safety and Health Management (2^{nd} ed.) McGraw Hill, New York (1989)					
Mode of Evaluation	Written Examination, Assignment and Seminar				

MEE235	ALTERNATIVE FUELS	3	0	0	3
Prerequisite	Knowledge on chemistry essential				
Objectives:	1. To make students familiar with importance of alternative fuels 2. To teach combustion and emission characteristics of various gaseous and liquid alternative flues 3. To teach engine requirements and adaptability of engines to alternative fuels				
Expected Outcome:	1. Learn limitations of fossil fuels and need for alternative fuels 2. Learn sources of various alternative fuels 3. Learn storage, distribution and safety aspects of alternative fuels 4. An understanding of engine requirements and combustion characteristics fuels				
Unit 1	Introduction				
Fossil fuels and their availability - Potential alternative liquid and gaseous fuels - Merits and demerits of various alternative fuels - Engine requirements					
Unit 2	Alcohol				
Methods of production - Properties - Blends of gasoline and alcohol - Performance in SI engines – Adaptability - Combustion and emission characteristics - Performance in CI engines - Emission characteristics - Properties of alcohol esters					
Unit 3	CNG, LPG, Biogas and Producer gas				
Production and properties of CNG, LPG, biogas and producer gas - Performance and emission in SI/CI engines - Storage, distribution and safety aspects					
Unit 4	Hydrogen				
Sources of Hydrogen - Properties - Production of hydrogen - Transportation, storage and safety aspects - Performance and emission characteristics – Adaptability - Fuel cell - Hybrid vehicles					
Unit 5	Vegetable oils				
Various vegetables oils - Properties - Esterification - Performance and emission characteristics - Bio-diesel: Feed stock, characteristics, preparation (lab and commercial), storage, applications, environmental impacts, economics, policy					
Textbook					
1. Osamu Hirao and Richard Pefley (1988), Present and Future Automotive Fuels, Wiley Interscience Publication, New York.					
References					
1. Alcohols and Motor Fuels: Progress in Technology - Series No. 19 - SAE Publication USA 2. SAE Papers 840367, 841156, 841334, 841333, 941969, 902095, 962094, JSAE 9938100, SAE 952508, 950777, 961988. 3. The Properties and Performance of Modern Alternative Fuels, SAE Paper No 84210. 4. R.L. Bechtold (1997), Alternative Fuels Guidebook, SAE. 5. CD ROM Collection (2004), 21st Century Complete Guide to Alternative Fuels, Progressive Management Publisher. 6. Nick Wagoner and Sheryl Wagoner (2006), Alternate Fuels: An Overview, Thomson Delmar Learning. 7. Reda Mohamed Bata (1994), Alternate Fuels: A Decade of Success and Promise (Progress in Technology), SAE International. 8. Gerhard Knothe, Jon Van Gerpen and Jurgen Krahl (2005), The Biodiesel Handbook, ISBN: 1893997790					
Mode of Evaluation	Written Examination, Assignment and Seminar				

MEE239	PROJECT MANAGEMENT	3	0	0	3
Prerequisite	-				
Objectives:	1. To enable the students to have overall view of project management techniques. 2. To introduce students to project definition, management techniques, planning and scheduling. 3. To teach students the commercial and aspects of projects				
Expected Outcome:	1. Demonstrate the core philosophy of project management. 2. Possess the knowledge of project management techniques. 3. Exposed to commercial and legal aspects of projects.				
Unit 1	Project definition				
Project definition – The nature and scope of project management – Project Management process – Context of project management – Project parameters / variables: - Scope, Cost, Time, Quality, Risk – Project classifications – Project success criteria, Project management techniques Project management techniques – Project planning – Earned value management – Risk management – Scheduling – Process improvement					
Unit 2	Planning and Scheduling				
Planning and Scheduling: - Sequence of activities – Plan with chart – PERT / CPM – Work break down structure – Project management mile stones – Body of knowledge (PMI) – ISO 10006 – Scrum (agile method) – Extreme project management – Morse carlo simulations techniques – Use of software in project management – Progress monitoring – Corrective action					
Unit 3	Project Commercial Aspects				
Commercial aspects of project – Cost estimates – Time estimates – Resources estimate – Control of cost - time – resources (utilisation) – Risk management – Project procurement – Selection and management of contractors – Method of payment – Authorization levels – penalty clause – stock and inventory planning Project Legal Aspects Legal aspects of project – Health - Safety - Occupational hazards and environmental aspects – Ethical issues – Governmental rules and regulations – fox workers – ESI - Workmen compensation – Medical facilities – Arbitration of issues – Judistication of courts – Law of contract					
Textbook					
1. Grag and Lawron, (2006), Project Management, Tata McGraw Hill.					
References					
1. Reck and Crane, (2000), Project Management, Wiley Eastern. 2. Dennis Locke, (2000), Project Management, Gower. 3. Morris and Pritco, (2004), Managing Projects, Wiley Eastern.					
Mode of Evaluation	Written Examination, Assignment and Seminar				