VASAVI COLLEGE OF ENGINEERING (Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
SCHEME OF INSTRUCTION AND EXAMINATION
B.E. IV th YEAR (Autonomous)

Sl No.	Syllabus Ref .No.	SUBJECT	Scheme of Instruction Hours per Week				Scheme of Examination			Credits
			L	T	D	P	Duration in Hours	Maximum Marks SEM. Exam	Maximum Marks Sessi–onals	
SEMESTER – I										
THEORY										
1	ME 4010	Thermal Turbo machines	3	2	-	-	3	70	30	4
2	ME 4020	Metrology and Instrumentation	3	1	-	-	3	70	30	3
3	ME 4030	Production and Operations management	3	1	-	-	3	70	30	3
4	ME 4040	Operations Research	3	1	-	-	3	70	30	3
5	HS 4010	Managerial Economics and Accountancy	3	-	-	-	3	70	30	3
6	ME 4xx0	Elective-1	3	1	-	-	3	70	30	3
PRACTICALS										
1	ME 4011	Metrology & Thermal Engineering Lab	-	-	-	2	3	50	25	1
2	ME 4021	Computer Aided Engineering Lab	-	-	-	2	3	50	25	1
3	ME 4016	Project Seminar	-	-	-	2	-	-	25	1
		TOTAL	**18**	**6**	**-**	**6**		**520**	**255**	**22**
		GRAND TOTAL	**30**					**775**		
INTER DISCIPLINARY COURSES										
THEORY										
1	ME 4050	Industrial Administration and Financial Management (Service Course to ECE)	3	-	-	-	3	70	30	3
SEMESTER – II										
THEORY										
1	ME 4xx0	Elective-II	3	-	-	-	3	70	30	3
2	ME 4xx0	Elective-III	3	-	-	-	3	70	30	3
PRACTICALS										
1	ME 4015	Project / Internship	-	-	18		Viva	50	50	9
		TOTAL	**6**	**-**	**18**			**190**	**110**	**15**
		GRAND TOTAL	**24**					**300**		

Elective-I		Elective-II		Elective-III	
Code No.	Subject Title	Code No.	Subject Title	Code No.	Subject Title
ME4110	Automobile Engineering	ME4200	Power Plant Engineering	ME4260	Fuels and Combustion
ME4120	Finite Element Analysis	ME4210	Computational Fluid Flows	ME4270	Control Systems
ME4130	Tool Design	ME4220	Machine Tool Design	ME4280	Robotics
ME4140	Composite Materials	ME4230	Mechatronics	ME4290	Additive Manufacturing Technologies
ME4150	Entrepreneurship	ME4240	Total Quality Management	ME4300	Production Drawing
CE4531	Disaster Mitigation & Management	ME4250	Intellectual Property Rights	CS4250	Information Security

SYLLABUS FOR B.E. 4/4 I-SEMESTER

THERMAL TURBO MACHINES

Instruction : 3+2 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4010
Credits : 4	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to:: 1. understand compressible flow and their application to normal shocks. 2. provide the knowledge of basic principles, governing equations and applications of turbo machines. 3. provide the knowledge of basic principles and applications of jet propulsion and rocket propulsion systems.	After completing the course the student will be able to: 1. understand the basics of compressible flow and analyse the flow through a normal shock and evaluate the flow properties downstream of a shock. 2. apply thermodynamic concepts to analyze turbo machines 3. analyse flow through turbo machines such as compressors, steam and gas turbines. 4. calculate the performance of turbo machinery. 5. estimate the performance of jet and rocket propulsion systems.

UNIT – I

Introduction to compressible flows: Speed of propagation of pressure waves, Mach number, Acoustic velocity, mach cone and mach angle; pressure field due to a moving source of disturbance; static and stagnation properties.

Introduction to flow in constant area ducts with friction – Fanno flow, variations of flow properties, variation of mach number with duct length.

Introduction to flow in constant area ducts with Heat Transfer – Rayleigh line, Rayleigh flow relations, Variation of flow properties, Maximum heat transfer.

Introduction to shocks waves – Development of Normal shock waves, governing equations, Prandtl– Meyer relation, Rankine– Hugoniot equations, Stagnation pressure ratio across the shock. basic problems.

UNIT – II

Roto dynamic compressors: Introduction and general classification. Comparison of Reciprocating and Rotary compressors. Positive displacement Rotary compressors: Roots Blower and Vane blower; basic problems

Centrifugal Compressors: Principle of Operation, T-s diagram, Euler's Equation, velocity triangles, types of blades, Nomenclature of an aerofoil blade, Analysis of Flow, pre whirl, slip factor and its effect on work input, work done and pressure rise in a centrifugal compressor, performance characteristic, basic problems

Axial Flow Compressors: Construction, Principle of operation, velocity triangles. Analysis of Flow, Work done factor, Stage efficiency, Degree of reaction, Performance characteristics; basic problems, chocking, Surging and stalling.

UNIT – III

Steam Turbines: Classification, flow over blades, De Laval Turbine - Nozzle efficiency, Blade efficiency and Gross stage efficiency of Impulse turbine, Velocity diagrams for Impulse turbine , blade efficiency of Impulse turbine, Optimum blade speed ratio, Maximum work done and blade efficiency of Impulse turbine, Simple problems, Compounding of steam turbines– pressure compounding, velocity compounding and pressure – velocity compounding- pressure velocity variations.

Parson Reaction turbine- Velocity diagram, Degree of reaction, blade efficiency, Maximum work done, Calculation of height of blades, Balancing of End thrust.

UNIT – IV

Gas Turbines: Applications and Classification of Gas Turbines– constant pressure and constant volume gas turbines, Joule cycle– configuration diagram and temperature – entropy diagram, Thermal efficiency, Maximum pressure ratio in terms of temperature ratio, optimum pressure ratio for maximum work output with and without considering machine efficiencies, Improvement of gas turbine plant performance– Inter– cooling, Reheating and Regeneration. Basic Problems on Joule cycle.

Combustion Chambers: - Introduction, types, Geometry, Factors affecting Design & Performance, Requirements of the Combustion Chamber, Gas Turbine Combustion Emissions

UNIT – V

Jet Propulsion: Introduction, Jet engine types, Application of jet engines, air craft propulsion theory, Energy flow through jet engines, thrust, thrust power and propulsive efficiency. Turbo jet, Turbo prop, Turbo fan engines, Ramjet engines, pulse jet engines, Thrust augmentation; Simple Problems

Rocket Propulsion: Type of Propellants, Types of Rocket engines, Rocket propulsion theory– Rocket applications, Simple Problems

Learning Resources:

1. Yahya S.M. "*Fundamentals of compressible flow', New Age International publishers, January 2016*
2. Yadav R '*Steam and Gas Turbines and Power plant Engineering '*, Central Publishing House Ltd, Allahabad , 2007
3. Ganesan, V., *Gas Turbines*, Tata McGraw Hill Book Company, New Delhi, 2010
4. Vasandani, V.P. and Kumar, D.S., *Treatise on Heat Engineering*, Chand and Co Publishers, New Delhi, 2011.
5. Cohen H Rogers and G.F.C. and H.I.H. Saravanamuttoo, "*Gas Turbine Theory',* Longman, 5th Ed. New York 2004.

SYLLABUS FOR B.E. 4/4 I-SEMESTER

METROLOGY AND INSTRUMENTATION

Instruction : 3+1 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4020
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are : 1. Analyze limit gauges, linear and angular measurements 2. Learn the principle of comparators, measurements of components geometries 3. Understand the assessment of surface roughness, thread and gear metrology. 4. Analyze the different instrumentation systems, sensors and transducers. 5. Discuss seismic, temperature and pressure measurement.	On completion of the course, the student will be able to: 1. Understand measurement, gauges and measuring devices. 2. Study the comparators and devices for measuring geometric features. 3. Measure roughness, thread metrology, gears and geometric tests on machines. 4. Learn about instrumentation which involves transducers and strain gauges. 5. Study the seismic transducers for the measurement of displacement, acceleration, pressure and temperature

UNIT – I

Limits and Fits, ISO system: Fits and types of interchangeability. Taylor's principle of plain limit gauges, Use of plug, Ring and Snap gauges. Introduction– Linear and Angular measurements– Line and end standards. Slip gauges – Gauge material and manufacturing methods, Height gauges, Tomlinson gauges. Sine bar, Auto collimator. , Free flow and Back pressure type pneumatic comparator.

UNIT – II

Measurement of straightness and flatness, Roundness measurement with bench centers and Talyrond, coordinate measuring machine in component geometries.
Surface Roughness Measurements – Numerical assessments, parameters as per ISO indices. Profilometer, Taylor Hobson Talysurf. Applications of thread metrology – 2 wire and 3 wire methods.

UNIT –III

Elements of instrumentation system. Concept of measurement measurand, sensors and transducers. Static and dynamic characteristics. Types of errors. Calculation of Uncertainty, Calibration Procedures, Data Acquisition Systems

UNIT-IV

Displacement transducers. LVDT. Strain measurement – wire and foil type resistance strain gauges. Rosette Gauges. Adjacent arm and self-compensating gauges. Proving ring. Strain gauge load cells, measurement of axial load and torsion by strain gauges. Piezo electric load cell, Torque cells, dynamometers

UNIT – V

Introduction to Seismic Transducers – displacement and acceleration measurement, Pressure measurement – Bourdon pressure gauge, Bulk modulus gauge, Pirani gauge. Temperature measurement by thermocouples. Laws of thermos-electricity. Types of materials used in thermocouples. Series and parallel circuits. Ambient temperature compensation, flow measurement

Learning Resources:

1. R.K. Jain, "Engineering Metrology", Khanna Publications, 1996.
2. I.C. Gupta – "A Text Book of Engineering Metrology" , Dhanpat Rai Publications, New Delhi
3. Doeblin, "Measurement Systems application and design", 5th ed., Tata McGraw Hill, 2004.
4. Thomas G Beckwith, Roy D Marangoni, John H Lienhard V, "Mechanical Measurements", 6th Ed., Pearson Education Asia, 2007
5. Rega Rajendra, Principles of Engineering Metrology, Jaico Publishing House, Mumbai, 2008

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SYLLABUS FOR B.E. 4/4 I-SEMESTER

PRODUCTION AND OPERATIONS MANAGEMENT

Instruction : 3+1 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4030
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. Understand types of productions and plant layouts. implantation of work place design. 2. estimation of demand using qualitative and quantitative model and minimization of errors. 3. finding of production schedule for intermediate period and MRP-I and MRP-II. 4. minimization of inventories to reduce total cost and purchasing of optimal quantity. 5. applying project management techniques like PERT and CPM for practical problems.	On completion of the course, the student will be able to: 1. obtain knowledge in plant location and its layout, different production systems like job, batch, mass and work study, standard time calculation. 2. obtain knowledge in forecasting and its methods like Qualitative and Quantitative models and forecasting errors. 3. apply production planning using systems like aggregate planning, Material Requirement Planning, Enterprise Resource Planning. 4. optimize Economic Order Quantity using production model under deterministic and probabilistic model. 5. apply network methods like CPM and PERT to project management and analyzes crashing of a network.

Unit– I

Production & Operations Management: Introduction, Types of Production Systems – Job shop, Batch, Flow shop. Types of business organizations and organization structures.

Plant location and layout: Factors affecting plant location, Break even analysis, plant layout objectives, types of layouts, merits and demerits.

Work Study: Introduction to method study and work measurement, standard time calculations, methods of rating, work sampling.

Unit– II

Forecasting: Introduction, forecasting objectives and uses, demand patterns, qualitative models – market survey, delphi, quantitative models – moving average, weighted moving average, simple exponential smoothing, trend adjusted exponential smoothing, least square method, simple regression, multiple regression.

Forecast Errors: mean absolute deviation (MAD), mean square error (MSE), Mean Forecast Error (MFE), mean absolute percentage Error (MAPE)

Unit– III

Aggregate planning and master scheduling: Introduction, objectives of aggregate planning, cost in aggregate planning, strategies in aggregate planning, master production scheduling.

Materials requirement planning MRP.1: Importance of MRP, MRP system inputs and outputs, MRP calculations and MRP2.

Unit– IV

Inventory Control: Importance of inventory control, types of inventory models, inventory costs deterministic inventory models – basic EOQ model derivation, production model without shortages, purchase model with instantaneous replenishment and with shortages, production model with shortages, inventory model with price breaks, fixed order quality system, periodic review system. ABC and VED analysis.

Unit– V

Project Management: Network fundamentals, differences between PERT and CPM, scheduling the activities, Fulkerson's rule, Earliest and Latest times, determination of ES and EF in forward path, LS & LF in backward path, determination of critical path, Free float, independent float, Total float, program evaluation and review technique, crashing of network.

Learning Resources:

1. Joseph Monk," Operations Management", TMH Publishers, New Delhi, 2004
2. Buffa Elwood S," Modern Production / Operations Management", John Wiley Publishers, Singapore, 2002
3. Everett, E. Adam. Jr and Ronald. J. Ebert, "Production and operations management: concepts, models and behaviour" Prentice Hall of India Pvt. Ltd., New Delhi, 5th ed. 1998.
4. Panneer Selvam R, "Production and Operations Management", 2nd ed, PHI Learning Pvt. Ltd., New Delhi, 2006.
5. S.D. Sharma, "Operations Research", Kedarnnath, Ramnath & Co., Meerut, 2009

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SYLLABUS FOR B.E. 4/4 I-SEMESTER

OPERATIONS RESEARCH

Instruction : 3+1 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4040
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to:	On completion of the course, the student will be able to:
1. understand the application of mathematics for real time problem solving to LPP 2. sensitivity analysis under set of constraints 3. Applying mathematical techniques to solve transportation problem and assignment problems 4. applying time value money and ignoring the same to find the optimal replacement of machines. 5. applying Johnsons rules to find the best sequence to minimize elapsed time and minimum no of servers to minimize waiting time of the customers and optimal utilisation of servers.	1. Format the practical problems into LPP and solve it by mathematical techniques (graphical & simplex) and apply the solution to the problem 2. Obtaining solution to LPP by Dual simplex, sensitivity analysis with restrictions. 3. Implement transportation technique to get initial solutions and optimal solution. 4. Optimal Replacement of machines and identify the best strategies of game theories 5. Optimal sequencing to minimum elapsed time for processing of n jobs on m machines. To minimize waiting time of the customer and optimization of no. of servers.

UNIT – I

Introduction: Definition and scope of operations research.

Linear programming: Introduction, Formulation of linear programming problems, graphical method of solving LP problem, Simplex method, maximization and minimization, degeneracy in LPP, unbounded and Infeasible solutions. Introduction of software to solve LPP.

UNIT – II

Duality: Definition, Relationship between optimal primal and dual solutions. Economic interpretation, Post optimal analysis (restricted to variation of resources i.e., RHS), Dual simplex method.

UNIT – III

Transportation model: Finding an initial feasible solution– north west corner method, least cost method, Vogel's approximation method, finding the optimal solution, optimal solution by stepping stone and MODI methods, special cases in transportation problems – Unbalanced transportation problem.

Assignment Problem: Hungarian method of assignment problem, maximization in assignment problem, unbalanced problem, problems with restrictions, travelling salesman problems

UNIT –IV

Replacement models: Introduction, replacement of items that deteriorate ignoring change in money value, replacement of items that deteriorate considering change in money value with time, replacement of items that fail suddenly – individual replacement policy, group replacement policy.

Game theory: Introduction, 2 person zero sum games, maximi– minimax principle, principle of dominance, solution for mixed strategy problems graphical method for 2 x n and m x 2 games.

UNIT – V

Sequencing models: introduction, general assumptions, processing n jobs through 2 machines, processing 'n' jobs through m machines processing 2 jobs through m machines.

Queuing theory: introduction, single channel – poission arrivals – exponential service times with infinite population and finite population.

Learning Resources:

1. S S Rao, "Engineering optimisation – Theory and Practice", 4th Edition, John Wiley & Sons Inc., 2009 .
2. Hamady A. Taha, "Operations Research – An introduction", 6th Ed., PHI Pvt. Ltd., 1997.
3. S.D. Sharma, "Operations Research", Kedarnnath, Ramnath & Co., Meerut, 2009.
4. Harvey M. Wagner, "Principles of Operations Research", 2nd Ed., PHI Pvt. Ltd., 1980.
5. V.K. Kapoor, "Operations Research", S. Chand Publishers, New Delhi, 2004.

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SYLLABUS FOR B.E. 4/4 I-SEMESTER

MANAGERIAL ECONOMICS AND ACCOUNTANCY

Instruction : 3 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : HS 4010
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are : • to create an awareness about the significance of economics in day to day life and its impact of policies of organizations'. • Helps in engineering the products according to the societal needs • Helps in leaning the investment decision making • to identify the economical ways of production and pricing the products based on the market structures • compare the performance of the company with competitors for improving the profits of the company.	On completion of the course, the student will be able to: • make decisions in solving the economic problems of the organization • make better sale of the product with customer centered products and services • make economical production by identifying the optimum combination of inputs and price them appropriately for better profits • understand the process of making long term investment decisions involving huge outlay • analyse the past performance of the company and make decisions for future • competent to set up own enterprise.

UNIT-I

Meaning and Nature of Managerial Economics: Introduction to Micro and Macro Eeconomics Managerial Economics –Nature, Scope ,Importance, Relation with other sciences and its usefulness to Engineers, Fundamental Concepts of Managerial Economics - Scarcity, Marginalism, Equi-marginalism, Opportunity costs, Discounting Principle, Time Perspective Principle, Risk and Uncertainty, Profits. Case study method – Definition & Methods of case study.

UNIT - II

Consumer Behavior: Demand – Concept, Determinants, Law of Demand, Relationship between total revenue, marginal revenue and demand, Price elasticity – Types, Factors & Methods to measure price elasticity, Introduction to Income, Cross & Advertising elasticity. Demand forecasting – Meaning and Methods to forecast, Law of supply - Concept and Factors influencing supply. Concept of Equilibrium – Law of diminishing marginal utility. (Theory questions and small numerical problems on measurement of arc and point elasticity can be asked).

UNIT - III

Theory of Production and Markets: Production Function, Law of Variable Proportions, Isoquants, Economies of Scale. Cost analysis – Types of costs, Cost-Output relationship.

Break-Even Analysis, Market structures – Types, Price determination in Perfect Competition with and without time element & pricing in Monopoly (theory questions and problems can be asked on Breakeven point).

UNIT - IV

Capital Management: Significance, Introduction to capital budgeting, traditional methods and discounted cash flow methods. Working capital – Determinants & Sources (Theory questions and numerical problems on evaluation of capital budgeting opportunities can be asked).

UNIT - V

Book-Keeping: Principles of Double entry system of Book keeping – Definition of accounting, Concepts and Conventions, Journal, Three column cash book, Bank Reconciliation statement, Trial Balance, Preparation of Final Accounts with simple adjustments, Analysis and interpretation of Financial Statements through Ratios (liquidity, solvency and profitability ratios).

(theory questions and numerical problems on preparation of final accounts, cash book, bank reconciliation statement, calculation of some ratios).

Learning Resources:

1. Mehta P.L., "Managerial Economics – Analysis, Problems and Cases", Sulthan Chand & Son's Educational publishers, 2011.
2. Financial Accounting by Jain & Narang
3. Financial Management by Khan & Jain. Mc. Graw Hill Education

Reference Books:

1. Micro Economics by M. L.Seth.
2. Maheswari S. N. "Introduction to Accountancy", Vikas Publishing House, 2005.
3. Pandey I.M. "Financial Management" Vikas Publishing House, 2009.
4. W. Chris lewis & Craig H Petersen "Managerial economics".
5. Modern Accounting by A. Mukherjee & M.Hanif

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SYLLABUS FOR B.E. 4/4 I-SEMESTER

AUTOMOBILE ENGINEERING (ELECTIVE-I)

Instruction : 3+1 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4110
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. Appreciate and understand the engine components 2. Acquire knowledge of different types of cooling and lubrication systems 3. Understand the need of suspension and steering systems 4. Acquire knowledge on operation of gear and brake mechanisms 5. Understand emissions and servicing of automobile	On completion of the course, the student will be able to: 1. Identify types of Automobiles and engine components, valve operation mechanisms and fuel injection system in petrol and Diesel engines. 2. Describe the engine cooling, lubrication and modern ignition systems. 3. Know the wheel alignment ,suspension mechanisms and construction of tyres 4. Analyse the Working principle and operation of gear mechanisms and operation of brake systems. 5. Know the servicing procedure of engine and pollution control techniques

UNIT-I

Introduction, Types of automobiles, Electrical and Hybrid Vehicles: series and parallel systems, Fuel cell vehicle. chassis and body, components of chassis. Engine components: cylinder block, cylinder head, crankcase, inlet and exhaust manifolds, gaskets, cylinder liners, constructional features of piston, piston slap, methods to overcome piston slap. Piston rings, compression rings, oil control rings, crank shaft.Valve Operating Mechanisms, fuel supply system for petrol and diesel engines. Petrol Injection System: single point and multipoint injection, mechanical and electronic injection. Introduction to CRDI system for diesel engines.

UNIT-II

Lubricating System: Petroil System, splash system, pressure lubrication: Wet sump and Dry Sump.
Cooling System: Air Cooling, Water cooling: Thermosyphon, pump circulation system, components of cooling system : Radiator, Thermostat Control and Anti Freezing agents.
Ignition System: Battery Ignition System ,Magneto Ignition System and Electronic Ignition System.
Starting motor: Bendex drive Mechanism, Automobile Air Conditioning .

UNIT-III

Suspension System: Rigid axle and Independent suspension system : Double wish bone type, Macpherson strut system, Air suspension system.
Steering System: front axle, types of stub axles, Wheel alignment, steering geometry: Caster ,Camber, Toe-In, Toe-Out, King Pin Inclination .Ackerman steering mechanism, rack and pinion steering gear mechanism, Steering Linkage for vehicle with Rigid axle front Suspension System and with independent front suspension.
Wheels and Tyres : types of wheels: Disc wheels, wire wheels, alloy wheels, Wheel dimensions, Basic construction of tyres, tube type and tubeless type tyres.

UNIT-IV

Power Train: Single Plate Clutch and Multi plate Clutch, Manual Gear Box : Constant Mesh , Sliding Mesh, synchromesh . Automatic Gear Box, Torque Converter, Propeller Shaft, Universal Coupling, Differential.
Brakes: Types , Drum and Disc brakes ,Mechanical and Hydraulic Brakes, Air Brakes, Master Cylinder, Wheel Cylinder , Hand Brake Linkage , **ABS** and SRS Airbag system .

UNIT –V

Automobile Emissions and control: emissions from automobiles, Euro Norms and Bharath Norms, Pollution Control Techniques. Catalytic Converters, EGR and Nano Fuel Additives.
Service Procedure: Tools and Equipment for Repair Engine Overhauling.

Learning Resources:

1. Crouse & Anglin, "Automobile Engineering", 10th Ed., Tata McGraw Hill Publishing Co. Ltd., New Delhi,. 2006.
2. Kirpal Singh, "Automobile Engineering", Vol. I & II, 13th edition, Standard Publishers, Delhi ,ISBN No. 9788180141966
3. R.B Gupta, "Automobile Engineering "Satya Prakashan, 2015
4. Joseph Heitner, "Automotive Mechanics", Affiliated East West Pvt. Ltd.
5. C.P. Nakra, "Basic Automobile Engineering", Dhanpat Rai Publishing Co. (P) Ltd., New Delhi, 2016.

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SYLLABUS FOR B.E. 4/4 I-SEMESTER

FINITE ELEMENT ANALYSIS (ELECTIVE-I)

Instruction : 3+1 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4120
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The course will enable the students to: 1. understand the concept of FEA and apply it to 1-dimensional and 2-dimensional problems in the field of Mechanical Engineering.	At the end of the course students shall be able to: • understand the finite element formulations and stress strain relations • evaluate structures like trusses, beams for their deflections, stresses and strains using one dimensional finite element from structural point of view. • solve engineering problems subjected to Bi-axial state of loading with two dimensional finite elements from structural point of view. • evaluate thermal stresses for one dimensional heat transfer models. • evaluate frequencies and interpret mode shapes of simple structures like a bar and a beam.

UNIT-I

Introduction to Finite Element Method. Stress and Equilibrium. Strain, displacement, stress– strain relations.

One dimensional problems:

Finite element modeling, coordinates and shape functions, Potential Energy approach. Assembly of Global stiffness matrix and load vector, Finite element equations, Penalty approach.

Introduction to quadratic shape functions.

UNIT – II

Analysis of trusses and beams:

Element stiffness matrix for a plane truss member. Analysis of plane trusses.

Element stiffness matrix for a 2D-beam member (one rotation and one translation at each node). Analysis of 2D beams.

Introduction to plane frames.

UNIT – III

Two dimensional problems:

Element stiffness matrix for constant strain triangle element (CST).

Two dimensional stress analysis using CST elements and treatment of boundary conditions.

Introduction to Finite element modeling of axi–symmetric solids. Two dimensional four noded iso–parametric elements.

UNIT – IV

Numerical integration using Gaussian Quadrature with two and three point formulae.

Steady state heat transfer analysis: One dimensional analysis of composite wall and a fin.

UNIT – V

Dynamic Analysis: Formulation of finite element model, element matrices, evaluation of Eigen values and Eigen vectors for a stepped bar and a beam.

Convergence requirements. Introduction to Finite Element analysis Software.

Learning Resources:

1. G.Ramamurthy, "Applied Finite Element Analysis", I.K. International Publishing House Pvt. Ltd., New Delhi. 2009.
2. Tirupathi R, Chandraputla and Ashok D Belagundu, "Introduction to finite elements in engineering", Prentice Hall of India, 1997.
3. Rao S S, "The Finite Element Method in Engineering", Pergamon Press, 1989.
4. Segerlind L J, "Applied Finite Element Analysis", Wiley Eastern, 1984
5. Reddy J N, "An Introduction to Finite Element Method", McGraw– Hill, 1984

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SYLLABUS FOR B.E. 4/4 I-SEMESTER

TOOL DESIGN (ELECTIVE-I)

Instruction : 3+1 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4130
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. discuss relative merits and applications of various tool materials and design of single point tools. 2. design and analyze various multi point cutting tools such as milling cutters, taps, dies, broaches. 3. design and analyze various multi point cutting tools such as drills and reamers. 4. design various dies for sheet metal operations. 5. understand and analyze various work holding devices used in machining.	On completion of the course, the student will be able to: 1. understand the significance of various tool materials and single point cutting tool. 2. use and suggest proper cutting tool for the required operation. 3. design and develop hole making tools for machining. 4. compute the size of the dies required for various press tool operations. 5. design and select proper jig or fixture for the machining operation.

UNIT – I

Advanced Cutting tool materials and processes: Desired properties, Types, major Constituent, relative characteristics, latest development; ISO: classification and coding of carbides tools. Coated tools. CBN, Sailon, Ucon.

Design of single point cutting tools: Design of flat and circular form tool correction and tool holding methods.

UNIT – II

Design of multi point cutting tools: Milling cutters: Major types, design and manufacturing of peripheral, end and face milling cutters. Forces and power estimation. Grinding of milling cutters.

Broaches: Pull and push types. Internal and External broaches, geometry and design and manufacturing of pull type and push type and push type broaches.

Taps and Dies: Types, geometry, design and manufacturing taps and dies.

UNIT – III

Multi point cutting tools: Twist drill geometry, design and manufacturing of twist drill. Effect of variation of different angles on torque and thrust forces. Types and design of shanks. Sharpening of twist drill.

Reamers: Types, geometry, Reaming allowance tolerance displacement, design and manufacture of twist drill.

UNIT – IV

Design of Press tools: Die set elements. Design of Die set for simple components by Blanking, Piercing, bending, Drawing, Forging and spinning.

Plastic Tools: Plastic Dies for simple components.

UNIT – V

Jigs & Fixtures: Design principles and construction features. Locating methods. Types of locating pins. Requirements and choice of locating systems. Redundant location, fool proofing. Setting blocks, types of clamping devices and their basis elements. Quick action clamps and nuts. Types of drill jigs and their classification. Types of jig bushes, jig feet, Indexing jigs. Design of fixtures for turning, grinding, welding and milling. Economic analysis of jigs and fixtures.

Learning Resources:

1. Donaldson, Leain and Goold , "Tool Design", Tata Mc Graw-Hill, New Delhi, 1983
2. Rodin, "Design of cutting tools", Mir Publications, Moscow
3. Amitabha Battacharya and Inyong Ham, "Design of Cutting tools, Use of Metal Cutting theory", ASTME publication Michigan USA., 1969.
4. Surendera Keshav & Umesh Chandra, "Production Engineering Design (Tool Design)", Satya Prakahan, New Delhi– 1994.
5. Gorishkin, "Jigs & Fixtures", MIR Publications, Mascow 1st edition, 1861

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SYLLABUS FOR B.E. 4/4 I-SEMESTER

COMPOSITE MATERIALS (ELECTIVE-I)

Instruction : 3+1 Hours / week	Semester End Exam Marks : 70	Subject Reference Code : ME 4140
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. understand the basic principles and importance of Composite materials. 2. analyse the composite materials for various Elastic constants and Load transfer mechanisms. 3. apply the macro-mechanics to obtain the properties of composite laminates. 4. asses the failure criteria of composites. 5. determine the strength of a orthotropic lamina using various theories of failure.	On completion of the course, the student will be able to: 1. Understand the importance of composite materials in engineering applications. 2. Analyse the composite for various Elastic constants. 3. Determine the macro level properties of composite beams and plates. 4. Understand the basic theories of failures associated with composites. 5. Calculate the strength of laminates in composites.

UNIT – I

Introduction: Definition and classification of Composites (PMC, MMC, CMC), FRP Composites, Fiber Reinforcements: Fiber Types and its properties, Fiber Forms, matrix materials and its properties: Thermoset Matrices, Thermoplastic matrices, Applications of Composite Materials.

UNIT – II

Manufacturing Processes: Hand– Lay– Up, Bag Molding, Autoclave processing, compression Molding, Resin Transfer Molding, Pultrusion, filament winding, Gel time test for resins, curing cycle.

Measurement of basic composite properties: Fiber and matrix tests, Tensile test, compressive test, in plane shear test, interlaminar shear test, flexure test.

UNIT – III

Micromechanics of composites:

Basic concepts: Volume and Mass fraction, Heterogeneous, Anisotropic, Orthotropic, Transversely lsotropic and Isotropic Materials.

Mechanical Properties: Prediction of Elastic constants, micromechanical approach, stress Partitinsing parameter, Halpin–Tsai equations.

Thermal properties: Thermal Expansion, Moisture Expansion, Transport Properties.

UNIT – IV

Macro mechanics of composites:

Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, Classification of Laminated composites, analysis of laminated composites, stresses and strain with orientation, Inter laminar stresses and edge effects.

UNIT – V

Strength of Orthotropic lamina: Tensile and compressive strength of unidirectional fiber composites, fracture modes in composites, delamination failure, Maximum stress theory, maximum strain theory Tsai– Hill Criterion, Tsai– Wu Criterion.

Laminate Strength: First ply Failure, Fiber Failure, Truncated Maximum– Strain Criterion.

Learning Resources:

1. Ronald F.Gibson, "Principles of composite Materials Mechanics", McGraw– Hill Inc, 1994.
2. Krishna, K.Chewla. "Composite materials", Springer– Verlag, 1987.
3. Carl. T.Herakovich, "Mechanics of Fibrous Composites", John Wiley sons inc., 1998
4. Ever J.Barbero, "Introduction to composite Materials Design", Taylor & Francis, 1999.
5. Jones, R.M., "Mechanics of composite Materials", McGraw– Hill Inc. ,1967.

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 I-SEMESTER

ENTREPRENEURSHIP (ELECTIVE-I)

Instruction : 3+1 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4150
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to : 1. Indian industrial environment-opportunities and challenges. 2. Characteristics of Entrepreneurs. 3. Project formulation 4. Project Management. 5. Behavioural aspects of entrepreneurs.	On completion of the course, the student will be able to: 1. analyse the relationship between entrepreneurship and economic growth, types of enterprises and their objectives. 2. analyse the Qualities of first generation entrepreneurs; Problems faced by women entrepreneurs and their remedies; Sources of ideas. 3. analyse market demand analysis; Financial analysis; Technical Analysis ; and Project Financing in India. 4. analyse Project Organisation; Project planning and control. 5. analyse Personality determinants; Leadership; Motivation; Time Management.

UNIT – I

Indian Industrial Environment – competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

UNIT – II

Identification and characteristics of entrepreneurs. Emergence of First generation entrepreneurs, environmental influence and women entrepreneurs. Concepts and evaluation of ideas and their sources. Choice of Technology – Collaborative interaction for Technology development.

UNIT – III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis. Project financing in India.

UNIT – IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

UNIT – V

Behavioural aspects of entrepreneurs. Personality – determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Learning Resources:

1. Bruce R. Barringer and R. Duane Ireland, " Entrepreneurship: successfully launching new ventures", 3rd edition, , Pearson Prentice Hall, 2009.
2. P. Denning and R. Dunham, "The Innovator's Way", MIT Press: Cambridge, Massachusetts, 2010.
3. Arya Kumar, "Entrepreneurship", Pearson Publications, Delhi, 2012.
4. Michael H. Morris, D.F.Kuratko, J G Covin, "Corporate Entrepreneurship and Innovation", Cengage learning, New Delhi,2010
5. Peter F. Drucker, "Innovation and Entrepreneurship", Routledge Classics, 2015
6. https://www.wfglobal.org/initiatives/national-entrepreneurship-network/

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 I-SEMESTER

DISASTER MITIGATION & MANAGEMENT (ELECTIVE-I)

Instruction : 3+1 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : CE 4531
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

COURSE OBJECTIVES	COURSE OUTCOMES
Objectives of this course are to:	Upon the completion of this course the students will be expected to:
1. Understand natural and manmade disasters, how to react effectively during disasters	1. Attain knowledge on various types, stages, phases in disaster with international & national policies & programmes with reference to the disaster reduction.
2. Explore the history of the disasters & comprehend how past events have helped shape the for true.	2. Understand various types of natural disaster, their occurrence, Effects, Mitigation and Management Systems in India
3. Study of various technologies used for disaster mitigation & management.	3. Understand different types of manmade disasters, their occurace severity, Effects, Mitigation and Management Systems in India.
4. Understand the roles of government agencies in disaster management.	4. Explain the utility of geography information systems (GIS), Remote sensing technology in all phases of disaster mitigation and management.
	5. Develop understanding on the concepts of risk, vulnerability, warning and forecasting methods in disaster management.

Unit-I

Introduction – Natural, human induced and human made disasters – international decade of disaster reduction.

Unit-II

Natural Disasters – Hydrometereological based disasters – Trophical cyclones, floods, drought and desertification – Zones Geographical based disasters – Earth quake, Tsunammis, Landslides and avalanches.

Unit-III

Human induced hazards – chemical industrial hazards, major power breakdowns, traffic accidents, etc.

Unit-IV

Use of remote sensing and GISI disaster mitigation and management.

Unit-V

Risk and vulnerability to disaster – mitigation and management options – warning and forecasting.

Learning Resources:

1. Rajib, S and Krishna Murthy, R.R.(2012) "*Disaster Management Global Challenges and Local Solutions"*, Universities Press, Hyderabad.
2. Navele, P & Raja, C.K. (2009), *Earth and Atmospheric Disasters Management*, Natural and Manmade, B.S. Publications, Hyderabad.
3. Fearn-Banks, K(2011), *Crises Computations Approach: A case book approach*, Route ledge Publishers, Special Indian Education, New York & London.
4. Bhattacharya, T. (2012), *Disaster Science and Management*, Tata McGraw Hill Company, Delhi.

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 I-SEMESTER

METROLOGY & THERMAL ENGINEERING LAB

Instruction : 2 Hours /week	Semester End Exam Marks : 50	Subject Reference Code : ME 4011
Credits : 1	Sessional Marks: : 25	Duration of Semester End Exam : 3 Hours

Metrology Lab	
Course objectives	**Course Out comes**
The objectives of this course are to: 1. Perform different measurements using measuring tools. 2. Conduct experiments for evaluation of temperature, displacement and pressure. 3. Understand the working of profile projector and make alignment tests.	On completion of the course, the student will be able to: 1. design limit gauges and analyze various measuring instruments. 2. measure temperature, displacement and thread nomenclature. 3. conduct alignment test on a lathe and determine tool angles using profile projector.

List of Experiments (Metrology)	
1	Linear & angular surface roughness measurements.
2	Design of snap gauge.
3	Temperature, displacement measurement
4	Determination of screw thread angles using Toolmakers microscope
5	Determination of Tool Angles using Profile Projector
6	Alignment tests on lathe

Thermal Engineering Lab	
Course objectives	**Course Out comes**
The objectives of this course are to: 1. apply basic knowledge and laws of thermodynamics, heat transfer and principles of turbomachinery on different turbomachinery and heat transfer equipment.	On completion of the course, the student will be able to: 1. evaluate the performance of thermal turbomachines such centrifugal blower and axial flow fan. 2. study the pressure distribution on various aerodynamic models and calculate lift and drag coefficients using low speed wind tunnel. 3. study the various modes of heat transfer using heat transfer equipment. 4. determine the COP of air conditioning / refrigeration system.

List of Experiments (Thermal Engineering)	
1	Determination of COP of the Air conditioning system.
2	Determination of performance parameters of centrifugal blower and axial flow fan
3	Pressure distribution on symmetrical and non– symmetrical specimen and measurement of lift and drag force in wind tunnel.
4	Determination of the efficiency of pin– fin subjected to natural and forced convection.
5	Determination of effectiveness of parallel and counter flow heat exchanger
6	Determination of Stefan Boltzman's constant

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 I-SEMESTER

COMPUTER AIDED ENGINEERING LAB

Instruction : 2 Hours /week	Semester End Exam Marks : 50	Subject Reference Code : ME 4021
Credits : 1	Sessional Marks: : 25	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. understand the CAE software applicability for analyzing structural and thermal problems	On completion of the course, the student will be able to: 1. Select appropriate finite element for solving structural and thermal problems 2. Correlate mathematical formulation using FE method 3. Simulate real life structural and thermal problems.

List of Experiments

1 Introduction to FEA software. Analysis using 1-d bar elements.

2 Analysis of Trusses.

3 Analysis of Beams with different boundary conditions.

4 Analysis of Beams with different loading conditions.

5 Analysis of Plane stress and Plane strain problems.

6 Analysis of axi-symmetric problems.

7 Analysis of three dimensional objects by modeling them in FEA software.

8 Modal Analysis of Beams.

9 Harmonic Analysis of Beams.

10 Transient Analysis of Beams.

11 Steady state Heat Transfer Analysis of a composite wall and a Fin .

12 Developing a 3-D Model in a modeling software and analyzing it by importing into FEA software.

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 I-SEMESTER

PROJECT SEMINAR

Instruction : 2 Hours /week	Semester End Exam Marks : --	Subject Reference Code : ME 4016
Credits : 1	Sessional Marks: : 25	Duration of Semester End Exam : --

Course objectives	Course Out comes
The objective of the project seminar is to actively involve the students in the initial work required to undertake the final year project	On completion of the course, the student will be able to do the literature search to identify the project, define the specifications, tools and techniques to be used in the project and becomes clear in expression of thoughts.

The objective of the project seminar is to actively involve the students in the initial work required to undertake the final year project. It may comprise of:

- Problem definition and specifications.
- A broad understanding of the available techniques to solve a problem of interest.
- Presentation (oral and written) of the project.

The Department can initiate the work related to project allotment at the end of III year II semester and complete it in the first two weeks of the fourth year I semester.

First 4 weeks of IV year Ist semester will be spent on special lectures by faculty members, research scholar and speakers from industries and R&D institutions. The objective of these talks is to expose students to real life / practical problems and methodologies to solve them.

A seminar schedule will be prepared by the coordinator for all the students. It should be from the 5th week to the last week of the semester and should be strictly adhered to.

Each student will be required to

1. Submit a one page synopsis of the seminar to be delivered for display on notice board.
2. Give a 20 minute presentation followed by 10 minutes discussion.
3. Submit a technical write up on the talk delivered.

At least two teachers will be associated with the evaluation of the project seminar for the award of the sessional marks which should be on the basis of performance of all the three items stated above.

NOTE: Three periods of contact load will be assigned to each project guide.

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 I-SEMESTER

INDUSTRIAL ADMINISTRATION AND FINANCIAL MANAGEMENT

(For ECE)

Instruction : 3 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4050
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. aware about types of business forms, organization structures, plant layouts, merits, demerits and applications. 2. understand method study procedure, PME, time study techniques and wage incentives. 3. importance of PPC and improving quality by control charts and sampling plants. 4. optimization of inventory to minimize total cost and other optimization techniques like LPP, project management techniques. 5. estimate selling price of a product, TVM and budgeting techniques, depreciation methods.	On completion of the course, the student will be able to: 1. understand business forms, organization structures and plant layouts. 2. implementation of method study and estimation of standard time. 3. understand types of production, functions of PPC, quality control by charts and sampling. 4. implement optimization techniques like LPP, assignment and project management techniques. 5. understand BEA, estimation of depreciation, selling price of a product and capital budgeting techniques.

UNIT – I

Industrial Organization : Types of various business organisations. Organisation structures and their relative merits and demerits. Functions of management.

Plant location and layouts: Factors affecting the location of plant and layout. Types of layouts and their merits and demerits.

UNIT – II

Work study: Definitions, Objectives of method study and time study. Steps in conducting method study. Symbols and charts used in method study. Principles of motion economy. Calculation of standard time– by–time study and work sampling. Performance rating factor. Types of ratings. Jobs evaluation and performance appraisal. Wages, incentives, bonus, wage payment plans.

UNIT – III

Inspection and quality control: Types and objectives of inspection S.Q.C., its principles quality control by chart and sampling plans. Quality circles, introduction to ISO.

Production planning and control: Types of manufacture. Types of production. Principles of PPC and its function. Production control charts.

UNIT – IV

Optimisation: Introduction to linear programming and graphical solutions. Assignment problems.

Project Management: Introduction to CPM and PERT. Determination of critical path.

Material Management: Classification of materials. Materials planning. Duties of purchase manager. Determination of economic order quantities. Types of materials purchase.

UNIT – V

Cost accounting: elements of cost. Various costs. Types of overheads. Break even analysis and its applications. Depreciation. Methods of calculating depreciation fund. Nature of financial management. Time value of money. Techniques of capital budgeting and methods. Cost of capital. financial leverage.

Learning Resources:

1. Pandey I.M., "Elements of Financial Management", Vikas Publ. House, New Delhi, 1994
2. Khanna O.P., "Industrial Engineering and Management", Dhanapat Rai & Sons.
3. Everrete E Admaa & Ronald J Ebert , "production and Operations Management", 5th Ed. , PHI , 2005
4. S N Chary, "Production and Operations Management", 3rd Ed. , Tata McGraw Hill, , 2006
5. Pannerselvam, "production and Operations Management", Pearson Education, 2007

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 II-SEMESTER

POWER PLANT ENGINEERING (ELECTIVE-II)

Instruction : 3 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4200
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. impart knowledge on various sources of energy and their working. 2. provide details of combustion process and the other associated circuits in thermal power plant. 3. become familiar with the method of generation of power using water. 4. become familiar with the method of generation of power using nuclear materials. 5. identify the components of costs for generation of power and study the environmental effects.	On completion of the course, the student will be able to: 1. identify the various sources of energy for power generation and explain the working of various sub systems such as coal handling, ash handling in a steam power plant. 2. describe the combustion process and the various sub systems in air and gas circuit, feed water and cooling water circuit and the working of gas turbine power plants. 3. describe the working of a hydro power plant. 4. describe the working of a nuclear power plant. 5. estimate the cost of power generation and the environmental effects of various power plants.

UNIT – I

Introduction to sources of Energy:

Resources and development of Power in India.

Steam Power plant: selection of site for a thermal power plant, Plant Layout, Working of different circuits, Types of Coal, Properties of Coal, Coal Handling, Fuel handling equipment and their choice. Coal storage systems.

Unit-II

Combustion Process: Overfeed and underfeed fuel beds, Travelling grate stokers, Spreader stokers, Retort Stokers, Pulverized fuel burning systems and its components, Ash Handling Systems, Combustion needs and draught system, working principle of Cyclone furnace, Dust collectors.

Cooling Towers and Heat rejection, Corrosion and feed water treatment.

Unit-III

Hydro Electric Power Plant : Water Power, Hydrological Cycle, measurement of run-off, selection of site for a hydro electric power plant, Essential features of a water power plant. Hydrographs, Flow duration curve and mass curve-related numerical problems, Storage and Pondage, Classification of dams and spillways.

Unit-IV

Nuclear Power Station : selection of site for a nuclear power plant, Nuclear fuels, conversion and breeding, fertile materials, Methods of enriching uranium, Nuclear Reactors, working of reactors, Pressurized water reactor, Boiling Water Reactor, Sodium Graphite Reactor, Fast Breeder Reactor, Gas cooled Reactor, Radiation Hazards and Shielding, Radioactive waste disposal.

Unit-V

Power plant Economics and Environmental considerations

Capital cost, Investment of fixed charges, Operating costs, General arrangement of power distribution, Load curves, Average Load and Load Factor, Delivery Factor, Related exercises.

Effluents from Power plants and impact on environment

Pollutants and Pollution standards, Methods of Pollution control.

Learning Resources::

1. Rajput, RK,'A Text Book of power plant Engineering', 3rd Edition, Laxmi Publications, New Delhi,2005.
2. Arora S C, Domukundwar S,'A Course in power plant engineering', Dhanapat Rai & sons, New Delhi, 2005
3. Yadav R, 'Steam &Gas Turbines and Power plant Engineering', 7th Edition, Central publishing House, Allahabad, 2007
4. Nag P K, 'Power plant Engineering',2nd Edition, Tata Mc Graw Hills Co. Ltd, New Delhi, 2002.
5. Wakil M M, 'Power plant Technology', Mc Graw Hill publications, New York, 2005.

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 II-SEMESTER

COMPUTATIONAL FLUID FLOWS (ELECTIVE-II)

Instruction : 3 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4210
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. equip the students with the necessary governing equations to use computational techniques to solve problems related to engineering flow problems 2. provide the essential numerical background for solving the partial differential equations governing the fluid flow and heat transfer	After completing the course, the student will be able to: 1. understand the differential equations of fluid flow and heat transfer 2. study the types of partial differential equations and understand the concept of turbulence. 3. Use flow simulation code for the flows in engineering and science using FDM and FVM 4. critically analyze different solvers and grid generation techniques

UNIT – I

Introduction to computational Fluid flows, CFF applications, comparison amongst Numerical, Analytical and Experimental approaches.

Review of the basic fluid dynamics: Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N– S equations. Heat transfer conduction equation for steady and unsteady flows, steady convection–diffusion equation.

Unit– II

Classification of partial differential equations – Elliptic, parabolic and hyperbolic equations. Physical examples of Elliptic, parabolic and hyperbolic partial differential equations, Well posed problem; Initial and boundary value problems.

Turbulence - Introduction, Mixing length model, K– epsilon turbulence model.

Unit– III

Concepts of Finite difference methods– forward, backward and central difference. Finite difference solution– 1-D steady state heat conduction without and with constant source term parabolic partial differential equations– Euler, crank Nicholson, Implicit methods.

Errors, consistency, stability analysis – Von Neumann analysis, convergence criteria

Unit– IV

Solution of System of Linear Algebraic Equations: Tridiagonal matrix algorithm (TDMA): Thomas algorithm Iteration methods: Jacobi, Gauss-Seidel and ADI methods.

Viscous incompressible flow, stream function– Vorticity method.

Introduction to grid generation– Types of grid – O,H,C.

Unit– V

Introduction to finite volume method: Finite volume formulations for diffusion equation, 1-D steady state heat conduction without and with constant source term convection diffusion equation: Central difference scheme, Upwind scheme, Exponential scheme, power law scheme. Solution algorithm for pressure velocity coupling in steady flows staggered grid, SIMPLE Algorithm.

Learning Resources:

1. Patankar S V, "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Company, New York 1980
2. Chung T J,"Computational Fluid Dynamics", Cambridge University Press, New York, 2002
3. H.K. Versteeg, W. Malalasekara, "An Introduction to computational Fluid Dynamics", 2nd Ed., Pearson Education, 2007
4. Muralidhar K, Sundararajan T, "Computational Fluid Flow and Heat Transfer", Narosa publication House, New Delhi, 2003
5. John D Anderson, "Computational Fluid Dynamics", Mc Graw Hill Inc., New York, 2003

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 II-SEMESTER

MACHINE TOOL DESIGN (ELECTIVE-II)

Instruction : 3 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4220
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. classify various mechanisms and machine tools. 2. explain various drives and design the gear box of machine tool. 3. design feed gear box and discuss materials for structures of machine tools. 4. design various bearings and spindles used in machine tools. 5. understand elements in hydraulic circuits and design for table and tool movement using hydraulic circuits.	On completion of the course, the student will be able to: 1. understand mechanisms for motion conversion and working of special purpose machines. 2. design and develop drives and speed control for machine tools. 3. develop feed gear box and design bed and structure of machine tool. 4. design and analyze spindle and bearings required to operate the machines. 5. appreciate and understand hydraulic systems in machine tools

UNIT – I

Classification of machine tools. Mechanisms used for converting rotary to linear motion and intermittent motion. Kinematic structures of machine tools– general purpose, special purpose, automatic screw cutting machines. Basic features of transfer machines. CAM design for automatic lathes.

UNIT – II

Drives of Machine tools: Selection of range of speeds and feeds. Layout in G.P., A.P. and Logarithmic progression, standardization of speeds and feeds. Productivity loss.

Selection of highest and lowest speeds, range ratio. Design of ray diagram and structural diagrams for machine tool gear boxes. Determination of number of teeth and module of gears in gear box design. Rules for lay out of gear box having sliding clusters. Sliding clustered drives, Ruppert drive.

UNIT – III

Feed gear boxes: Norton and Meander gear boxes. Stepped and step less regulation of speeds.

Strength and Rigidity design analysis. Design of beds, frames, Columns and Guide ways.

Materials for structures. Methods to improve the rigidity of structures. Overall compliance of machine tool. Thermal effects– functional accuracy of machine tool.

UNIT – IV

Spindle units: Spindle of lathe, drilling, milling and grinding machines, Materials for spindles. Spindle design. Effect of clearance on the rigidity of spindle.

Hydro– dynamic, hydro– static bearings; Requirements of spindle bearings.

UNIT – V

Hydraulic controls: Various controls used in machine tools. Basic hydraulic circuits for table quick return. Hydraulic and pneumatic systems used in machine tools– positive displacement pumps. Power pack. Relief valves check valves, flow control valves, multi position direction control valves, Filters, Accumulators, Speed regulation of surface grinding machine, Hydro– copying systems.

Learning Resources:

1. G.C. Sen & A. Bhattacharya, "Principles of Machine Tools", New Central Book Agency, Calcutta, 2011
2. N K Mehta,"Machine tool design and numerical control", 2nd Ed., Tata McGraw– Hill publishing co. Ltd., 1998
3. S.K. Basu, "Design of Machine Tools", Allied Publishers, 1965
4. S.R Majumdar, "Hydraulic Systems– Principles & Maintenance", Tata McGraw–Hill Publishing company Limited: New Delhi, 2006
5. Acharkhan, "Machine Tool Design" Volume-2, MIR Publicatins, Moscow, 5th edition, 1932

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 II-SEMESTER

MECHATRONICS (ELECTIVE-II)

Instruction : 3 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4230
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. identify the need for mechatronics and its applications 2. understand the drive mechanisms in mechatronics 3. study various fluid power systems 4. access various electronic components and devices 5. design mechatronics for mechanical applications.	On completion of the course, the student will be able to: 1. interpret the importance of mechatronics and elements involved. 2. evolve at various drives for typical applications in mechatronics 3. understand various drives and circuits 4. predict the importance and functioning of various electronic components. 5. choose various mechatronic elements to design mechatronics based systems.

UNIT – I

Introduction to mechanization & automation. Need of interface of electrical & electronic devices with mechanical elements. The concept of Mechantronics: Flow chart of mechatronics system. Elements of mechatronics system. Drive mechanisms. Actuators. Feedback devices and control system. Application in industries and systems development.

UNIT – II

Drive mechanisms: Feeding and indexing, orientation, escapement and sorting devices, conveyor systems. Introduction to electrical actuators: A.C servo motors, D.C. servomotors, stepper motors.

UNIT – III

Introduction to fluid power systems: Industrial pneumatics and hydraulics. Merits of fluid power. Pneumatic and hydraulic elements symbols. Study of hydraulic control values, pumps & accessories. Hydraulic circuits and mechanical servo control circuits, Electro– hydraulic and Hydro – pneumatic circuits.

UNIT – IV

Introduction to industrial electronic devices: Diodes, Transistors, Silicon controlled Rectifiers (SCR), Integrated Circuits (IC), Digital circuits. Measurement systems & Data acquisition systems: sensors, digital to analog and analog– to– digital conversion. Signal processing using operational amplifiers. Introduction to micro processor & micro controller. Temperature measurement interface and LVDT interface. Systems Response.

UNIT – V

Design of Modern CNC machines and mechatronics elements: machine structures, guide ways, spindles, tool monitoring systems, adaptive control systems. Flexible manufacturing systems. Multipurpose control machines. PLC programming

Learning Resources:

1. W. Bolton, "Mechatronics", 3rd Ed., Pearson Education India
2. HMT Limited, "Mechatronics, Tata Mc.Graw– Hill Publishing Company Limited; New Delhi, 1998.
3. Michael B Histand & David G. Alciatore, "Introduction to Mechatronics and Measurement systems", 4th Ed., Tata McGraw-Hill International edition, 2012
4. S.R Majumdar, Oil hydraulic systems– Principles & Maintenance, Tata McGraw–Hill Publishing Company Limited: New Delhi, 2006

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 II-SEMESTER

TOTAL QUALITY MANAGEMENT (ELECTIVE-II)

Instruction : 3 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4240
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

COURSE OBJECTIVE:	**COURSE OUTCOMES:**
The objectives of this course are to: 1. understanding the cost and value of the quality and role of leader in TQM. 2. stimation of customer satisfaction and methods to improve it and supplier rating 3. measuring of TQM and types of tools for that and various quality standards. 4. preparation of house of quality and QFD process. implementation of FMEA. 5. impact of Taguchi methods in TQM. implementation of TQM for a practical case.	On completion of the course, the student will be able to: 1. learn nomenclature in TQM, types leaderships theories and best practices in TQM. 2. understand the customer satisfaction and its continuous improvement. 3. tools and techniques of TQM and quality assurance systems. 4. implementation of QFD and DFMEA to TQM 5. apply various testing of hypothesis, 2 level & 3 level ANOVA, taguchi methods. TPM

Unit-I

Introduction to TQM: Definition of quality, Dimensions of quality, Quality planning, quality costs, analysis of quality costs, strategies for improving quality, Benefits of TQM..

Leadership role in TQM: Definition, characteristic of quality leaders, leadership concept. Dr. Stephen Covey"s seven habits of highly effective people. Deming philosophy, ethics, barriers to implement TQM.

Unit-II

Customer satisfaction: Understanding customer, customer perception of quality, customer complaints & feedback, service quality, translating needs into requirements, customer retention. Strategies for achieving motivated work force, employee empowerment.

Continuous process improvement: Continuous process improvement procedure, Juran trilogy, types of quality problems, quality improvement strategies, PDCA cycle, Kaizen, 5"S principle, Six Sigma

Supplier Partnering: Principles of customer and supplier relationship, partnering, sourcing, selection certification and supplier rating

Unit-III

Performance measures in TQM: Basic concept, measures and strategy

Tools and Techniques: SPC, check sheet, flow charts, graphs, histograms, pareto charts, cause and effect diagram, scatter diagram, control charts for variables and attributes, process capability.

Quality systems and bench marking: ISO 9000 requirements, implementation and documentation. Benchmarking definition , reasons for benchmarking, process and advantages.

UNIT-IV

Quality Function Deployment(QFD): house of quality, building house of quality, QFD process, Benefits of QFD.

Failure mode effect analysis: (FMEA): Design of FMEA, process FMEA, reliability, strategies of FMEA

UNIT-V

Taguchi Quality: Loss function, orthogonal array, S/N ratio, parameter design and tolerance design

Total Productive maintenance: process, improvements needs and developing plans

Case studies: TQM in India a case studies

Learning Resources:

1. Dale H.Besterfiled, "Total Quality Management", 6th edition, PHI, New Delhi
2. B.Senthil Arasu and J.Praveen Paul, "Total Quality Management", 4th edition, Scietech, Kolkata., 2015
3. Poornima M.Charantimath, Total Quality Management, Pearson India, 2nd edition, New Delhi, 2011
4. N.G.Logothetis, "Managing for Quality", Tata McGraw-Hill, 5th edition
5. B L Hansen and P M Ghare, "Quality control and application", Prentice-Hall, 1987

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 II-SEMESTER

INTELLECTUAL PROPERTY RIGHTS (ELECTIVE-II)

Instruction : 3 Hours/week	Semester End Exam Marks : 70	Subject Reference Code : ME 4250
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. have an insight on various intellectual properties. 2. know the procedure to file patents. 3. analyse the classes of articles registrable under industrial designs. 4. understand registered and unregistered trademarks. 5. know the subject matter of copyrights and the procedure to apply for copyright protection.	On completion of the course, the student will be able to: 1. Learn the meaning and nature of IPR and have knowledge of various international conventions 2. Awareness about how to file a patent and rights and obligations of a patentee 3. Knowledge of the aspects of industrial design and the articles eligible for registration 4. Know the importance of protecting trademarks and the associated goodwill 5. Learn the procedure to apply for copyrights and the various forms of copyrights

UNIT – I

Introduction: Overview of intellectual property (IP), importance of IP, Types of IP, territoriality of IP, impact of IP in socio-economic development, International organizations, treaties, and conventions associated with intellectual property; WTO, WIPO, GATT, TRIPS & TRIMS

UNIT – II

Patents: Meaning of a patent, commercial significance, patentable subject matter, filing and obtaining of a patents, rights and obligations of a patentee, specification, register of patents, rights and obligations of a patentee, compulsory licenses - revocation, surrender, i0nfringement. Utility models differences between a utility model and a patent.

UNIT – III

Industrial Design: Meaning of an industrial designs, registration, rights conferred by registration, infringement of "copyright in design".

Trade Marks: Meaning of a trade mark, purpose of protecting trademarks, trademarks registry, assignment, transmission, and licensing of trade marks, passing off.

UNIT – IV

Copy Rights: Nature of copy right, subject-matter of copyright, rights conferred by copyright, broadcasting, publication, computer programme, database, assignment, transmission, and relinquishment of copyright, infringement of copy right.

UNIT – V

Other forms of intellectual property: confidential information, know-how, industrial and trade secrets, and geographical indications.

Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, enforcement measures, emerging issues in intellectual property protection.

Unfair Competition: meaning of unfair competition, relation between unfair competition and intellectual property laws.

Learning Resources:

1. P.Narayanan, Intellectual property law, 3rd edn., Eastern Law House Revised 2017
2. B.L.Wadehra, Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications, 5th edition, Universal law Publishing Pvt. Ltd., India 2014
3. Cronish W.R., Intellectual property - patents, copyright, trademarks and allied rights, Sweet & Maxwell, 1999
4. Deborah E. Brouchoux, Intellectual Property, 3rd edition, Cengage learning 2012

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 II-SEMESTER

FUELS AND COMBUSTION (ELECTIVE-III)

Instruction : 3 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4260
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. Classify and study fuels and their properties 2. study stoichiometry relations and the combustion process 3. familiarize different types of burners. 4. Know alternate fuels for IC Engines	After completing the course the student will be able to: 1. Identify the different sources of fuel and characterize the fuels 2. Understand the thermodynamics and kinetics of combustion. 3. Solve the problems related to theory of combustion, air requirement for burning fuel 4. Conceptualize design considerations of burners 5. Use alternate fuels in IC Engines

UNIT – I

Types of fuels – solid, liquid and gaseous fuels, family of coal origin of coal, analysis and properties of coal, action of heat on coal, oxidation of coal, hydrogenation of coal, efficient use of solid fuels, manufactured fuels, agro fuels, solid fuel handling, properties related to combustion, handling and storage.

UNIT – II

Origin and classification of Petroleum, refining and other coversion processes, composition of petroleum with respect to combustion, property and testing of petroleum products, various petroleum products, nature of Indian Crudes & Petroleum refining in India, storage and handling of liquid fuels, liquid fuels combustion equipment.

Types of gaseous fuels, Natural gasses, methane from coal mine, Producer gas, water gas, blast furnace gas, LPG.

UNIT – III

Stoichiometry relations, theoretical air required for complete combustion, calculation of miniumum amount of air required for known composition, calculation of dry flue gases if fuel composition is known, calculation of composition of fuel and excess air supplied from exhaust gas analysis, flue gas analysis. (O_2, CO_2, NO_X, SO_X)

UNIT – IV

Burner Design: Ignition and concept of ignition, auto ignition, temperature flame propagation, various methods of flame stabilization, Incorporation in burner design, basic features of solid, liquid and gaseous fuel burner, design consideration of different types of coal, oil and gas burners, recuperative and regenerative burners.

UNIT – V

Alternate fuels for IC engines: Edible oils and non– edible oils for use in diesel engines, gaseous fuels like hydrogen, CNG, LPG for use in petrol engine.

Learning Resources:

1. Sharma S P, "Fuels and Combustion", Tata McGraw-Hill, New Delhi, 2000
2. Roger A, "Combustion Fundamentals", McGraw-Hill, New Delhi, 2000
3. Shaha A K, "Combustion Engineering & Fuel Technology", Oxford and IBH Publications, New York, 2003
4. Kenneth K Kou, 'Principles of Combustion', Wiley & sons Publications, New York 2002
5. S.R. Turns, "An introduction to combustion – Concepts and applications", Tata McGraw- Hill, 2000

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 II-SEMESTER

CONTROL SYSTEMS (ELECTIVE-III)

Instruction : 3 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4270
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. describe physical systems through mathematical models and graphical representations and assess their response and stability in frequency and time domains and design suitable control methods.	On completion of the course, the student will be able to: 1. develop Transfer functions for various systems using mathematical modelling. 2. simplify the systems given in pictorial representation and examine the steady state and transient behaviour 3. estimate the system behaviour using Routh criterion, Root locus and Bode diagrams. 4. assess the frequency response of the control systems using Polar and Nyquist plot and explain the principle of compensators. 5. model the system in state space domain and test for controllability and observability.

UNIT – I

Control Systems Classification: Examples of control systems, Open Loop & Closed Loop Systems. Mathematical models and Transfer functions from governing equations of mechanical, electrical, hydraulic, pneumatic, and thermal systems. Force- Voltage and Force-Current analogy.

UNIT – II

Block diagrams, Block diagram reduction. Signal flow graphs, Mason's gain formula. Transient response of 1^{st} order system to Step, Ramp, Parabolic and Impulse inputs. Time domain specifications of 2^{nd} order systems, Response of 2^{nd} order systems to Step input. Steady state error, Static and Dynamic Error Coefficients, Sensitivity.

UNIT – III

Routh stability criteria , Root Locus method for negative feedback systems.

Frequency Response, Bode plots. Experimental determination of transfer functions.

UNIT – IV

Polar and Nyquist Plots , Nyquist stability criteria. Gain and Phase Margins.

Introduction to compensator design (***qualitative treatment only***): Lead, Lag and Lag–Lead compensators.
PID controller, Correlation between transient and frequency response.

UNIT – V

State– space representation of linear control systems. Conversion of Transfer function into State Space, Conversion of State-Space in to Transfer Function, Solution of state equations by Laplace transformation technique and Time Domain technique. State Transition Matrix . Zero Input Response and Zero State Response. Concept of Controllability and Observability.

Learning Resources:

1. R.C. Dorf, "Modern Control Systems", Addison Wesley, 1989
2. M. Gopal, "Control Systems", Tata McGraw-Hill, 2004.
3. Ogata, K. "Modern Control Engineering", Prentice Hall, 2004
4. Norman S. Nise, "Control Systems Engineering", John Wiley & Sons, Inc., 2001.
5. William J. Palm, III, Modelling, Analysis, and Control of Dynamic Systems, John Wiley & Sons Inc., 2^{nd} Edition, 1999.

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 II-SEMESTER

ROBOTICS (ELECTIVE-III)

Instruction : 3 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4280
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. understand basic terminology and configuration of robots and know various applications of robots. 2. study D-H transformation and direct and inverse kinematics of various robots. 3. understand velocity relationships between joints and end effector and learn trajectory planning techniques. 4. learn Lagrange and Newton-Euler methods for dynamic analysis. 5. list and Understand various robot interfacing devices.	On completion of the course, the student will be able to: 1. explain basic terminology of robotics and Summarize various applications of robots. 2. apply direct and inverse kinematics to different robot manipulators using principles of D-H transformation. 3. utilize Jacobian matrix for velocity relationship of joints and end effector and plan trajectory of robots using different techniques like cubic polynomial etc. 4. estimate robot dynamics using Lagrange and Newton-Euler methods and develop control laws. 5. explain different types of end effectors, sensors and drives that are needed for effective working of robots.

UNIT – I

Laws of robotics, Basic terminology, Basic configurations, Degrees of freedom, work envelope, motion control methods. Application in industry – material handling, loading & unloading, processing, welding & painting applications, assembly and inspection, Robot specification requirements.

UNIT – II

Rotation matrix. Euler angles. RPY representation, Homogeneous transformation matrix. Denavit – Hartenberg convention. Direct and inverse kinematics for industrial robots for position and orientation, Redundancy.

UNIT – III

Manipulator Jacobian Joint–End effector velocity, Direct and inverse velocity analysis, Trajectory planning, interpolation, cubic polynomial linear segments with parabolic blending, Static force and moment transformation, Singularities.

UNIT – IV

Robot dynamics: Lagrangian and Newton–Euler formulation for RR & RP manipulators.
Control: individual joint, computed torque.

UNIT – V

End effectors: classification and working principle, Sensors: Position and velocity, Proximity and range, tractile and force. Drives for robots: Electrical, hydraulic and pneumatic. Introduction to Robot vision.

Learning Resources:

1. M W Spong and M Vidyasagar, "Robot Dynamics and Control", Ed. 1, John Wiley and sons, 1990
2. R.K. Mittal, I.J. Nagrath, "Robotics and Control", Tata McGraw-Hill, 2003.
3. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, "Industrial Robotics: Technology, Programming, and Applications, McGraw-Hill Companies , 1986
4. H.Asada and J-J.E.Slotine, "Robot Analysis and Control", Wiley Interscience, 1986
5. K.S. Fu, R.C.Gonzalez , C.S.G. Lee , "Robotics, Control Sensing Vision and Intelligence", McGraw-Hill, Int. Ed. 1987.

SYLLABUS FOR B.E. 4/4 II-SEMESTER

ADDITIVE MANUFACTURING TECHNOLOGIES (ELECTIVE-III)

Instruction : 3 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4290
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to : 1. Understand the fundamentals of various additive manufacturing technologies. 2. learn different types of liquid based AM systems 3. learn different types of solid based AM systems 4. learn different types of powder based AM systems, 5. discuss Rapid tooling, Applications of AM systems.	On completion of the course the student will be able to: 1. understand the importance of additive manufacturing technologies and its historical development 2. explain the process. advantages, disadvantages of liquid based AM systems 3. explain the process. advantages, disadvantages of solid based AM systems 4. explain the process. advantages, disadvantages of powder based AM systems 5. understand the latest developments in the field of AM technologies.

UNIT – I

Introduction, Prototyping fundamentals, Historical development, Fundamentals of rapid prototyping, Advantages of Rapid prototyping, Commonly used terms, Rapid prototyping process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, AM data formats, Classification of AM process

UNIT-II

Liquid based AM systems: Stereolithography Apparatus(SLA): Models and specifications, Process, Working principle, photopolymers, Photopolymerisation, Layering technology, laser and laser scanning, Applications, Advantages and disadvantages, Case studies

Solid ground curing(SGC): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies

UNIT-III

Solid based AM systems: Laminated object manufacturing(LOM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies.

Fused Deposition Modeling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies.

UNIT-IV

Powder based AM systems: Selective laser sintering(SLS): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies.

Three dimensional printing (3DP): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies.

UNIT-V

Rapid Tooling: Introduction to RT, conventional tooling v/s RT, need for RT, RT classification: Indirect RT methods: spray metal deposition, RTV epoxy tools, ceramic tools, Investment casting, spin casting, die casting, sand casting, 3D keltool process. Direct RT : direct AIM, LOM tools, DTM RT process, EOS direct tool process and direct metal tooling using 3DP

Applications of AM systems: Application – material relationship, Application in design, Application in engineering, analysis and planning, aerospace industry, automotive industry, jeweller industry, coin industry, GIS Application, arts and architecture.

RP medical and bio engineering Application: planning and simulation of complex surgery, customized implant and prosthesis , design and production of medical devices, forensic science and anthropology, visualization of bio-molecules.

Learning Resources:

1. Chua C.K., Leong K.F. abd LIM C.S., "World Rapid prototyping : Principles and Applications", 2nd Ed., Scientific Publications, 2004
2. D.T.Pham and S.S.Dimov, "Rapid Manufacturing", Springer, 2001
3. Amithaba Ghose, "Rapid prototyping", Eastern Law House, 1997
4. Paul F.Jacobs, " Stereolithography and other RP & M Technologies" , ASME Press, 1996
5. Paul F.Jacobs, "Rapid Prototyping & Manufacturing" , ASME Press, 1996

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 II-SEMESTER

PRODUCTION DRAWING (ELECTIVE-III)

Instruction : 3 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : ME 4300
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objectives	Course Out comes
The objectives of this course are to: 1. Practice the conventional representation of machine elements and designation of material. 2. Calculate limits, fits and tolerances, apply surface finish and surface treatments on part drawings 3. Make production drawings for the parts and prepare process sheets	On completion of the course, the student will be able to: 1. Convergent with conventional representation. 2. Understand the use of limits fits and surface finish symbols. 3. Prepare production drawings and process sheets.

UNIT – I

Layout of drawing sheet, title block, conventional representation of : Materials, machine components, welding symbols, hydraulic, pneumatic symbols, surface treatment.

UNIT – II

Limits and Fits: Basic definition of terms, alpha numeric designation of limits / fits. Types of Fits. Tolerances of form and position, surface roughness, process sheet.

UNIT – III

Part drawings from assemble drawings, indicating conventions: IC engine connecting rod, foot step bearing, hydraulic cylinder, stuffing box, hooks joint, piston, screw jack, tool post.

N.B.: Tolerance charts to be provided in the examination hall for calculation of limits.

Learning Resources:

1. K.L. Narayana, P. Kannaiah and K. Venkata Reddy, "Production Drawing", New Age International Pvt. Ltd., Revised Ed. 1997
2. T. Narasimha Reddy, T. A. Janardhan Reddy and C. Srinivasa Rao, "Production Drawing Practice", Hitech Publishers, 2001
3. R.K. Jain, "Engineering Metrology", Khanna Publishers, 2009

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 II-SEMESTER

INFORMATION SECURITY (ELECTIVE-III)

Instruction : 3 Hours /week	Semester End Exam Marks : 70	Subject Reference Code : CS 4250
Credits : 3	Sessional Marks: : 30	Duration of Semester End Exam : 3 Hours

Course objective	Course outcomes
Students should be able to	At the end of the course, students will be able to
• Learn legal and technical issues in building secure information systems. • Understand security standards and practices.	• Understand various components of Information Security. • Identify types of threats and the associated attacks to information security. • Analyze strategies to protect information assets from common attacks. • Evaluate security policies, standards and practices. • Identify the role of management in enforcing security policies and standards.

UNIT-I

Introduction: History, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, the SDLC, the Security SDLC. Need for Security: Business Needs, Threats, Attacks, and Secure Software Development

UNIT-II

Legal, Ethical and Professional Issues: Law and ethics in Information Security, Relevant U.S. Laws, International Laws and Legal Bodies, Ethics and Information Security. Risk Management: Overview, Risk Identification, Risk Assessment, Risk Control Strategies, Selecting a Risk Control Strategy, Quantitative versus Qualitative Risk Control Practices, Risk Management discussion Points, and Recommended Risk Control Practices.

UNIT-III

Planning for Security: Security policy, Standards and Practices, Security Blue Print, Security Education, Continuity strategies. Security Technology: Firewalls and VPNs: Physical Design, Firewalls, Protecting Remote connections.

UNIT-IV

Security Technology: Intrusion Detection, Access Control, and other Security Tools: Intrusion Detection and Prevention Systems-Scanning, and Analysis Tools- Access Control Devices. Cryptography: Foundations of Cryptology, Cipher methods, Cryptographic Algorithms, Cryptographic Tools, Protocols for Secure Communications, Attacks on Cryptosystems.

UNIT-V

Implementing Information Security: Information security project management, Technical topics of implementation, Non Technical Aspects of implementation, Security Certification and Accreditation. Security and Personnel: Positioning and staffing security function, Employment Policies and Practices, and Internal control Strategies. Information Security Maintenance: Security management models, Maintenance model, and Digital Forensics.

Suggested book:

1. Michael E Whitman and Herbert J Mattord, Principles of Information Security, (2011),Cengage Learning.

Reference Books:

2. Thomas R Peltier, Justin Peltier, John Blackley, Information Security Fundamentals,(2010), Auerbach Publications.
3. Detmar W Straub, Seymour Goodman, Richard L Baskerville, Information Security, Policy, Processes, and Practices,(2008) PHI.
4. Mark Merkow and Jim Breithaupt, Information Security Principle and Practices,(2007), Pearson Education.

Online resources:

1. http://nptel.ac.in/courses/106106129/

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR B.E. 4/4 II-SEMESTER

PROJECT / INTERNSHIP

Instruction : 18 Hours /week	Semester End Exam Marks : 50	Subject Reference Code : ME 4015
Credits : 9	Sessional Marks: : 50	Semester End Exam : VIVA *

Solving a real life problem should be the focus of U.G project. Faculty members should prepare project briefs well in advance. They should be made available to the students at the Departmental Library. A project may be classified as hardware/ Software/modelling /simulation. It should involve elements such as analysis, design and synthesis.

The Department will appoint a project coordinator who will be in– charge of the following:

- Grouping of students (maximum of three in a group)
- Allotment of projects and project guide.
- Project monitoring at regular intervals

A Project allotment is to be completed by the 4th week of 1st semester of IV year so that students get sufficient time for completion of their project.

All the project are to be checked for progress at least twice in a semester. It should be on the basis of presentation of the students.

Sessional marks to be based on the Grade/ Marks, awarded by a monitoring committee comprising of faculty members as well as by the supervisor.

Efforts to be made so that some of the projects are carried out in industries.

Norms of final documentation of the project report are to be provided by the Department.

* Excellent /Very Good /Good /Satisfactory/ Unsatisfactory