With Effect from the Academic Year 2016 - 2017

Chaitanya Bharathi Institute of Technology (Autonomous)
Department of Mechanical Engineering

SCHEME OF INSTRUCTION & EXAMINATION

B.E. IV-Year (Mechanical Engineering)

I-Semester

S. No	Syllabus Ref. No	SUBJECT	Instruction Per week				Scheme of Examination			Credits
			L	T	D/P	Lab	Duration in Hrs	Maximum Marks: End Exam	Maximum Marks: Sessional	
THEORY										
1	ME 411	Thermal Turbo Machines	4	1	-	-	3	75	25	3
2	ME 412	Metrology and Instrumentation	4	-	-	-	3	75	25	3
3	ME 413	Finite Element Analysis	4	1	-	-	3	75	25	3
4	ME 414	Operations Research	4	-	-	-	3	75	25	3
5		ELECTIVE - II	4	-	-	-	3	75	25	3
PRACTICALS										
1	ME 415	Thermal Engineering Lab	-	-	-	3	3	50	25	2
2	ME 416	Metrology and Instrumentation Lab	-	-	-	3	3	50	25	2
3	ME 417	Computer Aided Engineering Lab	-	-	-	3	3	50	25	2
4	ME 418	Project Seminar	-	-	3	-	-	-	25	1
		TOTAL	**20**	**2**	**3**	**9**	**-**	**-**	**-**	**22**
ELECTIVE - II										
1	ME 461	Renewable Energy Sources	4	-	-	-	3	75	25	3
2	ME 462	Computational Fluid Dynamics	4	-	-	-	3	75	25	3
3	ME 463	Automobile Engineering	4	-	-	-	3	75	25	3
4	ME 464	Entrepreneurship	4	-	-	-	3	75	25	3
5	PE 461	Robotics	4	-	-	-	3	75	25	3
6	CE 461	Disaster Mitigation and Management	4	-	-	-	3	75	25	3
Service course [B.E]										
1	ME 419	Industrial Administration and Financial Management (ECE)	4	-	-	-	3	75	25	3
2	ME 464	Entrepreneurship (EEE, CSE, Civil)	4	-	-	-	3	75	25	3

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ME 411

Thermal Turbo Machines

Instruction	4	Theory + 1 Tutorial Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives:

1. Student will demonstrate basic knowledge by understanding concepts of various gas dynamics equations, necessary for CFD
2. Student will acquire basic knowledge in designing of nozzles and diffusers used in rockets and aircrafts
3. Student will come to know the design of ducts, combustion chambers and various types of shocks
4. Student will come to know the working principles of various rotary compressors like centrifugal compressor and rotary compressor
5. Student will understand the applications of various steam turbines and velocity triangles in order to calculate power developed by them
6. Student will demonstrate the basic knowledge in gas turbines and various methods to improve efficiency of gas turbine cycles.

Outcomes: At the end of the course, students will be able to

1. Design various configurations of steam nozzles by the principles of gas dynamics which are essential or pre-requisite to computational fluid dynamics
2. Understand Fanno curves along with shock waves
3. Understand the importance of Rayleigh curves in gas dynamics
4. Calculate power required by various types of rotary compressors with the principles of gas dynamics
5. Specify steam turbine as per the application and also calculate power developed by them
6. Calculate thermal efficiency of gas turbines with the principles of gas dynamics and suggest suitable methods to improve work output and efficiency of the plant.

UNIT-I

Introduction to compressible flows: Speed of propagation of pressure waves, Mach number, Acoustic velocity and Mach cone, limits of compressibility, pressure field due to a moving source of disturbance, one dimensional compressible flow. Isentropic flow with variable area, Mach number variation, Area ratio as function of Mach number, flow through nozzles and diffusers. Flow in constant area ducts with friction-Fanno flow, variation of flow properties, variation of Mach number with duct length, isothermal flow with friction

UNIT-II

Flow in constant area duct with Heat Transfer, -The Rayleigh liner, Rayleigh flow relations, variation of flow properties, Maximum heat transfer. Flow with Shock Waves-Development of Normal Shock waves, governing equations, Prandtl -Meyer relation, Rankine-Hugoniot equations, Stagnation pressure ratio across shock.

UNIT-III

Blade nomenclature of an aerofoil, Rotodynamic compressors: Introduction and general classification, Comparison of Reciprocating and Rotary compressors, Positive displacement Rotary compressors, Flow through rotary compressors. Static and total head quantities, Thermodynamic cycles and work done, calculation of various efficiencies. Velocity diagrams and prewhirl. Euler equation for energy transfer between fluid and rotor, Analysis of Centrifugal compressors and analysis of axial flow compressors, Chocking, Surging and Stalling.

UNIT-IV

Steam Turbines: Classification, flow over blades, pressure velocity variations, Compounding of steam turbines- pressure compounding, velocity compounding and pressure-velocity compounding, Impulse turbine with several blade rings, Nozzle efficiency, Blade efficiency and Gross stage efficiency of Impulse turbine, Velocity diagrams for Impulse turbine-De Laval Turbine, blade efficiency of Impulse turbine, Optimum blade speed ratio, Maximum work done and blade efficiency of Impulse turbine, Degree of reaction of Reaction turbine, Parson Reaction turbine, Velocity diagram for Parson Reaction turbine, blade efficiency of Parson Reaction turbine, Maximum work done and blade efficiency of Parson Reaction turbine, Height of blades of Reaction turbine, Balancing of End thrust

UNIT-V

Gas Turbines: Applications and Classification of Gas Turbines- constant pressure and constant volume gas turbines, Joule cycle-configuration diagram and temp-entropy diagram, Thermal efficiency of Joules cycle, 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. Simple Problems on Joule cycle.

Air Craft Propulsion: Air craft engine types, air craft propulsion theory, Turbo jet engines, Ramjet engines, Pulse jet engines, Rocket Propulsion: Types of Propellants, Types of Rocket engines, Rocket propulsion theory-Rocket applications

Text Books:

1. Yahya S M, *Fundamentals of Compressible Flow,* New Age International Publishers, Third Edition, 2007.
2. Mathur ML, & Mehta F S, *Thermal Engineering,* Jain Brothers, New Delhi, 2003
3. Dennis G Shepherd, *Aerospace Propulsion,* Elsevier Publishing Company, New York, 1995.

Suggested Reading:

1. Cohen H Rogers G F C, Saravana Mutto H I H, *Gas Turbine Theory,* Longman 5th Edition, New York, 2004.
2. Ganeshan V, *Gas Turbines*, Tata Me Graw Hills, New Delhi, 2003
3. Yadav, R *Steam and Gas Turbines*, Central Publishing House Ltd, Alllahabad, 2003

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ME 412

Metrology and Instrumentation

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives:

1. Student will understand the need for measurement and fundamental concepts of measurement.
2. Student will get familiarize with limits, Fits& tolerances and the instruments used to measure these limits.
3. Student will able to have knowledge of various precision linear and angular measuring instruments.
4. Student will learn the importance of Geometric form and how to measure form errors.
5. Equip the student to have knowledge in the concepts of classification of instrument errors and their characteristics.
6. Student will enable to understand the working principles of various instruments used for the measurement of strain, forces, pressure, and temperature.

Outcomes: At the end of the course, students are able to

1. Learn and understand the need for measurement and fundamental concepts of measurement.
2. Demonstrate sound knowledge in gauges design and gauge selection for inspection.
3. Acquire the knowledge about fundamentals of linear and angular measurements and various instruments used for measuring the different parameters.
4. Demonstrate an ability to select and use the appropriate measuring instruments to measure surface roughness and other geometric form errors.
5. Recognize the concepts of errors, classification and instrument characteristics.
6. Apply the skills in measuring various quantities like strain, force, pressure & temperature.

UNIT-I

Limits, Fits and Tolerances: Types of fits, Selective assembly and interchangeability, Taylor's Principle for plain limit gauges, Use of Plug, Ring and Snap gauges, Introduction to Linear and Angular measurements, Slip gauges and End bars, Gauge material and manufacturing methods, Different types of Micrometers, Height gauges, Tomlinson gauges, Sine bar.

UNIT-II

Comparators: Dial indicator, Sigma Mechanical comparator, Back pressure type Pneumatic comparator. Optical projector and its Principle and Applications, Tool maker's Microscope and its Principle and applications, measurement of straightness and flatness, Auto collimator, Roundness measurement with bench centers and talyround, Coordinate Measuring Machine.

UNIT-III

Surface Roughness Measurements: Profilometer, Taylor Hobson Talysurf, Application of screw Thread metrology - 2 wire and 3 wire methods, Best wire size, Spur Gear nomenclature, Gear tooth thickness measurement by gear tooth vernier, Parkinson gear tester.
Introduction to Interferometry and its applications, The N.P.L. flatness Interferometer.

UNIT-IV

Elements of instrumentation system: Static and Dynamic characteristics of instruments, Types of errors, Strain measurement, Wire and foil type resistance strain gauges, Rosette Gauges, Bonding procedure, Strain Gauge Factor, Application of strain gauges, Strain gauge load cells, measurement of axial load and torsion by strain gauges, Piezo electric load cell.

UNIT-V

Introduction to Transducers: Displacement and acceleration measurement, L.V.D.T, Pressure measurement by Bourdon pressure gauge, Bulk modulus pressure gauge and Pirani gauge, Temperature measurement by thermo couples, Laws of thermo electricity, Types of materials used in thermocouples, Series and parallel circuits.

Text Books:

1. R.K. Jain, *Engineering Metrology*, Khanna Publications, 1996.
2. Doeblin, *Measurement Systems Application and Design*, TMH, 5th Edn., 2004.
3. Anand Bewoore & Vinay Kulkarni, *Metrology & Management*, McGrawhill Education India, 2014.
4. I B.C. Nakra & K.K. Chaudhary , *Instrumentation Measurement and Analysis* , 3rd Edn., McGrawhill, 2014

Suggested Reading:

1. IC Gupta., *Engineering Metrology*, Dhanpat Rai Pub. New Delhi, 1984.
2. Rega Rajendra, *Principles of Engineering Metrology*, Jaico Publishing House, Mumbai, 2008.

ME 413 **Finite Element Analysis**

Instruction	4	Theory + 1 Tutorial Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives:

1. Equip the students with the Finite Element Analysis fundamentals and formulations
2. Enable the students to formulate the axial, truss, beam and 2d problems
3. Enable the students to formulate the heat conduction and dynamics problems
4. Able to understand use of numerical integration and Gaussian quadrature
5. Enable the students to understand the convergence requirements and to formulate torsional and 3D problems
6. Enable the students to perform engineering simulations using Finite Element Analysis software (ANSYS)

Outcomes: At the end of the course a student will be able to

1. Apply FE method for solving field problems using Virtual work and Potential energy formulations
2. Analyze linear problems like axial, trusses and beam; 2D structural problems using CST element and analyze the axi-symmetric problems with triangular elements
3. Write shape functions for 4 node quadrilateral, isoparametric elements and apply numerical integration and Gaussian quadrature to solve the problems
4. Solve linear 1D and 2D heat conduction and convection heat transfer problems, analysis of torsion of circular shaft
5. Evaluate the Eigen values and Eigenvectors for stepped bar and beam, formulate 3D elements, check for convergence requirements
6. Apply FE for 1D transient heat conduction, use of FEA software ANSYS for engineering solutions

UNIT-I

Fundamental concepts: Introduction to Finite Element Method, Stresses and Equilibrium, Boundary conditions, Strain-Displacement and Stress-Strain relationship.

One dimensional problems: Finite element modeling coordinates and shapes functions, Virtual work and Potential Energy approach, Assembly of Global stiffness matrix and load vector, Finite element equations, Treatment of boundary conditions, Analysis of Axial element and Quadratic element.

UNIT-II

Analysis of Trusses and Frames: Element stiffness matrix for a truss member, Analysis of plane truss with two degrees of freedom at each node. Analysis of Beams: Element stiffness matrix for two nodes (two degrees of freedom per node). Analysis of frames with two translations and rotational degrees of freedom per node. Torsion: Analysis of circular shaft subjected to torsion.

UNIT-III

2D Triangular Elements: Plane stress, Plane strain and Axisymmetry, Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Finite element modeling of axi-symmetric solids subjected to axi- symmetric loading with triangular elements.

UNIT-IV

Quadrilateral Elements and Numerical Integration: Two dimensional Four nodded iso-parametric Elements, Numerical Integration and Gaussian Quadrature

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

UNIT-V

Heat Transfer Analysis: Steady State Heat Transfer Analysis: One dimensional analysis of a fin and two dimensional analysis of thin plate. Time dependent field problems: Application to one dimensional heat flow in a rod.

3D Elements and FEA Software: Introduction to finite element formulation of three dimensional problems in stress analysis, Convergence requirements, Finite Element Analysis Software: Modeling, Analysis and Post Processing.

Text Books:

1. Ramamurthy, G. *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,* Practice Hall of India, 1997.
3. Daryl L. Logan, *A First Course in the Finite Element Method,* Cengage Learning, 2011.

Suggested Reading:

1. Rao S S, *The Finite Element Method in Engineering*, Pergamon Press, 1989.
2. Segerlind L J, *Applied Finite Element Analysis*, Wiley Eastern, 1984.
3. Reddy JN, *An Introduction to Finite Element Method*, McGraw-Hill, 1984.
4. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt., *Concepts and Applications of Finite Element Analysis*, 4th Edition. Wiley

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ME 414

Operations Research

(for Mech, Prod and I.T)

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives:

1. Students will understand the significance of Operations Research concept and techniques
2. Students will come to know the formulation of LPP models
3. Students will understand the Algorithms of Graphical and Simplex Methods
4. Students will understand the Transportation and Assignment techniques
5. Students will come to know the procedure of Project Management along with CPM and PERT techniques
6. Students will understand the concepts of sequencing and queuing theory

Outcomes: At the end of the course, the students were able to

1. Recognize the importance and value of Operations Research and mathematical formulation in solving practical problems in industry;
2. Formulate a managerial decision problem into a mathematical model;
3. Apply Operations Research models to real time industry problems;
4. Build and solve Transportation Models and Assignment Models.
5. Apply project management techniques like CPM and PERT to plan and execute project successfully
6. Apply sequencing and queuing theory concepts in industry applications

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, Degeneracy in Simplex, Duality in Simplex.

UNIT-II

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Special cases in Transportation problems - Unbalanced Transportation problem, Degeneracy in Transportation, Profit Maximization in Transportation.

UNIT-III

Assignment Techniques: Introduction, Hungarian technique of Assignment techniques, unbalanced problems, problems with restrictions, Maximization in Assignment problems, Travelling salesman problems

UNIT-IV

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times, Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, duration of the project, Free float, Independent float and Total float, Crashing of network.

UNIT-V

Sequencing Models: Introduction, General assumptions, processing 'n' jobs through two machines, processing 'n' jobs through three machines.

Queuing Theory: Introduction, Kendal's Notation, single channel - poisson arrivals - exponential service times

Text Books:

1. Hamdy, A. Taha, *Operations Research-An Introduction*, Sixth Edition, Prentice Hall of India Pvt. Ltd., 1997.
2. S.D. Sharma, *Operations Research*, Kedarnath, Ramnath & Co., Meerut,2009
3. V.K. Kapoor, *Operations Research*, S. Chand Publishers, New Delhi, 2004

Suggested Reading:

1. Harvey M. Wagner, *Principles of Operations Research*, Second Edition, Prentice Hall of India Ltd., 1980.
2. R. Paneer Selvam, *Operations Research*, Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2008.
3. Nita H. Shah, Ravi M. Gor, Hardik Soni, *Operations Research*, PHI Learning Private Limited, 2013

ME 415

Thermal Engineering Lab

Instruction	3	Periods per week
Duration of End Examination	3	Hours
End examination	50	Marks
Sessionals	25	Marks
Credits	2	

Objectives:

1. Student will acquire basic knowledge in determining thermal conductivity of an insulating powder in composite slab or cylinder.
2. Student will demonstrate basic knowledge in evaluating the heat transfer coefficients under natural convection and forced convection phenomena
3. Student will determine the necessary constants pertaining to radiation
4. Student will acquire basic knowledge in understanding the working principles of axial flow fan and its overall efficiency.
5. Student will come to know in estimating overall efficiency of a centrifugal compressors
6. Student will demonstrate basic knowledge the importance of pressure distribution over cylinder and an aerofoil section on turbo machines

Outcomes: At the end of the course, the students were able to

1. Estimate thermal conductivity of insulating powder in composite slab or cylinder
2. Measure the heat transfer coefficients under natural and forced convection phenomena
3. Know the properties associated with radiation heat transfer
4. Determine overall efficiency of axial flow fan
5. Determine overall efficiency of centrifugal fan
6. Determine pressure distribution over cylinder and an aerofoil section and the effect of lift and drag forces on them.

Experiments:

1. Determination of COP of Air Conditioning System
2. Determination of percentage relative humidity and study of Humidification and Dehumidification process in Air Conditioning Systems
3. Determination of COP of Refrigeration Systems using Capillary tube/thermostatic expansion valve
4. Determination of Overall efficiency of Centrifugal Blower
5. Determination of Overall efficiency of Axial Flow Fan
6. Pressure distribution on symmetrical and non-symmetrical specimen in Wind tunnel
7. Measurement of Lift and Drag force of the models in wind tunnel test section
8. Determination of Thermal conductivity of metal bar
9. Determination of efficiency of pin-fin subjected to natural and forced convection
10. Determination of effectiveness of heat parallel flow and counter flow heat exchanger
11. Determination of Emissivity of given test plate
12. Determination of Stefan-Boltzmann constant

Note: Student should complete a minimum of 10 experiments.

Suggested Reading:

1. Yahya S M, *Fundamentals of Compressible Flow,* New Age International Publishers, Third Edition, 2007.
2. Mathur ML, & Mehta F S, *Thermal Engineering,* Jain Brothers, New Delhi, 2003

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ME 416

Metrology and Instrumentation Lab

Instruction	3	Periods per week
Duration of End Examination	3	Hours
End examination	50	Marks
Sessionals	25	Marks
Credits	2	

Objectives:

1. Student will choose the proper measuring instrument for the precise measurement of Length, Height and diameter
2. Student will able to select the proper measuring instrument for the angular measurement.
3. Student will indentify gear & screw thread parameters using optical projector and tool makers microscope.
4. Student will get familiarize with limits & fits, gauge selection and design.
5. Student will enable to understand the working principles in the measurement of Flatness, Roundness and Surface roughness.
6. Student will equip with various aspects regarding displacement.

Outcomes: At the end of the course, the students were able to

1. Identify methods and devices for measurement of length, height and diameter.
2. Acquire the knowledge about angular measurement and various measuring instruments.
3. Recognize & measure the gear and screw thread parameters using profile projector and tool maker microscope.
4. Demonstrate the sound knowledge in gauges selection and design.
5. Acquire adequate knowledge in the measurement of flatness, roundness and surface roughness.
6. Demonstrate the measurement of displacement.

Experiments:

1. Measurement with inside, outside and depth micrometers.
2. Measurement with height gauges, height masters, etc.
3. Measurement of Linear and Angular dimensions with Tool Maker's Microscope – Diameter of a thin wire and single point cutting tool angle.
4. Measurement with Dial Indicator and its calibration.
5. Measurement of angles with Sine bar and Bevel protractor.
6. Measurement of roundness errors with bench centers.
7. Measurement of flatness errors (surface plate) with precision level.
8. Measurement with optical projector.
9. Checking machined components with plug gauges and adjustable snap gauges.
10. Surface roughness measurement by Taylor Hobson -Talysurf.
11. Measurement of Gear tooth thickness.
12. Displacement measurement with LVDT.

Note: Student should complete a minimum of 10 experiments.

Suggested Reading:

1. IC Gupta, *Engineering Metrology*, Dhanpat Rai Pub., New Delhi, 1984.
2. B.C. Nakra & K.K. Chaudhary , *Instrumentation Measurement and Analysis*, , 3rd Edn. McGrawhill, 2014

ME 417

Computer Aided Engineering Lab

Instruction	3	Periods per week
Duration of End Examination	3	Hours
End examination	50	Marks
Sessionals	25	Marks
Credits	2	

Objectives: Students will understand

1. The fundamental knowledge on using analytical tools like ANSYS for Simulation.
2. Various fields, where these tools can be used to improve the output of a product.
3. How these tools are used in Industries by solving some real time problems.
4. Models of trusses, plate structure, beams using ANSYS general purpose software
5. The solve heat transfer problems using ANSYS
6. Evaluating and interpret FEA results for design

Outcomes: At the end of the course a student should be able to:

1. Use FEA software to analyze complex structural systems.
2. Perform modal analysis of parts
3. Perform steady-state and transient heat transfer analysis
4. Produce graphical displays, including animations, of the results.
5. Perform buckling analysis
6. Acquire knowledge on utilizing ANSYS.

Experiments:

1. Analysis of plane truss & special truss with various cross sections and materials
2. 2D & 3D beam analysis with different sections, different materials for different loads
3. Static analysis of plate with a hole.
4. Plane stress, plane strain and axisymmetric loading on the in plane members.
5. Static analysis of connecting rod with tetrahedron and brick elements.
6. Static analysis of flat and curved shell due to internal pressure.
7. Buckling analysis of plates, shells and beams to estimate BF and modes.
8. Modal analysis of beams, plates and shells for natural frequencies and mode shapes.
9. Harmonic analysis of a shaft and transient analysis of plate.
10. Steady state heat transfer analysis of chimney and transient analysis of castings.
11. Non linear analysis of cantilever beam.
12. Coupled field analysis

Note: 1. Student should complete a minimum of 10 experiments.

2. Any of FEA software ANSYS/ABAQUS/NASTRAN/NISA/CAEFEM/ADINA may be used

Suggested Reading:

1 Tadeusz, A. Stolarski, Y. Nakasone, S. Yoshimoto, *Engineering Analysis with ANSYS Software*, 1st Edition, Elsevier Butterworth-Heinemann publications, 2007

2. ANSYS Inc. *User Manuals for Release 15.0*

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ME 418

Project Seminar

Instruction	3	Periods per week
Sessionals	25	Marks
Credits	1	

The objective of the project seminar is to actively involve the student in the initial work required to undertake the final year project. Dealing with a real time problem should be the focus of the under graduate project.

It may comprise of

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

The department should appoint a project coordinator who will coordinate the following.

- Grouping of students as project batch(a maximum of 3 in group)
- Allotment of projects and project guides
- Project monitoring at regular intervals.

Each project group/batch is required to

1. Submit a one page synopsis of the seminar to be delivered for display on notice board.
2. Give a 30-40 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write up on the talk delivered.

Three (3) 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 on all the three items stated above.

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ME 461

Renewable Energy Sources (Elective – II)

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives: Student will learn the

1. Need and importance of non-conventional energy resources
2. Extent of solar energy which can be utilized as energy resource
3. Concept of wind energy and its merits and demerits
4. Operating principles of ocean and geothermal energy
5. Advantages and disadvantages of bio-energy over conventional energy
6. Merits and demerits of tidal energy, wave energy and OTEC

Outcomes: At the end of the course, the students are able to

1. Understand the depletion and of environmental impact conventional sources of energy and will suggest suitable and alternative renewable energies in place of fossil energies
2. Know the absorption, conversion and utilization of solar energy
3. Understand the problems associated with utilizing the wind energy
4. Describe the physics of geothermal resources and describe how biomass is currently used as a source of energy
5. Explain the physical principles of wave energy, the generation of tides and how to harness their power
6. Understand the environmental impact of OTEC plants

Unit-I

Statistics on conventional energy sources and supply in developing countries, Definition-Concepts of RES, Limitations of RES, Classification of NCES-Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

Unit-II

Solar Energy- Solar Radiation – Energy available from Sun, Solar Thermal Collectors – Flat Plate and Concentrating Collectors –Solar Applications, Solar engines-Stirling, Brayton engines, fundamentals of photo Voltaic Conversion – p-n junction – PV solar cells and its materials-solar satellite system

Unit-III

Wind energy- merits and demerits-Wind power plant-site selection-classification of wind power plants-Windmill rotors- Horizontal axis and vertical axis rotors-.working principle-New developments.

Unit-IV

Geothermal energy- Layers in earth-Definition and classification of resources.

Biomass energy-Biomass- Source, Composition, Conversion technologies – Direct combustion-Pyrolysis–Gasification, Biomass gasifier –float and fixed dome types

Unit V

Wave, Tidal and OTEC energy- Difference between tidal and wave power generation-single basin and double basin tidal plants-progressive wave.

OTEC power plants- Open and closed OTEC Cycles- Environmental impacts of OTEC.

Text Books:

1. S. Hasan Saeed and D.K. Sharma, *Non Conventional Energy Resources*, S.K. Kataria & Sons, New Delhi, 2014
2. Dr. R.K. Singal, *Non Conventional Energy Resources*, S.K. Kataria & Sons, New Delhi, 2005
3. G.D. Rai, *Non Conventional Energy Sources*, Khanna Publishers, New Delhi, 2011

Suggested Reading:

1. Mittal K M, *Non-Conventional Energy Systems*,Wheeler Publishing Co. Ltd, New Delhi, 2003.
2. Ramesh R & Kumar K U, *Renewable Energy Technologies*, Narosa Publishing House, New Delhi, 2004
3. Shali Habibulla, *Non-Conventional Energy Sources*, State Institute of Vocational Education, Hyderabad, 2005
4. Ashok V Desai, *Non-Conventional Energy*, Wiley Eastern Ltd, New Delhi, 2003
5. R.K. Hegde, *Power Plant Engineering*, Pearson Education India, 2015

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ME 462

Computational Fluid Dynamics (Elective – II)

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives:

1. Understanding of governing equations of fluid flow.
2. Student understand finite difference and finite volume methods to solve fluid flow equations.
3. Issues that arise in the solution of such equations.
4. Various methods to overcome those issues and modern trends in CFD.
5. Get exposure to grid generation.
6. Various boundary conditions and their implementation.

Outcomes: At the end of the course, the students were able to

1. Classify basic equations of fluid flow
2. Choose appropriate boundary conditions
3. Choose proper numerical technique to solve equations.
4. Critically analyze different mathematical models and computational methods for flow simulations
5. Interpret computational results.
6. Acquire the required knowledge to take advanced courses in CFD.

UNIT-I

Basic Equations: Continuity, momentum and energy equations, navier-stokes equations, Heat transfer conduction equations for steady and unsteady flows, steady convection-diffusion equation.

UNIT-II

Models: Reynolds and Favre averaged N-S equations, Mixing length model, k-epsilon turbulence model

Classifications of partial differential equations: Elliptic, parabolic and hyperbolic equations, Initial and boundary value problems

UNIT-III

Finite Difference Method: Forward, backward and central difference

Parabolic partial differential equations: Euler, implicit and crank Nicholson methods, ADI models, Errors, consistency, stability analysis, Vonnumen analysis, Convergence criteria.

UNIT-IV

Elliptic partial differential equations - Jacobi, Gauss seidel methods, Viscous incompressible flow, Stream-function-vorticity method

Introduction to grid generation- types of grids O, H, C

UNIT – V

Finite Volume Method: Finite volume formulation for diffusion equation, convection diffusion equation, Solution algorithm for pressure velocity coupling in steady flows, staggered grid, SIMPLE algorithm.

Text Books:

1. J.D. Anderson, Jr., *Computational Fluid Dynamics: The Basic with Applications* McGraw Hill, Inc., 2012
2. H. Versteeg and W. Malalasekra, *An Introduction to Computational Fluid Dynamics*: The Finite Volume Method, Pearson,2nd edn. 2011

Suggested Reading:

1. John F. Wendt (Editor), *Computational Fluid Dynamics - An Introduction*, Springer – Verlag, Berlin, 1992
2. Charles Hirsch, *Numerical Computation of Internal and External Flows*, Vols. I and II. John Wiley & Sons, New York, 1988.
3. K. Muralidhar and T. Sundarajan.. *Computational Fluid Flow and Heat Transfer*, Narosa Publishing House. 2008
4. C.J.Date , *Introduction to CFD*, Dorling Kindersley Pvt Ltd, 2007

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ME 463

Automobile Engineering (Elective – II)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: The student will learn

1. The anatomy of the automobile in general
2. The location and importance of each part
3. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels
4. Suspension, frame, springs and other connections
5. ignition, controls, electrical systems and ventilation
6. Emissions, pollution regulations, EURO and BHARATH stages

Outcomes: At the end of the course, the student will be able to

1. Identify the different parts of the automobile
2. Explain the working of various parts like engine, transmission, clutch, brakes
3. Describe how the steering and the suspension systems operate.
4. Understand the environmental implications of automobile emissions
5. Develop a strong base for understanding future developments in the automobile industry

Unit I

Types of automobiles: Normal, Hybrid and Hydrogen Fuel vehicles. Engine location and its components, chassis layout; crank shaft proportion, firing order, piston and piston rings, cylinder liners, valves and operation mechanism, inlet and exhaust manifolds, carburetion and fuel injection system, Mechanical Fuel Injection system & Electronic Fuel Injection System.

Unit II

Lubricating Systems: Wet sump, dry sump and petroil systems - Cooling systems: Water pumps, radiators, thermostat control anti freezing compounds - Types of Ignition Systems, Modern Ignition systems, Types of Batteries and charging systems, starting motors, lighting and electrical accessories, automobile air-conditioning.

Unit III

Steering systems: Linkage arrangements and its components modified Ackerman linkage, wheel alignment, caster and camber. Rack and pinion assembly, recent trends, Wheel and tyres: Tyre construction, specification. Tyre wear and causes, wheel balancing, Types q/' Suspension system, Independent suspension, coil and leaf springs, torsion bar, shock absorbers.

Unit IV

Power Train: Clutches, gear and gearbox manual, semi-automatic and automatic gearboxes. Torque converter, propeller shaft, universal coupling differential, four-wheel drive system
Brakes Systems: Description and operation of hydraulic brake, leading and trailing shoe layout, disc brakes, master cylinder and hand brake linkage, Recent Trends.

Unit V

Maintenance: Pollution control, trouble shooting and servicing procedure overhauling, engine tune up, tools and equipment for repair and overhaul testing equipment, pollution control technologies used for petrol and diesel engines. Types and study of catalytic converters, Euro norms 2 & 3 and Bharat Norms – Recent Trends.

Text Books:

1. *Crouse & Anglin, Automotive Mechanics*, TataMcGraw Hill. Publishing Co. Ltd., New Delhi, Tenth Edition – 2004
2. Kirpal singh., *Automobile Engineering Vol. I & II* Standard Publishers, Delhi.

Suggested Reading:

1. Joseph Heitner, *Automotive Mechanics*, Affiliated East West Pvt. Ltd.
2. C.P Nakra, *Basic Automobile Engineering*, Dhanpat Rai Publishing Co(P) Ltd., New Delhi, 2003.
3. G.B.S. Narang, *Automobile Engineering*, Khanna Publishers, New Delhi, 2014
4. R.K. Rajput, *A Textbook of Automobile Engineering*, Laxmi Publications, New Delhi, 2012

With Effect from the Academic Year 2016 - 2017

ME 464

Entrepreneurship (Elective – II)
(for Mech, Prod, Civil, EEE, ECE, I.T, Chemical, BioTech and CSE)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. The essence of Entrepreneurship
2. The environment of industry and related opportunities and challenges
3. Concept a procedure of idea generation
4. Elements of business plan and its procedure
5. Project management and its techniques
6. Behavioral issues and Time management

Outcomes: After completing this course, students will be able to:

1. Apply the entrepreneurial process
2. Analyze the feasibility of a new business plan and preparation of Business plan
3. Evaluate entrepreneurial tendency and attitude
4. Brainstorm ideas for new and innovative products or services
5. Use project management techniques like PERT and CPM
6. Analyze behavioural aspects and use time management matrix

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, Corporate Social Responsibility.

UNIT-II

Identification and characteristics of entrepreneurs: First generation entrepreneurs, environmental influence and women entrepreneurs, Conception and evaluation of ideas and their sources, Selection of Technology, Collaborative interaction for Technology development.

UNIT-III

Business plan: Introduction, Elements of Business Plan and its salient features, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility studies, Executive Summary.

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

Behavioral aspects of entrepreneurs: Personality, determinants, attributes and models, Leadership concepts and models, Values and attitudes, Motivation aspects, Change behavior

Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai, *Dynamics of Entrepreneurial Development and Management*, Himalaya Publishing House, 1997.
2. Prasanna Chandra, *Project-Planning, Analysis, Selection, Implementation and Review*, Tata Mcgraw-Hill Publishing Company Ltd. 1995.
3. S.S. Khanka, *Entrepreneurial Development*, S. Chand & Co. Pvt. Ltd., New Delhi

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, *Entrepreneurship*, Tata Me Graw Hill Publishing Company Ltd., 5lh Ed., 2005
2. Stephen R. Covey and A. Roger Merrill, *First Things First*, Simon and Schuster Publication, 1994.
3. Sudha G.S., *Organizational Behavior*, National Publishing House, 1996.

With Effect from the Academic Year 2016 - 2017

PE 461

Robotics (Elective – II)

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives: Students will understand

1. The configuration, work envelop and motion controls and applications
2. Familiarities with the kinematics of robots.
3. Robot end effectors and their design.
4. Familiarities with the dynamics of robots.
5. Robot Programming methods & Languages of robot.
6. Various Sensors and drives and their applications in robots

Outcomes: At the end of the course, the students will be

1. Equipped with robot anatomy, work volume and robot applications
2. Familiarized with the kinematic motions of robot
3. Having good knowledge about robot end effectors and their design concepts
4. Familiarized with the robot dynamics
5. Equipped with the Programming methods & drives used in robots
6. Equipped with the principles of various Sensors and their applications in robots.

Unit I

Robots: History and evolution of robots, Laws of Robotics, basic configuration, degree 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: Homogenous transformation matrix, Denavit-Hartenberg convention, Euler angles, RPY reprensation, Direct and inverse kinematics for industrial robots for position and orientation, Redundancy

Unit III

Manipulator Jacobian: Joint, End effector velocity, direct and inverse velocity nalysis, Trajectory Planning, interpolation, cubic polynomial, linear segments with with parabolic blending, static force and moment transformation, solvability, stiffness, singularities

Unit IV

Robot dynamics: Lagrangian formulation, link inertia tensor and manipulator inertia tensor, Newton-Euler formulation for RR & RP manipulators, Control: Individual joint, computed torque

Unit V

End effectors: position and velocity measurement, Sensors: Proximity and range, tactile, force and torque, Drives for Robots: Electrical, Hydraulic and Pneumatic, Robot vision: Introduction to technique, image acquisition and processing, introduction to robot programming languages

Text Books:

1. Spong and Vidyasagar, *Robot Dynamics and Control*, John Wile and Sons, 1990
2. R.K. Mittal, I.J. Nagrath, *Robotics and control*, Tata Mcgraw-Hill Publishing Company Ltd. 2003
3. Groover, *Industrial Robotics*, Mcgraw-Hill Publishing Company Ltd. 2003

Suggested Reading:

1. Asada and Siotine, *Robot analysis and Intelligence*, Wiley Interscience, 1986
2. K.S. Fu Gon ZalezRC., lEEc.S.G., *Robotics, Control Sensing Vision and Intelligence*, McGraw Hill, Int. Ed., 1987
3. Richard S. Paul, *Robot Manipulators: Mathematics, Programming, and Control*, MIT Press (MA)

With Effect from the Academic Year 2016 - 2017

CE 461

Disaster Mitigation and Management (Elective – II)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: Students will understand

1. The basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts.
2. The nature, mechanism causes, consequences and mitigation measures of the various natural disasters including hydro metrological and geological based disasters.
3. Risks, vulnerabilities and human errors associated with human induced disasters including chemical, biological and nuclear warfare agents.
4. The knowledge of various chronological phases in the disaster management cycle.
5. The disaster management framework and legislations in the context of national and global conventions.
6. The applications of geospatial technologies like remote sensing and geographical information systems in disaster management.

Course Outcomes:

1. Ability to analyse and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at local level
2. Ability to choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan.
3. Ability to understand various mechanisms and consequences of natural and human induced disasters for the participatory role of engineers in disaster management.
4. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans
5. Ability to understand various participatory approaches/strategies and their application in disaster management
6. Ability to understand the concepts of remote sensing and geographical information systems for their effective application in disaster management.

UNIT-I:

Introduction to Natural, human induced and human made disasters – Meaning, nature, types and effects; International decade of natural disaster reduction (IDNDR); International strategy of natural disaster reduction (ISDR)

UNIT-II:

Natural Disasters– Hydro meteorological disasters: Causes, impacts, Early warning systems, structural and non-structural measures for floods, drought and cyclones; Tropical cyclones: Overview, cyclogenesis, drought monitoring and management.; Geographical based disasters: Earthquakes and Tsunami- Overview, causes, impacts, zoning, structural and non-structural mitigation measures; Tsunami generation; Landslides and avalanches: Overview, causes, impacts, zoning and mitigation measures. Case studies related to various hydro meteorological and geographical based disasters.

UNIT III:

Human induced hazards: Risks and control measures in a chemical industry**,** Causes, impacts and mitigation measures for chemical accidents, chemical disaster management, current status and perspectives; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents and traffic accidents .

UNIT IV:

Use of remote sensing and GIS in disaster mitigation and management; Scope of application of ICST (Information, communication and space technologies in disaster management, Critical applications& Infrastructure; Potential application of Remote sensing and GIS in disaster management and in various disastrous conditions like earthquakes, drought, Floods, landslides etc.

UNIT V:

Concept of Disaster Management: Introduction to disaster management, Relationship between Risk, vulnerability and a disaster, Disaster management cycle, Principles of disaster mitigation: Hazard identification and vulnerability analysis, Early warning systems and forecasting; Infrastructure and development in disaster management; Disaster management in India: National disaster management framework at central, state, district and local levels. Community based disaster management.

Text Books :

1. Rajib, S and Krishna Murthy, R.R, *Disaster Management Global Challenges and Local Solutions,* Universities Press Hyderabad, 2012
2. *Notes / Reading material published by National Disaster Management Institute*, Ministry of Home Affairs, Govt. of India.

Suggested Reading:

1. Navele, P & Raja, C.K., *Earth and Atmospheric Disasters Management, Natural and Manmade*. B.S. Publications, Hyderabad, 2009
2. Fearn-Banks, K, *Crises computations approach: A case book approach*. Route ledge Publishers, Special Indian Education, New York & London, 2011
3. Battacharya, T., *Disaster Science and Management*. Tata McGraw Hill Company, New Delhi., 2012

With Effect from the Academic Year 2016 - 2017

ME 419

Industrial Administration and Financial Management (for ECE and EEE)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Students able to learn

1. The roll importance and functions of Management in Industrial Organization
2. Various types of business organizations and organization structures.
3. Importance of plant location and plant layout
4. Importance of industrial engineering like method study and work measurement.
5. The importance of project management techniques
6. The total cost of a product based on elements of cost

Outcomes: At the end of the course, the students will be able to

1. Understand the role and importance of management and its principles.
2. Understand the need and importance of various types of layouts used in manufacturing industries
3. Apply the techniques of method study and work measurement in industry to enhance productivity
4. Apply the techniques of project management in industry
5. Understand the importance of quality control and plot the control charts
6. Calculate the total cost of the product based on its elements.

UNIT-I

Industrial Organization: Definition of an organization, types of various business organizations, organization 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 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

Optimization: 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 ordering 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.

Text Books:

1. Pandey I.M. , *Elements of Financial Management*, Vikas Publ. House, New Delhi, 1994
2. James C Van Horne, John M Wachowicz, Jr., *Fundamentals of Financial Management*, 13th edition, Prentice Hall Financial Times
3. Khanna O.P., *Industrial Engineering and Management*, Dhanapat Rai & Sons

Suggested Reading:

1. S.N. Chary, *Production and Operations Management*, Tata McGraw Hill, 3rd Edition, 2006.
2. Paneer Selvam, *Production and Operations Management*, Pearson Education, 2007.
3. Joseph Monk, *Operations Management*, TMH Publishers, New Delhi, 2004.
4. Buffa Elwood S, *Modern Production /Operations Management* , John Wiley Publishers, Singapore, 2002
5. Everrete E. Adama & Ronald J. Ebert, *Production & Operations Management*, Prentice Hall of India, 5th Edition, 2005.
6. S.D. Sharma, *Operations Research*, Kedarnath, Ramnath & Co., Meerut,2009

With Effect from the Academic Year 2016 - 2017

Chaitanya Bharathi Institute of Technology (Autonomous)

Department of Mechanical Engineering

SCHEME OF INSTRUCTION & EXAMINATION

B.E. IV-Year (Mechanical Engineering)

II-Semester

S. No	Syllabus Ref. No	SUBJECT	Instruction Per week				Scheme of Examination			Credits
								Maximum Marks		
			L	T	D/P	Lab	Duration in Hrs	End Exam	Sessional	
THEORY										
1	ME 421	Production and Operations Management	4	-	-	-	3	75	25	3
2	ME 422	Production Drawing	-	-	6	-	3	75	25	3
3		ELECTIVE - III	4	-	-	-	3	75	25	3
4		ELECTIVE - IV	4	-	-	-	3	75	25	3
PRACTICALS										
1	ME 423	Seminar	-	-	3	-	-	-	25	1
2	ME 901	Project	-	-	6	-	-	100	50	9
		TOTAL	**12**	**-**	**15**	**-**	**-**	**-**	**-**	**22**
ELECTIVE - III										
1	ME 471	Power Plant Engineering	4	-	-	-	3	75	25	3
2	ME 472	Intellectual Property Rights	4	-	-	-	3	75	25	3
3	ME 473	Mechatronics	4	-	-	-	3	75	25	3
4	ME 474	Mechanics of Composite Materials	4	-	-	-	3	75	25	3
5	ME 475	Supply Chain Management	4	-	-	-	3	75	25	3
6	PE 471	Manufacturing Systems and Simulation	4	-	-	-	3	75	25	3
ELECTIVE - IV										
1	PE 412	Modern Machining and Forming Methods	4	-	-	-	3	75	25	3
2	PE 481	Micro Manufacturing	4	-	-	-	3	75	25	3
3	PE 482	Non - Destructive Testing and Evaluation	4	-	-	-	3	75	25	3
4	PE 483	Product Design and Process Planning	4	-	-	-	3	75	25	3
5	PE 484	Nano Materials and Technology	4	-	-	-	3	75	25	3
6	CSE 481	Information Security	4	-	-	-	3	75	25	3
Service Course [B.E.]										
1	ME 414	Operations Research	IT	4	-	-	-	3	75	25	3
2	ME 419	Industrial Administration and Financial Management	EEE	4	-	-	-	3	75	25	3
3	ME 464	Entrepreneurship	ECE, IT, Chem	4	-	-	-	3	75	25	3
4	ME 472	Intellectual Property Rights	ECE, Civil, EEE, CSE, IT	4	-	-	-	3	75	25	3

With Effect from the Academic Year 2016 - 2017

ME 421

Production and Operations Management

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives:

1. Understand plant layout design to facilitate material flow and processing of a product in the most efficient manner
2. Understand work study methods to improve the performance of workers
3. Gain some ability to recognize situations in a production system environment that suggests the use of certain quantitative methods to assist in decision making on operations management and strategy.
4. Understand how Materials Requirement Planning and MRPII systems are used in managing operations
5. Recognize the importance of Inventory control to ensure their availability with minimum capital lock up.
6. Evaluate the quality processes in manufacturing and service sector to improve the operational performance

Outcomes: At the end of the course, the student will be able to

1. Identify and evaluate the processes, tools and principles of production and operations management to better understand the logistics and supply chain operations
2. Demonstrate the ability to apply mathematical forecasting techniques
3. Identify future challenges and directions that relate to production and operations management to effectively and efficiently respond to market changes
4. Apply the tasks, tools and underlying principles of operations management in the manufacturing an d service sectors to improve organizational performance
5. Explain and evaluate the quality process in manufacturing and service sector to improve the operational performance

UNIT-I

Production & Operations Management: Introduction: Types of Production Systems, job shop, batch, flow shop

Plant location and layout: Factors affecting plant location, 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, wages and incentives, types of incentive plans.

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): Importance of MRP, MRP system inputs and outputs, MRP calculations, bill of materials.

UNIT-IV

Inventory Control: Importance of inventory control, types of inventory models, inventory costs deterministic inventory models, basic EOQ model, 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 and inventory model with probabilistic demand.

UNIT-V

Quality Control: Introduction, history and early contributions by quality gurus, quality tools, process capability, quality control by control charts, control charts for variables and attributes, sampling plans, operating characteristic curves, introduction to total quality management

Text Books:

1. Stevenson, *Production operation Management*, Mc-Graw Hill International
2. Joseph Monks, *Operations Management*, TMH Publishers, New Delhi, 2004.
3. Buffa Elwood S, *Modern Production /Operations Management* , John Wiley Publishers, Singapore, 2002

Suggested Reading:

1. Everrete E. Adama & Ronald J. Ebert, *Production & Operations Management*, Prentice Hall of India, 5th Edition, 2005
2. Panneer Selvam R, *Production and Operations Management*, Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2006.
3. S.D. Sharma, *Operations Research*, Kedarnath, Ramnath & Co., Meerut,2009
4. S.N. Chary, *Production and Operations Management*, Tata McGraw Hill, 3rd Edition, 2006.

With Effect from the Academic Year 2016 - 2017

ME 422

Production Drawing

Instruction	6 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Students will understand

1. The need and the importance of production drawing
2. How to make part drawing from given assembly drawings.
3. Indication of size, form and positional tolerances on the drawing sheets
4. Surface finish and heat treatment process on the drawing sheets.
5. Writing process sheets
6. Notations, symbols and abbreviations on production drawings

Outcomes: On completion of the course the students will develop abilities to

1. Draw part drawings from given assembly drawings of machine parts.
2. Indicate tolerance values on the parts drawn on sheet as per alpha numeric codes for given assembly drawings
3. Indicate form tolerances and position tolerances on the parts drawn on the sheet as per universally accepted norms for a given assembly drawing
4. Indicate values of surface finished and heat treatment process on the parts drawn for a given assembly drawings.
5. Write process sheet for every part that is drawn from given assembly drawings
6. Interpret a production drawing and process sheet.

UNIT-I

Parts-I: Format of drawing sheet, title block, columns for materials, Processes, parts list, conventional representation of parts: screwed joints, welded joints, springs, gears.

UNIT-II

Parts II: Elements of electrical, hydraulic and pneumatic circuits, machine tool elements), methods of indicating notes on drawing

UNIT-III

Limits and Fits: Basic definition of terms, alpha numeric designation of limits/fits, types of fits, Interchangeability and selective assembly, Exercises involving selection/interpretation of fits and calculation of limits, dimensional chains

UNIT-IV

Production Drawing: Conventional practices of indicating tolerance on size and geometrical form, position, surface finish, surface treatments, part drawing from assembled drawings (Stuffing box, Screw jack, I.C engine connecting rod, Revolving center, Square tool post, Single tool post, Universal coupling, Flange coupling, Steam engine cross head, Drill jig (plate type), Non return valve, Blow off cock), specification and indication of above features on the drawings, calculation of limits suggesting suitable fits for mating parts

UNIT-V

Assignments: Sketches of conventional representation of parts described with syllabus at (1) process sheets, tolerances and finishes obtainable from different processes. Study of IS 2709 on limits and fits

NOTE: Tolerance charts to be provided in the examination hall for calculation of limits

Text Books:

1. K.L. Narayana, P. Kannaiah and K. Venkat Reddy, *Production Drawing*, New Age Intl., (P) Ltd., Revised Edition, 1997.
2. P. Narasimha Reddy, T.A. Janardhan Reddy and C. Srinivasa Rao, *Production Drawing Practice*, Hitech Publishers, 2001

Suggested Reading:

1. Venkata Reddy, *Production Drawing*. New Age International. ISBN 978-81-224-2288-7, 2009
2. Farazdak Haideri, *Machine Drawing & Computer Graphics*, Nirali Prakashan. ISBN 978-93-8072-527-7
3. R.L. Murthy, *Precision Engineering in Manufacturing*, New Age International Private Ltd., 1996
4. Doeblin, *Measurement Systems Application and Design*, TMH, 5 th Edn., 2004.

With Effect from the Academic Year 2016 - 2017

ME 423

Seminar

Instruction	3 Periods per week
Sessionals	25 Marks
Credits	1

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of state of the art topics in a broad area of his /her specialization.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to following aspects of seminar presentations.

- Literature survey
- Consolidation of available information
- Power point Preparation
- Technical writing

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.

2. Give twenty(20) minutes presentation through OHP/ PPT/ Slide Projector followed by Ten(10) minutes discussion

3. Submit a report on the seminar topic with list of references and hard copy of the slides.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule should be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar should be from any peer reviewed recent journal publications.

With Effect from the Academic Year 2016 - 2017

ME 901

Project

Instruction	6 Periods per week
Duration of End Examination	Viva Voce
End Examination	100 Marks
Sessionals	50 Marks
Credits	9

Dealing with a real time problem should be the focus of under graduate project.

All projects will be monitored at least four times in the II-semester through individual presentations (Project batch wise).

Every student should maintain a project dairy, wherein he/she needs to record the progress of his/her work and get it signed at least once in a week by the guide(s). If working outside and college campus, both the external and internal guides should sign the same.

Sessional marks should be based on the marks, awarded by a project monitoring committee of faculty members as well as the marks given by the guide.

Common norms are established for final documentation of the project report, the students are directed to download from the website regarding the guidelines for preparing the project report and the project report format.

The project report shall be evaluated for 100 Marks by the External Examiner.

If the project work found inadequate in the end examination, the candidate should repeat the project work with a new problem or improve the quality of work and report it again.

Break up for 100 Marks in the end examination:

1. Power point presentation 30 Marks
2. Thesis/Report preparation 20 Marks
3. Viva-voce 30 Marks

With Effect from the Academic Year 2016 - 2017

ME 471

Power Plant Engineering (Elective – III)

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives: Student will learn

1. Different types of power plants and their site selection criteria
2. Operation of thermal power plant
3. About hydraulic power plant, dams and spillways
4. Different types of nuclear power plants including Pressurized water reactor, Boiling water reactor, Liquid metal fast breeder reactor and Gas cooled reactor
5. The power plant economics
6. The environmental and safety aspects of power plant operation.

Outcomes: At the end of the course, the student will be able to

1. Select the suitability of site for a power plant.
2. Propose ash handling, coal handling method in a thermal power plant
3. Understand the flow-sheet of hydro-power plant
4. Explain working principle of different types of nuclear power plant.
5. Know the various factors of plant load and economy
6. Indicate safety aspects of power plants

Unit - I

Introduction: Power plant, classification of power plants, conventional and non-conventional power plants

Steam power plant: Plant Layout, types of coals, coal handling equipment, Ash handling systems

UNIT II

Steam power plant: Combustion Process - Overfeed and Underfeed stokers-traveling grate stokers, spreader stokers, retort stokers- Pulverized fuel burning system-cyclone furnace-Fluidized bed combustion (FBC).

UNIT III

Hydro electric power plant: Hydrological cycle, flow measurement, Hydrographs - drainage area characteristics, Types of hydroelectric power plants- storage and pondage - classification of dams and spill ways.

UNIT - IV

Nuclear power plant: Nuclear fuel - breeding and fertile materials - types of reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Gas cooled Reactor-Radioactive waste disposal.

UNIT - V

Power plant economics and environmental considerations:

Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor - related exercises-Fixed cost and variable cost-methods to find depreciation cost Effluents from power plants and Impact on environment – pollutants - Pollution control.

Text Books:

1. R.K. Rajput, *A Text Book of Power Plant Engineering* 4th edition, Laxmi Publications (P) Ltd., New Delhi, 2015
2. P.K. Nag, *Power Plant Engineering* 4th edition, McGraHill Education(India) Private Limited, New Delhi, 2014
3. S.C. Arora and S. Domukundwar, *A Course in Power Plant Engineering*, Dhanpat Rai & Sons, New Delhi, 2005

Suggested Reading:

1. R. Yadav, *Fundamentals of Power Plant Engineering*, Central Publishing House, Allahabad, 2012
2. R.K. Hegde, *Power Plant Engineering*, Pearson Education India, 2015
3. P.C. Sharma, *A Text Book of Power Plant Engineering*, S.K. Kataria & sons, New Delhi, 2016

With Effect from the Academic Year 2016 - 2017

ME 472

Intellectual Property Rights (Elective – III)

(for Mech, Prod, Civil, ECE, EEE, CSE, IT)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will learn

1. Fundamental aspects of IP
2. Aspects of IPR acts.
3. Awareness of multi disciplinary audience
4. Awareness for innovation and its importance
5. The changes in IPR culture
6. About techno-business aspects of IPR

Outcomes: At the end of the course, a student

1. Will respect intellectual property of others
2. Learn the art of understanding IPR
3. Develop the capability of searching the stage of innovations.
4. Capable of filing a patent document independently.
5. Completely understand the techno-legal business angle of IP. .
6. Capable of converting creativity into IP and effectively protect it.

UNIT-I

Overview of Intellectual Property: Introduction and the need for intellectual property right (IPR), IPR in India – Genesis and Development, IPR abroad, Some important examples of IPR. Importance of WTO, TRIPS agreement, International Conventions and PCT

Patents: Macro economic impact of the patent system, Patent and kind of inventions protected by a patent, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Why protect inventions by patents. Searching a patent, Drafting of a patent, Filing of a patent, the different layers of the international patent system, (national, regional and international options), compulsory licensing and licensers of right & revocation, Utility models, Differences between a utility model and a patent. Trade secrets and know-how agreements

UNIT-II

Industrial Designs: What is an industrial design. How can industrial designs be protected? What kind of protection is provided by industrial designs? How long does the protection last? Why protect industrial designs?

UNIT-III

Trademarks: What is a trademark, Rights of trademark? What kind of signs can be used as trademarks. Types of trademark, function does a trademark perform, How is a trademark protected? How is a trademark registered. How long is a registered trademark protected for? How extensive is trademark protection. What are well-known marks and how are they protected? Domain name and how does it relate to trademarks? Trademark infringement and passing off.

UNIT-IV

Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights. Distinction between related rights and copyright. Rights covered by copyright? Copy rights in computer programming.

UNIT-V

Enforcement of Intellectual Property Rights: Infringement of intellectual property rights Enforcement Measures Emerging issues in Intellectual property protection. Case studies of patents and IP Protection.

Unfair Competition: What is unfair competition. Relationship between unfair competition and intellectual property laws.

Text Books:

1. Ajit Parulekar and Sarita D' Souza, *Indian Patents Law – Legal & Business Implications*; Macmillan India ltd , 2006
2. B. L.Wadehra; *Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications*; Universal law Publishing Pvt. Ltd., India 2000
3. P. Narayanan*; Law of Copyright and Industrial Designs*; Eastern law House, Delhi 2010

Suggested Reading:

1. Cronish W.R1 *Intellectual Property; Patents, copyright, Trad and Allied rights*, Sweet & Maxwell, 1993.
2. P. Narayanan, *Intellectual Property Law*, Eastern Law Edn., 1997.
3. Robin Jacob and Daniel Alexander, *A Guide Book to Intellectual Property Patents, Trademarks, Copy rights and designs*, Sweet, Maxwell 4th Edition.

With Effect from the Academic Year 2016 - 2017

ME 473

Mechatronics (ELECTIVE - III)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. How to identify, formulate, and solve engineering problems
2. The design a system, component, or process to meet desired needs within realistic constraints
3. The how to use the techniques, skills, and modern engineering tools necessary for engineering practice
4. The use of drive mechanisms and fluid power systems
5. The use of industrial electronic devices
6. The demonstrate the design of modern CNC machines, and Mechatronics elements

Outcomes: At the end of the course, the students will be able to

1. Model and analyze electrical and mechanical systems and their interconnection
2. Integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems
3. Do the complete design, building, interfacing and actuation of a mechatronics system for a set of specifications
4. Be proficient in the use of fluid power systems in various mechatronics applications
5. Demonstrate the use of industrial electronic devices
6. Demonstrate the design of modern CNC machines, and mechatronics elements

UNIT-I

Introduction to mechanization & automation: Need of interface of electrical & electronic devices with mechanical elements, the concept of Mechatronics, 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. servomotors, D.C. servomotors, stepper motors

UNIT-III

Introduction to fluid power systems: Industrial Pneumatics and hydraulics, merits of fluid power, pneumatic & hydraulic elements symbols, study of hydraulic control valves, pumps & accessories, hydraulic circuits & 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

Text Books:

1. William Bolton, *Mechatronics*: *Electronic control systems in mechanical and electrical engineering*, 6th edition, Pearson Education
2. HMT Ltd, *Mechatronics*, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998

Suggested Reading:

1. Michaels Histand & David G, Alciatore, *Introduction to Mechatronics and Measurement Systems*, Tata McGraw-Hill International Edition
2. Devdas Shetty, Richard A. Kolk, *Mechatronics System Design*, Cengage Learning
3. S.R. Majumdar, *Oil Hydraulic Systems – Principles & Maintenance*, McGraw-Hill Publishing Company Limited, New Delhi
4. Godfrey Onwubolu, *Mechatronics: Principles and Applications*, Butterworth-Heinemann

With Effect from the Academic Year 2016 - 2017

ME 474

Mechanics of Composite Materials (ELECTIVE - III)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand the

1. Properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
2. How to predict the elastic properties of long fiber composites based on the constituent properties. An ability to rotate stress, strain and stiffness tensors using ideas from matrix algebra.
3. Linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior. An ability to analyze a laminated plate in bending using classical lamination theory.
4. How to predict the failure strength of a laminated composite plate. A knowledge of issues in fracture of composites.
5. Exposure to recent developments in composites, including metal and ceramic matrix composites.
6. How to use the ideas developed in the analysis of composites towards using in industrial application.

Outcomes: At the end of the course, a student should be able to

1. Understand the various fabrication methods of composite materials.
2. Understand the specifics of mechanical behavior of layered composites compared to isotropic materials.
3. Determine stresses and strains in composites.
4. Apply constitutive equations of composite materials and understand mechanical behavior at micro and macro level.
5. Understand the failure of composites including fracture.
6. Understand the theory of plate and shell; understand the bending analysis of composite beams.

Unit-I

Introduction: Fibers, matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composites and carbon composites.

Unit-II

Micromechanics of lamina and mechanical properties: Prediction of elastic constants, micromechanical approach, Halpin-Tsai equations, thermal properties, hygro properties, mechanics of load transfer from matrix to fibre.

Unit-III

Macro-mechanics of lamina: Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation, inter-laminar stresses and edge effects, simplified composite beam solutions, bending of laminated beams.

Unit-IV

Strength, fracture, fatigue and design: Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: single and multiple fractures, de-bonding, fibre pullout and de-lamination.

Strength of an orthotropic lamina: Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria, designing with composite materials

Unit-V

Manufacturing processes: Hand lay-up, prepregs, bag molding, autoclave processing, RTM, 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, inter-laminar shear test, flexure test.

Text Books:

1. Jones, R.M., *Mechanics of Composite Materials*, Mc Graw Hill Co., 1967
2. B.D. Agarwal et.al, *Analysis and performance of fiber composites*, 3rd edition, Wiley sons., 2013
3. P.K. Mallick, *Fiber Reinforced Composites Materials*, Manufacturing, and Design, Taylor & Francis, Third Edition 2007 ,

Suggested Reading:

1. Ever J Barbero, *Introduction to composite materials design*, Taylor &Francis, 1999.
2. Hyer, M.W., *Stress Analysis of Fibre Reinforced Composite Materials*, McGraw Hill Co., 1998.
3. Carl. T. Herakovich, *Mechanics of Fibrous Composites*, John Wiley Sons Inc., 1998.

ME 475

Supply Chain Management (Elective – III)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. The significance of supply chain management in engineering.
2. The awareness about transportation and warehouse management systems.
3. The designing supply chain networks.
4. The concept of demand and supply and integrating it with supply chain management.
5. The acquainted with planning and managing inventories.
6. The pricing and revenue management

Outcomes: At the end of the course, the student is able to

1. Apply supply chain management concepts in engineering applications
2. Plan an effective transportation and warehouse management systems
3. Design an effective supply chain networks
4. Integrate and optimize demand and supply gaps
5. Apply inventory management techniques
6. Understand and design a pricing and revenue management systems

UNIT-I

Concept of SCM, Concept of Logistics Management, Supply Chain, Types of supply chain, functions in SCM, Transportation Management, Warehousing Management, Warehouse management systems.

UNIT-II

Designing the supply chain Network, Designing the distribution network, Network Design, Network Design in an uncertain environment.

UNIT-III

Planning and Demand:Planning demand & supply in a supply chain, demand forecasting, aggregate planning, planning supply & demand.

UNIT-IV

Planning & managing inventories in a supply chain, managing economies of scale, cycle inventory, and managing uncertainty safety inventory optimal level of product availability

UNIT-V

Sourcing, Transporting & Pricing Products, sourcing decisions, transportation, pricing & revenue management. Coordination & technology in the supply chains, coordination in supply chain, information technology and supply chain.

Text Books:

1. N. J. Kumar & Mukesh Bhatia, *Supply Chain Management***,** Neha publishers & Distributors,2010
2. Michael H. Hugos, *Essentials of Supply Chain Management*, 3rd edition, John Wiley & Sons, Inc, Hoboken, New Jersy,2011
3. Sunil Chopra & Peter Meindl, *Supply Chain Management* – Strategy, Planning and Operation, Pearson Education, Inc., Upper Saddle River, New Jersey, 2003

Suggested Reading:

1. Martin Christopher, *Logistics & Supply Chain Management*, 5th edition, Financial Times Series,2010
2. Dobler Donald. W, David.N.Burt, *Purchasing & supply Management Text & Cases*. McGraw-Hill, 1996
3. Chitale A.K. Gupta R.C, *Materials Management-Text and Cases*, Prentice-Hall Of India Pvt. Limited, 2007

PE 471

Manufacturing Systems and Simulation (Elective – III)

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives: Student will understand

1. The systems, subsystems for manufacturing techniques
2. The information technologies relevant to manufacturing systems
3. The discrete and continuous systems
4. The system simulation and associated concepts
5. The queuing theory concepts applied to system simulation
6. The awareness about programming with GPSS and SIMSCRIPT

Outcomes:

1. Student is able to have overall view of various manufacturing processes
2. Capable of applying information systems and automation to manufacturing
3. Ability to build various models suitable for appropriate manufacturing facility
4. Able to understand and conceptualize systems simulations
5. Ability to simulate discrete and continuous systems
6. Capable of programming with GPSS and SIMSCRIPT

UNIT-I

Manufacturing Systems: Definition of systems, basic concepts and problems concerning systems, systems design, decision making procedures, Structural, transformational and procedural aspects of manufacturing, modes of production, process systems for manufacturing, logistic systems, material flow & technological information flow, management & information systems for manufacturing, managerial information flow in manufacturing systems

UNIT-II

Information Systems: Fundamentals of information technology, information systems, information networking, parts oriented production information systems and computerized production scheduling, online production control systems, Computer based production management systems, Automation systems for manufacturing, Industrial automation, Kinds of automation, principles of CIM, effectiveness of CIM, factory automation, automatic machine tools for mass production, NC machine tools, computer controlled manufacturing systems, FMS, automated assembly, automatic material handling, automatic inspection & testing, computer integrated automation systems- unmanned factory

UNIT-III

System Models: Concepts, continuous and discrete systems, systems modeling, type of models, subsystems, corporate model and system study

System simulation: Techniques, comparison of simulation and analytical methods, types of simulation, distributed log model, cobweb models

UNIT-IV

Continuous system Simulation: Numerical solution of differential equation, analog computers, hybrid computers, continuous system simulation languages CSMP, system dynamic growth models, logistic curves

Discrete systems simulation: Events generation of arrival patterns, simulation programming tasks, analysis of simulation output

Queuing theory: Arrival pattern distribution, service times, queuing disciplines and measure of queues

UNIT-V

GPSS and SIMSCRIPT: General description of GPSS and SIMSCRIPT, programming in GPSS simulation programming techniques: Data structures, implementation of activities, event and queues, event scanning, simulation algorithms in GPSS and SIMSCRIPT

Text Books:

1. Geofery Gordan, *Systems Simulation*, Prentice Hall, 1980
2. Allan Carrie, *Simulation of Manufacturing Systems*, John Wiley & Sons Ltd,1998

Suggested Reading:

1. Adelaide Marzano, *Manufacturing system simulation*, VDM Verlag
2. Davi Bedworth & James Bailey, *Integrated Production Control system Management, analysis & design*, 2nd edition, John Wiley & Sons Ltd.,2010
3. Ronald Zskin & Charles Standridge, *Modeling and Analysis of Manufacturing Systems*, John Wiley & Sons Ltd.,2011
4. Deo. N., '*ystem simulation with Digital Computers*, Prentice Hall, 1980

PE 412

Modern Machining and Forming Methods (ELECTIVE – IV)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will learn

1. The importance of non-conventional machining processes
2. Various non-conventional machining processes and their process parameters
3. The relative merits, limitations and applications of various non-conventional machining processes
4. The knowledge regarding working media and its functions of non-conventional machining processes
5. The concepts of non-conventional forming processes such as rubber pad forming, hydro forming, stretch forming, etc.,
6. The concepts of HERF and to provide the description of HERF process

Outcomes: At the end of the course, the students are able to

1. Select the non-conventional machining process for a particular application
2. Demonstrate the capability of comparison of various non-conventional machining methods
3. Describe the various non-conventional machining processes
4. Exhibit the proficiency of selecting working media for various non-conventional machining processes
5. Exhibit the basic understanding of non-conventional forming processes
6. Compare various non-conventional forming processes based on their merits, limitations and applicability

UNIT-I

Mechanical Energy Methods:

Ultrasonic Machining (USM): Introduction, Process description, abrasive slurry, Abrasive materials and their characteristics, Functions of liquid medium in slurry, Types of transducers, effect of process parameters, applications and limitations

Abrasive Jet Machining (AJM): Principle of operation, process details, process variables and their effect on MRR and accuracy, equation for MRR, advantages, disadvantages and applications

Water Jet Machining (WJM): Schematic diagram, equipment used, advantages and applications

Abrasive Water Jet Machining (AWJM): Process, advantages, limitations and applications

UNIT-II

Thermal methods: Electro Discharge Machining (EDM): Process description with schematic diagram, process parameters, functions and characteristics of dielectric medium, dielectric fluids, over cut and side taper, flushing, mechanism of metal removal, crater volume, types of power supply circuits, mathematical analysis of metal removal rate (MRR), equations for surface finish, characteristics of spark eroded surfaces, advantages, disadvantages and applications

Wire EDM: Process description and applications

LASER Beam Machining (LBM): Principle of LASER beam production, materials used, process parameters, advantages, limitations and applications,
Plasma Arc Machining (PAM): Introduction, equipment used, process description and parameters, types of plasma arc: transferred arc and non transferred arc and process applications,
Electron Beam Machining (EBM): Schematic of the process, process parameters, principle of production of electron beam, equipment used, advantages, disadvantages and applications,

UNIT-III
Electro chemical, Chemical and other machining processes: Electro-chemical machining (ECM): Schematic of process parameters, function and characteristics of electrolyte, chemistry of the process, MRR for pure metal and alloys, electrode feed rate (EFR), advantages, limitations and applications
Chemical Machining: Chemical blanking and chemical milling, advantages, limitations and applications
ION Etching: Process description, merits, limitations and applications, hot machining, high speed machining, process parameters, advantages and applications

UNIT-IV
High Energy Rate Forming Processes (HERF): Introduction, applications, advantages,
Explosive Forming: Principles, explosive materials, Equipment, types of explosive forming, standoff operation and contact operation, the pressure pulse, gas bubble and the process applications
Electro-Hydraulic Forming (EHF): Schematic of process, description and its applications,
Electro-Magnetic Forming (EMF): Process description, merits, limitations and applications

UNIT-V
Other Forming Processes:
Rubber Pad Forming: Principle of the process, process details and its types, Guerin, wheelon, Mar forming and Hydro forming processes and applications,
Stretch Forming: Introduction, types of stretch forming, stretch draw forming, rotary stretch forming or stretch wrapping, compression forming, radial draw forming.
Tube spinning: introduction, methods of tube spinning, backward spinning, forward spinning, machines and tools used, machine variables, speeds and feeds, effect of tube spinning on work metal properties and applications.

Text Books:

1. P.C. Pandey and H.S. Shah, *Modern Machining Process* Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1980
2. J Paulo Davim, *Modern Machining Technology, A Practical Guide*, 1st Edition, Woodhead Publishing in Mechanical Engineering

Suggested Reading:

1. Hassan Abdel-Gawad El-Hofy, *Advanced Machining Processes, Nontraditional and Hybrid Machining Processes*, McGraw Hill Publishing Co. Ltd.,
2. Davies and Austin, *Developments in High Speed Metal Forming*, The Machinery Publishing Co. Ltd., 1985
3. Production Technology, HMT
4. A. Bhattacharya, *New Technology*, The Institution of Engineers (India), 1984

With Effect from the Academic Year 2016 - 2017

PE 481

Micro Manufacturing (ELECTIVE - IV)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. The importance of micromachining, Nano polishing, Micro forming and Micro welding.
2. Micromachining processes
3. The Nano polishing methods
4. The micro forming processes
5. The concepts of micro welding to the students
6. The recent trends and applications of micro manufacturing

Outcomes: At the end of the course, the students are able to

1. Suggest suitable micromachining process to a particular application.
2. Select the process parameters of particular micro machining process
3. Describe the various micro, machining, welding and forming processes
4. Compare various micro machining / forming/ welding processes based on relative merits and demerits.
5. Demonstrate the understanding of various nano machining operations.
6. Exhibit the knowledge regarding the recent trends in micro-manufacturing processes

UNIT I

Micro Machining I: Introduction, scaling laws, mechanical micro machining, ultra sonic micro machining, abrasive jet micro machining, water jet micro machining, abrasive water jet micro machining, micro turning, chemical and electro chemical micro machining, electric discharge micro machining, electro discharge grinding.

UNIT II

Micro Machining II: Beam energy based micro machining, electron beam micro machining, laser beam micro machining, ion beam micro machining, plasma beam micro machining, hybrid micro machining, electro chemical spark micro machining, electrolytic in process dressing.

UNIT III

Nano Polishing: Abrasive flow finishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing, magnetic float polishing, elastic emission machining, chemo-mechanical polishing

UNIT IV

Micro Forming and Welding: Micro extrusion, micro and nano structured surface development by nano plastic forming and roller imprinting, micro bending with laser, laser micro welding, electron beam for micro welding.

UNIT V

Recent Trends and Applications: Metrology for micro machined components, ductile regime machining, AE based tool wear compensation, machining of micro gear, micro nozzle, micro pins and applications.

Text Books:

1. Jain V. K., *Micro Manufacturing Processes*, CRC Press, Taylor & Francis Group, 2012
2. Janocha H., *Actuators – Basics and applications*, Springer publishers, 2012
3. Jain V.K., Introduction to Micro machining, Narosa Publishing House, 2011

Suggested Reading:

1. Bharat Bhushan, *Handbook of nanotechnology*, springer, Germany, 2010.
2. Bandyopadhyay. A.K., *Nano Materials*, New age international publishers, New Delhi, 2008, ISBN:8122422578.
3. Jain V.K., *Advanced Machining Processes*, Allied Publishers, Delhi, 2002
4. Mcgeoug.J.A., *Micromachining of Engineering Materials*, CRC press 2001, ISBN-10:0824706447.

PE 482

Non - Destructive Testing and Evaluation (ELECTIVE - IV)

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives: Student has to understand the

1. Need, basic concepts and technologies of Non Destructive Testing (NDT)
2. Security precautions from Radiography, protection from radiation and measurement of radiation received by personnel.
3. Technology of acoustic emission (AE), the associated instrumentation and applications
4. Technologies like neutron radiography; laser induced ultrasonics, surface analysis and thermography
5. Merits and demerits of the different NDT Technologies
6. Latest research and developments in NDT

Outcomes: At the end of the course, the students will be able to demonstrate

1. the knowledge of different NDT techniques.
2. clear understanding of liquid penetrant inspection and magnetic particle inspection.
3. view and interpret radiographs, utilize the various principles of radiography for different components of different shapes.
4. the knowledge of acoustic emission for NDT and the instrumentation used for NDT.
5. the ability to analyze and prepare a technical report.
6. the knowledge of latest research, developments and trends in NDT.

UNIT-I

Liquid penetrate inspection: Principles of penetrate inspection, characteristics of a penetrate, water washable system, post emulsification system , solvent removable system, surface preparation and cleaning, penetrate application, development, advantages limitations, and applications.

Magnetic particle instruction: Principle, magnetization methods, continuous and residual methods, sensitivities, demagnetization, magnetic particles, applications advantages and limitations.

UNIT-II

Eddy current testing: Principle, lift-off factor, and edge effect, skin effect, inspection frequency, coil arrangements, inspection probes, types of circuit, reference pieces, phase analysis, display methods and applications.

UNIT-III

Ultrasonic testing: Generation of ultra sound, characteristics of an ultrasonic beam, sound waves at interfaces, sound attenuation, display systems, probe construction, type of display, inspection techniques, identification of defects, Immersion testing , sensitivity and calibration. Reference standards. Surface condition, Applications.

UNIT-IV

Radiography: Principle and uses of radiography, limitation principle, radiation sources, production of X-Rays, x-ray spectra, attenuation of radiation, radiographic equivalence, shadow formation enlargement and distortion, radio graphic film and paper, Xeroradiography, fluoroscopy, exposure factors, radiographic screens, identification markers and image quality indicators, inspection of simple shapes, inspection of complex shapes, viewing and interpretation of radiographs, radiation hazard, protection against radiation, measurement of radiation received by personnel.

UNIT-V

Acoustic Emission: Physical Principles, Sources of emission, instrumentation and applications, Other NDT Techniques: Neuron radiography, Laser induced ultrasonics, surface analysis, and thermography.

Text Books:

1. Barry Hull & Vernon John, *Non Destructive Testing*, 1988.
2. H J Frissell (Editorial Coordinator), Non-*Destructive Evaluation and quality control*, ASM handbook-International Publication USA, 1989..
3. Dove and Adams, *Experimental Stress analysis and Motion Measurement*, Prentice Hall of India, Delhi

Suggested Reading:

1. *Non-Destructive Examination and Quality Control*, ASM International, Vol.17, 9th edition (1989)
2. J. Prasad and C. G. K. Nair, *Non-Destructive Test and Evaluation of Materials*, Tata McGraw-Hill Education, 2nd edition (2011).
3. B. Raj, T. Jayakumar and M. Thavasimuthu, Practical *Non Destructive Testing*, Alpha Science International Limited, 3 rd edition (2002).
4. T. Rangachari, J. Prasad and B.N.S. Murthy, *Treatise on non-destructive testing and evaluation*, Navbharath Enterprises, Vol.3, (1983

PE 483

Product Design and Process Planning (ELECTIVE – IV)

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives: Student will understand

1. The Product Design and Process Functions
2. The essence of innovation in product development
3. The Human Machine Interactions (ergonomics)
4. The various Intellectual Property Rights
5. The interaction between Design, Manufacturing, Quality and Marketing
6. The awareness about overall view of Process Planning

Outcomes: At the end of the course, the student is able to

1. Have overall view of Product Design and Process Planning
2. Apply creativity techniques in Product Development
3. Applying ergonomically enabled concepts in developing a new product
4. Have awareness and apply Intellectual Property Rights
5. Integrate various stages of developing a new product
6. Develop and execute an effective Process Plan

UNIT-I

Product Design and Process Design functions: selection of right product, systematic procedure of product innovation, factors contributing to successful technological innovation, need for creativity and innovation, techniques of innovation like brain storming and Delphi techniques

UNIT-II

Product Selection and Evaluation: Function of design, design with Human Machine Interaction (HMI) and collection of ideas and purpose of project, selection criteria, screening ideas for new products using evaluation techniques, principles of ergonomics.

UNIT-III

New Product Planning: Interaction between the functions of design, manufacture, quality, testing and marketing, design and material selection, steps for introducing new products after evaluation.

UNIT-IV

New Product Development: Research and new product development, patents, definitions, patent search, patent laws, international code for patents, Intellectual Property Rights (IPR).

UNIT-V

Process Selection and Planning: Process selection, process planning, process sheets, selection of manufacturing process, estimation of machining time in various cutting operations, estimation of costs for manufacture, value engineering in product design, group technology, concepts of concurrent engineering.

Text Books:

1. Niebel BW & Draper AB, *Production Design & Process Engg*, McGraw Hill, Kogakusha, 1974
2. K. G. Swift & J. D. Booker, *Process Selection*: From Design to Manufacture", Butterworth-Heinemann Ltd; 2nd Revised edition, 2003
3. Bhaskaran Gopalakrishnan, *Product Design and Process Planning in CE (Design & Manufacturing*", Chapman and Hall publishers, 1994

Suggested Reading:

1. Harry Nystrom, *Creativity and Innovation*, John Wiley & Sons,
2. Brain Twiss, *Managing Technological Innovation*, Pittrnan Publications, 1992
3. Harry, B.Waton, *New Product Planning*, Prentice Hall Inc., 1992
4. Chitale, A. K. & Gupta RC., *Product Design & Manufacturing*, PHI, 1997

With Effect from the Academic Year 2016 - 17

PE 484

Nano Materials and Technology (Elective – IV)
(for Mech, Prod and Chemical)

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives: Student will learn the

1. Nanotechnology approach and challenges
2. Materials of nanotechnology
3. Nano structures
4. Nano fabrication
5. Special nano materials
6. Bio materials

Outcomes: At the end of the course

1. Understand the developments and challenges in nano technology
2. Understand synthesis and properties of nanostructured materials
3. Analyze magnetic and electronic properties of nano materials
4. Analyze nano fabrication methods and their applications
5. Understand the characterization of nano and bio materials and their use
6. Analyze the synthesis and characterization of nano wires and tubes

Unit I

Introduction: Nanoscale, Properties at Nanoscale, advantages and disadvantages, importance of Nanotechnology, Bottom-up and Top-down approaches, challenges in nanotechnology, proximal probe technologies

Unit II

Materials of Nanotechnology: Introduction, Si-based materials, Ge-based materials, Ferroelectric materials, Polymer materials, GaAs& InP (HI-V) group materials, Nanotribology and materials, characterization using Scanning Probe Microscope, AFM, FFM

Unit III

Nano Structures: Zero dimensional Nanostructure (Nano particles), synthesis procedure, characterization techniques, properties and applications of Nano particles

One dimensional Nanostructures (Nano Wires, Nano Tubes), various Synthesis procedure, characterization procedure and principles involved, properties and applications of Nano Wires, Types of Nano Tubes, Synthesis procedure, characterization properties and applications of Nano Tubes

Unit IV

Nano Fabrication: Introduction, Basic fabrication techniques (Lithography, thin film deposition, and doping), MEMS fabrication techniques, Nano fabrication techniques (E-beam Nano-imprint fabrication, Epitaxy and strain engineering, Scanned probe techniques)

Unit V

Special Nano Materials: Nano Composites: Introduction, Synthesis procedures, various systems (metal-polymer, metal-ceramics and Polymer-ceramics), Characterization procedures, applications,

Nano Biomaterials: Introduction, Biocompatibility, anti-bacterial activity, principles involved, applications

Text Books:

1. A.K. Banopadyay, *Nano Materials*, New Age Publications
2. T. Pradeep, *Textbook of Nanoscience and Nanotechnology*, McGraw Hill Education (India) Private Limited, New Delhi
3. Dieter Vollath, *Nanomaterials: An Introduction to Synthesis, Properties and Applications*, Wiley, 2013

Suggested Reading:

1. Carl C. Koch, *Nano Materials Synthesis, Properties and Applications*, Jaico Publishing House
2. Willia Tllsey Atkinson, *Nano Technology*, Jaico Publishing House
3. George W. Hanson, *Fundamentals of Nanoelectronics*, Pearson Education, 2009
4. T. Pradeep, *Nano: Essentials-understanding Nano Science and Technology*, TMH, 2007
5. Sabu Thomas, Nandakumar Kalarikkal, A. Manuel Stephan, B. Raneesh, *Advanced Nano-materials*: Synthesis, Properties, and Applications, Apple Academic Press

With Effect from the Academic Year 2016 - 2017

CSE 481

Information Security (Elective – IV)

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives: Student will understand the

1. Information assurance as practiced in computer operating systems, distributed systems, networks and representative applications.
2. Several ethical issues in information system
3. Principal concepts, major issues, technologies, and basic approaches in information security.
4. Prevalent network and distributed system attacks, defenses against them, and forensics to investigate the aftermath.
5. Cryptography, how it has evolved, and some key encryption techniques used today.
6. Security policies (such as authentication, integrity and confidentiality), as well as protocols to implement such policies in the form of message exchanges.

Outcomes: At the end of the course, the students are able to understand the

1. Basic concepts and goals of Information security such as Confidentiality, Integrity, Authentication, Non-Repudiation, Authorization, and Availability and their relevance in various Contexts.
2. Classical cryptosystems and techniques used to break them.
3. Ideas of public key cryptosystems and digital signature schemes
4. Different network issues as well as database security issues and the solutions for them through firewall, intrusion detection system
5. Critical evaluation of a range of access control and authentication mechanisms
6. Legal privacy and ethical issues in computer security

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-secure software development

Unit II

Legal, Ethical and Professional Issues: Law and Ethics 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 discuss points, 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 VONs: 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, crypryptographic 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, internal control strategies

Information Security Maintenance: Security management models, the maintenance model, digital forensics

Text Books:

1. Michael E. Whitman and Hebert J. Mattord, *Principles of Information Security*, 4th edition, Ed. Cengage Learning, 2011
2. Thomas R. Peltier, Justing Peltier, John Blackley, *Information Security Fundamentals*, Auerbacj Publications, 2010

Suggested Reading:

1. Detmar W Straub, Seymor Goodman, Richard L Baskerville, *Information Security Policy Processes and Practices*, PHI, 2008
2. Marks Merkow and Jim Breithaupt, *Information Security, Principle and Practices'*, Pearson Education, 2007
3. Mark Rhodes-Ousley, *Information Security, The Complete Reference* McGraw-Hill Education, New York, 2013
4. Alberts, Christopher and Dorofee, Audrey, *Managing Information Security Risks*: *The OCTAVE Approach* Addision-Wesley Publications, 2003