B.E. SYLLABUS

MECHANICAL ENGINEERING

VII & VIII SEMESTER

With

Scheme of Teaching

& Examination
### VII SEMESTER

<table>
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<tr>
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<td>Operations Management &amp; Entrepreneurship</td>
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12ME 701–POWER PLANT ENGINEERING (4-0-0)

Hours per week: 4  CIE Marks: 50
Credits: 4  SEE Marks: 50
Examination Hrs: 03  Total Marks: 100

UNIT-I

Chapter-1: Steam Power Plant
Different types of fuels used for steam generation, Equipment for burning coal in lump form, stokers, different types, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace, Coal and ash handling. 10 Hours

UNIT-2

Chapter-1 Contd: Generation of steam using forced circulation, high and super critical pressures, A brief account of Benson, Velox, L’mont steam generators

Chimneys: Natural, forced, induced and balanced draft, Calculations involving height of Chimney to produce a given draft.
Cooling towers and Ponds.
Accessories for the steam generators: Super heaters, De-super heater, Economizers, air pre heaters and re heaters. 10 Hours

UNIT-3

Chapter-2: Diesel Engine Power Plant:
Applications of Diesel Engines in Power field, Method of starting diesel engines, cooling and lubrication system for the diesel engine. Intake and exhaust system, general layout, advantages and disadvantages over steam power plant.

Chapter-3: Hydro-Electric Plants
Storage and Pondage, flow duration and mass curves, hydrographs, low, medium and high head plants, pumped storage plants, Penstock, water hammer, surge tanks, power house general layout, advantages and disadvantages over thermal power plant. 12 Hours

UNIT- 4

Chapter-4: Gas turbine Power Plant:
Advantages and disadvantages of gas turbine plant, open turbine plants with intercooling, reheating and regeneration. Closed gas turbine power plant.

Chapter-5: Nuclear Power Plant
Principles of release of nuclear energy, fusion and fission reactions, nuclear fuels used in the reactors, Multiplication and thermal utilization factors, Elements of the nuclear reactor, moderator, control rod, fuel rods, coolants, Brief description of reactors of the following types-Pressurized water reactor, boiling water reactor, sodium graphite reactor, fast breeder reactor and gas cooled reactor, radiation hazards, shielding, radioactive waste disposal. 10 Hours

UNIT-5

Chapter-6: Power station estimation:
Choice of site for power station, load duration curve, load factor, capacity factor, use factor, diversity factor, demand factor, effect of variable load on power plant, selection of the number and size of units.

Chapter-7: Economics of power generation:
Cost of energy production, selection of plant and generating equipment and operating characteristics of power plants, tariffs for electrical energy.

TEXT BOOK:
2. Power plant Engineering by Domakundawar, Dhanpath Rai Sons, 2003

REFERENCES:

12ME 702–MECHANICAL VIBRATIONS (3-2-0)

Hours per week: 5  CIE Marks: 50
Credits: 4  SEE Marks: 50
Examination Hrs: 03  Total Marks: 100

UNIT-I

Introduction:
Types of Vibrations, Simple Harmonic Motion, and Principle of superposition applied to simple harmonic motions, Beats and simple problems.

Undamped Free Vibrations:
Single Degree of Freedom systems, Natural frequency of undamped free vibrations, Parallel and series combination of springs-equivalent stiffness, effect of mass of spring on natural frequency, Problems on identification of natural frequency of different systems, Torsional vibrations.

UNIT-II

Damped Free Vibrations:
Single degree of freedom systems, Different types of damping, Concept of critical damping and its importance, Study of response of viscous damped systems for cases of under-damping, critical-damping and over-damping, Logarithmic Decrement, Problems on rectilinear and rotary systems.

UNIT-III

Forced Vibrations:
Single Degree of Freedom Systems, Forced Vibration of spring-mass-damper system, transient and steady state solution, Reciprocating and rotating unbalance, Force transmitted to the base due to harmonic excitation-Force Transmissibility, Vibrations due to support motion-Motion Transmissibility, vibration isolation.
UNIT-IV

Analysis of two Degrees of Freedom Systems:
Introduction, principal modes of vibration, masses on tightly stretched strings, double pendulum, combined rectilinear and angular modes, system with damping, undamped forced vibrations with harmonic excitation, undamped dynamic vibration absorber, problems. Vibrometers and Accelerometers, Whirling of shafts with and without air damping, Discussion on speeds above and below critical speed of shaft, Numerical problems. 10 Hours

UNIT-V

Numerical methods for multi degree freedom systems:
Introduction, Influence coefficients, Maxwell’s reciprocal theorem, Dunkerley’s equation, Orthogonality of Principal modes, Method of Matrix Iteration and orthogonality principle. Holzer’s Method, Stodola Method

Machine condition monitoring and Diagnosis 10 Hours

TEXT BOOKS:


REFERENCE BOOKS:


12ME 703 – INDUSTRIAL ROBOTICS (4-0-0)

Hours per week: 4
Credits: 4
Examination Hrs: 03
Total Marks: 100

UNIT – I

Introduction to robotics
Definition, anatomy of robot, classification configurations, robot links and joints, robot specifications, resolution accuracy and repeatability, simple numerical problems, robot drive systems, hydraulic, pneumatic and electric drive systems, wrist and its motions, end
effectors, types of end effectors, mechanical grippers, methods of constraining parts in grippers, types of gripper mechanisms, simple numerical problems, vacuum cups, magnetic grippers, adhesive grippers, hooks, scoops and other gripper devices, tool as end effectors, examples.

UNIT – II

Robot motion analysis
Direct kinematics and inverse kinematics, 3D homogeneous transformations, rotation, translation and displacement matrix, composite rotation matrix, rotation matrix about an arbitrary axis, links, joints and their parameters, Denavit-Hertenberg (D-H) representation, application of D-H matrices to different robot configurations.

UNIT – III

Robot control and trajectory planning
Basic control systems and models, transfer function with examples, transfer function for spring-mass-damper system, transient response of a second order system, transfer function of a robot joint, different types of controllers, proportional (P) controller, integral (I) controller, derivative (D) controller, PID controller, simple numerical problems.

Trajectory planning, definition, steps in trajectory planning, joint space techniques, use of a p-degree polynomial as interpolation function, cubic polynomial trajectories, linear function with parabolic blends, joint space verses Cartesian space trajectory planning, simple numerical problems on joint space trajectory planning.

UNIT – IV

Robot sensors and Machine Vision
Classification of robot sensors and their functions, touch sensor, tactile sensor, binary sensor, analog sensor, proximity sensor, range sensor, force and torque sensor.

Machine vision, functions of machine vision system, sensing and digitizing, imaging devices, analog to digital signal conversion, quantization and encoding, simple numerical problems, image storage, image processing and analysis, image data reduction, segmentation, feature extraction, object recognition, robotic machine vision applications, inspection, identification, visual servoing and navigation.

UNIT - V

Robot Programming
Introduction to robot programming, robot cell layout, work cell control and interlocks, manual programming, lead through and walkthrough programming, off-line programming, VAL programming language, example, AML and VAL-II robot programming languages, examples, Programming with graphics, example. (08 Hours)

TEXT BOOKS:
2. Robot Technology Fundamentals, James G. Keramas, Cengage Learning, 1999
REFERENCE BOOKS:


Scheme Examination:

TWO questions to be set from each unit and students shall answer FIVE full questions choosing ONE question from each unit

12ME 704–Mechatronics (4-0-0)

Hours per week: 4  CIE Marks: 50
Credits: 4  SEE Marks: 50
Examination Hrs: 03  Total Marks: 100

UNIT 1

Introduction: Introduction to Mechatronic systems, Measurement systems, control systems, microprocessor based controllers, Mechatronics approach. Examples and discussions on typical mechatronic systems.

Review of Transducers and Sensors: Introduction to Transducers and sensors, their classification, light sensors, proximity sensors and Hall-effect sensor, encoders, selection of sensors.

10 Hours

UNIT 2


12 Hours

UNIT 3


10 Hours
UNIT 4

10 Hours

UNIT 5
Microprocessors: Logic gates, flip flops. Introduction to microprocessor, microprocessor based digital control, Basic elements of control system, 8085 A microprocessor architecture terminology such as CPU, memory & address, ALU, assembler data registers, Fetch cycle, write cycle, state, Bus, interrupts, Microcontrollers. Differences b/w microprocessor & micro controllers. Classification of micro controllers

10 Hours

TEXT BOOKS:
2. “Programmable Logic Controllers” John W Webb and Ronald A Reis, Prentice Hall, Inc. 3 edn, 1994

REFERENCE BOOKS:
2. Pneumatics Basic level TP101, Peter Croser and Frank Ebel, Festo Didactic Publications. 2003

Scheme Examination:
TWO questions to be set from each unit and Students shall answer FIVE full questions choosing at least ONE question to be answered from each unit.

12ME 705 – PROJECT PART - I (0-0-3)

Hours per week: 3 CIE Marks: 50
Credits: 3 SEE Marks: 50
Examination Hrs: 03 Total Marks: 100

Preparing a project - brief proposal including

- Problem Identification
- A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
- List of possible solutions including alternatives and constraints
- Cost benefit analysis
- Time Line of activities
- Identification of a real life problem in thrust areas
- Developing a mathematical model for solving the above problem
- Finalization of system requirements and specification
Proposing different solutions for the problem based on literature survey
Future trends in providing alternate solutions
Detailed design and development plans
Preparation of part drawings for manufacturing.
Consolidated report preparation of the above

Or similar relevant academic activities suited for a particular project as approved by the guide.

12ME 706—SEMINAR (0-0-2)

12ME 707—DYNAMICS LAB (0-0-2)

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Part - A
1. Determination of a Pressure distribution in Journal bearing.
2. Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes.
3. Determination of Fringe constant of Photoelastic material using
   a) Circular disc subjected to diametral compression,
   b) Pure bending specimen (Four point bending).
4. Determination of stress concentration using Photoelasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2D Crane hook.

Part - B
5. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems. (Longitudinal and torsional)
7. Determination of critical speed of a rotating shaft.
8. Experiments on Gyroscope (Demonstration only).
9. Determination of equilibrium speed, sensitiveness, power and effort of porter/propel Governor.

Scheme of Examination:
One Question from Part A : 20 marks
One Question from Part B : 20 marks
Viva Voce : 10 marks

ELECTIVES

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12ME 711 – FOUNDRY TECHNOLOGY (3-0-0)

Hours per week : 3  
Credits : 3  
Examination Hrs: 03  

CIE Marks : 50  
SEE Marks : 50  
Total Marks : 100

UNIT - 1

FOUNDRY METALLURGY: Oxidation of liquid metals, gas dissolution in liquid metals, methods of degassing, fluidity, factors affecting fluidity, fluidity tests, hot tearing, shrinkage of liquid metals. CASTING DESIGN: Introduction to casting design, redesign considerations, design for minimum casting stresses, design for directional solidification, design for metal flow, safety factors, design for low pattern cost.  8 Hours

UNIT - 2

SOLIDIFICATION OF CASTINGS: Crystallization and development of cast structure - nucleation, growth and dendritic growth. Coring and segregation. Concept of progressive and directional solidification, solidification time and Chvorinov’s rule. Structure of castings - refinement and modification of cast structure
MELTING FURNACES: Introduction to various types of furnaces. Developments in cupola melting – hot blast cupola, water cooled cupola, balanced blast cupola, cokeless cupola, cupola charge calculations.  10 Hours

UNIT - 3

RISERING AND GATING: Need for risering, general considerations of risering, riser types, riser size and location. Requirements of a riser. Sand, insulating, and exothermic materials used for risers. Riser feeding distance and theory of risering. Riser efficiency, methods to improve riser efficiency. Gating system – Classification, theoretical consideration of gating, laws of fluid flow, turbulence in gating system, need for tapered sprue, gating ratio( simple problems). SPECIAL MOULDING TECHNIQUES: Principles, materials used, process details and application of no-bake sand systems, vacuum moulding, flaskless moulding, and high pressure moulding.  8 Hours

UNIT - 4

FERROUS FOUNDRY: Melting procedures, casting characteristics, production, specification, and properties of some typical steels, grey cast iron, malleable iron, and spheroidal graphite cast iron castings. NON-FERROUS FOUNDRY: Melting procedures, casting characteristics, production, specification, and properties of some typical aluminum, copper, and magnesium based alloy castings.  8 Hours

UNIT – 5

MODERNIZATION AND MECHANIZATION OF FOUNDRY: Need for modernization, and mechanization, moulding and core making, melting, pouring, shake out equipment and fettling, dust and fume control, material handling equipments for sand moulds and cores, molten metal and castings, reclamation of sands. Pollution control.  8 Hours
TEXT BOOKS:
1. Principles of metal casting, Heine Loper & Rosenthal TMH - 2005

REFERENCES BOOKS:
2. Foundry Technology, P. N. Rao, 2009

12ME 712– CONTROL ENGINEERING (3-0-0)

Hours per week : 3
Credits : 3
Examination Hrs: 03

CIE Marks : 50
SEE Marks : 50
Total Marks : 100

UNIT-1
Introduction: Control system, open and closed loop control systems, concept of feedback.
2 Hours

Mathematical Model: Transfer functions models, Models of mechanical systems, electrical systems, hydraulic systems and thermal systems.
5 Hours

UNIT-2
Block diagram and signal flow graph: Block representation of system elements, example of the use of block diagrams, Block diagram Reduction, Signal flow graph, Mason’s gain formula.
8 Hours

UNIT-3
System Responses: Types of input signals, First order and second order system response to step input, steady-state error, system types, System stability criteria, Routh criteria. 8 Hours

UNIT-4
Frequency Response: Polar and rectangular plots for the frequency response, Nyquist stability criterion, stability analysis. Phase and gain margin.
5 Hours

5 Hours

UNIT-5
System Analysis using Root locus Plots: General rules for construction of Root Locus plots, analysis using root locus plot
5 Hours
**Control action:** Basic concept of Proportional control, integral control, derivative control, proportional plus derivation control, PID control.  

**TEXT BOOKS:**


**REFERENCE BOOKS:**

2. Gopal M (2005) ”Modern Control Systems”, New Age International Publisher

**12ME 713– REFRIGERATION AND AIR-CONDITIONING (3-0-0)**

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UNIT - 1

**REFRIGERATION:** Principles, ideal cycle, Bel, Coleman and Boot strap air cycles, COP calculations. Refrigerants – ECO friendly refrigerants.  

**UNIT - 2**

**VAPOUR COMPRESSION SYSTEM:** Thermodynamic analysis, performance of system under varying operating conditions, cascade refrigeration, multistage refrigeration working principles.  
**VAPOUR ABSORPTION AND OTHER SYSTEMS:** Ammonia – water system, Lithium Bromide – water system. Use of enthalpy –concentration charts, steam jet refrigeration and solar refrigeration systems.

**UNIT - 3**

**AIR CONDITIONING:** Psychrometry, psychrometer, psychometric processes, air conditioning cycles, cooling and reheat cycles, by-pass factor – humidification.  

**COOLING LOAD:** Effective temperature, comfort conditions, sensible heat factor ratio, number of air changes, cooling/heating load calculations.

**UNIT - 4**

**DUCT DESIGN AND AIR DISTRIBUTION:** Considerations, methods of duct design air distribution systems, fans and air conditioning systems control.
UNIT - 5
BALANCING OF COMPONENTS: Condensers, air cooled, water cooled and evaporative condensers, selection, evaporates – flooded, dry expansion, shell and tube and double pipe, compressors – reciprocating, rotary and centrifugal types. Expansion devices, cooling towers.

8 Hours

TEXT BOOK:

REFERENCES:

12ME 714 –DESIGN OF PRESSURE VESSEL & PIPING (3-0-0)

Hours per week : 3
Credits : 3
Examination Hrs: 03

UNIT - 1
INTRODUCTION
Methods for determining stresses - Terminology and Ligament Efficiency - Applications.

8 Hours

UNIT - 2
STRESSES IN PRESSURE VESSELS
Introduction - Stresses in a circular ring, cylinder - Membrane stress Analysis of Vessel Shell components - Cylindrical shells, spherical sheels, torispherical heads, conical head - Thermal stresses - Discontinuity stresses in pressure vessels.

8 Hours

UNIT - 3
DESIGN OF VESSELS
Design of tall cylindrical self supporting process columns - supports for short vertical vessels – stress concentration - at a variable thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of reinforcement - pressure vessel design.

9 Hours

UNIT - 4
BUCKLING AND FRACTURE ANALYSIS IN VESSELS
Buckling phenomenon - Elastic Buckling of circular ring and cylinders under external pressure - collapse of thick walled cylinders or tubes under external pressure - effect of supports on Elastic Buckling of cylinders - Buckling under combined External pressure and axial loading - Control and significance of Fracture Mechanics in Vessels - FEM application.

9 Hours
UNIT - 5

PIPING  Introduction - Flow diagram - Piping layout and piping stress Analysis.  8 Hours

TEXT BOOK:


REFERENCES:

12ME 715 – MODELING & SIMULATION OF ENGINEERING SYSTEMS ( 3-0-0)

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UNIT - 1


10 Hours

UNIT - 2


8 Hours

UNIT - 3


8 Hours

UNIT - 4

Frequency response of Linear, Time invariant systems - frequency response of first-order and second-order systems - state space formulations of systems, problems relating frequency response to pole location –transient response- poles and frequency response. Feedback systems:  

8 Hours

UNIT - 5

Systems with feedback - block diagrams - properties of feedback systems - relative stability-phase and gain margins.  

8 Hours

TEXT BOOK:

REFERENCES:

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**UNIT-1**

Types of Maintenance – Preventive Maintenance, Predictive Maintenance, Reliability Centered Maintenance, Concept of Reliability, Availability and Maintainability History and Impact of TPM, Maintenance to Productive maintenance, Definition, Features and Working of TPM, Benefits of TPM.

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**UNIT-2**

Terotechnology – introduction, main functions, elements of Life-cycle cost and trade-off, essence of terotechnology

**Equipment six big losses** - breakdown loss, setup loss, ldling and Minor stoppages, design speed loss, start-up loss, defect and rework losses

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**UNIT-3**

Total Productive Maintenance - Zero breakdowns, Zero Defects and TPM, maximizing equipment effectiveness, eight pillars of TPM, TPM small group activities, TPM organization, management decision, educational campaign, creation of organizations, establishment of basic policies and goals, formation of master plan. TPM implementation

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**UNIT-4**

Eliminating six big losses, autonomous maintenance and maintenance skills training, measuring maintenance effectiveness

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**UNIT-5**

Implementation of TPM – Discussion of real life case studies, TPM-Bajaj Way – 10 pillar approach, pitfalls of TPM and lessons on TPM

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**TEXT BOOKS:**

REFERENCE BOOKS:
1. Training Material – M/s Baja Auto Ltd., Pune
Other resources from the internet

Scheme Examination:
Two questions to be set from each unit and Students shall answer FIVE full questions choosing at least ONE question to be answered from each unit.

12ME 717 – ADVANCED MANUFACTURING PROCESSES (3-0-0)

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UNIT – 1
Tool-based Micro machining – Conventional machining
Introduction, micro cutting, micro milling, micro tool geometry, effect of feed rate on cutting force for different tool geometry, micro turning, turning of microstructure array, Turning of brittle materials, micro grooving and micro threading, micro drilling, burr formation in micro drilling, effect of induced low frequency vibration on micro drilling, fabrication of micro drills by Wire electro discharge grinding (WEDG), Fly- cutting, burr formation mechanism, cutting mode in micromachining, burr minimization, micro shaping, micro grinding.  

UNIT-2
Tool-based Micro Machining – Nonconventional machining

UNIT – 3
High speed machining (HSM), definition of basic features of HSM, physical aspects of HSM, HSM technology and appliances, HSM spindle with tool clamping system, basic application of HSM Technology, machining of thin-walled parts using HSM.

Dry and Semi-dry machining, Dry machine tools and equipment, dry machining operations, introduction to near-dry machining, minimal quantity lubrication (MQL) media and mixture spraying systems, near-dry machine tools and machining operations.

Hard part machining (HM), definition of basic features of HM, physical aspects of HM, applications of HM Technology, surface finish produced by hard part machining.
High performance and high efficiency machining, high-performance cutting (HPC), machine tools and tooling for high performance cutting, simplified machining operations in HPC, multitasking and one-pass machining, multitasking machines and tooling. 8 Hours

UNIT – 4

Hybrid thermal machining and thermally assisted machining processes

Hybrid thermal machining processes: Electro erosion dissolution machining, electro-discharge grinding, abrasive electro-discharge machining, EDM with ultrasonic assistance, electrochemical discharge grinding, brush-erosion dissolution mechanical machining

Laser Assisted Machining (LAM), definition of basic features of LAM, schematic diagram of LAM, Plasma Assisted Machining (PAM), definition of basic features of LAM, effect of surface temperature on cutting force. 8 Hours

UNIT – 5

Sensor assisted Machining

Sensors and System Architecture: Sensing objective during machining, multiple-sensor drive machining process control system, monitoring methods in manufacturing, sensor application verses level of precision and error-control parameters, sensors used for monitoring metal cutting and grinding operations, construction of direct spindle integrated with measuring ring and force sensors, tool monitoring systems, intelligent monitoring system.

Practical Examples of Monitoring Systems for Metal Cutting Applications: Monitoring systems on turning centres, drilling process monitoring using sensors for torque and force measurements within the tool holder and current sensor, Tool-condition monitoring systems, the tool-breakage and tool-wear detection system, the collision-monitoring system, Typical applications of the acoustic emission principle for tool-condition monitoring, Method of dimensional error compensation in precision hard turning, Fundamental structure of the sensor-based intelligent manufacturing system, Hardware structure of the intelligent machining centre, Sensor-assisted intelligent machining system.

Touch-trigger Probing and Laser Measuring Systems: Examples of on-machine probing for tool and part measurements, 3D touch probes for machine tools, Radio transmission (a) and inductive transmission systems, Trigger signal transmission for touch probes using optical transmission, tool setting probing systems for CNC lathes, high precision pull-down arm (HPPA) and high precision removable arm (HPRA), Laser system for monitoring of tool breakage, high speed scanning probe and its use in measurements of cylinder bores, in-line inspection using vision sensors. 10 Hours

TEXT BOOKS:


REFERENCE BOOKS:


UNIT – 1

SPARK IGNITION ENGINES:

UNIT – 2

COMPRESSION IGNITION ENGINES

UNIT – 3

POLLUTANT FORMATION CONTROL:

UNIT – 4

ALTERNATIVE FUELS
Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas - Properties, Suitability, Engine Modifications, Merits and Demerits as fuels

UNIT – 4

RECENT TRENDS
Learn Burn Engines - Stratified charge Engines - Gasoline Direct Injection Engine - Homogeneous charge Compression Ignition - Measurement techniques: Bosch Smoke meter, Measurement of Brake Power by dynamometers

REFERENCES:
1. R.B.Mathur and R.P.Sharmal, "Internal Combustion Engines".

12ME 722 – MAINTENANCE & RELIABILITY ENGINEERING (3-0-0)

<table>
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UNIT 1

Introduction:
Need for maintenance, objectives, functions and importance of maintenance systems, Type of maintenance systems – planned, breakdown, preventive, predictive, design-out, corrective, opportunistic, Total Productive Maintenance
Condition based maintenance – condition monitoring
Computers in maintenance – introduction, features and benefits

10 Hours

UNIT 2

Maintenance planning and Scheduling: Planning of maintenance, manpower allocation, long range planning, short range planning, planning techniques and procedures, estimation of maintenance work, maintenance control, scheduling, repair order control, manpower requirement, maintenance job analysis, spare parts control

10 Hours

UNIT 3

Economics in Maintenance: Maintenance costs, repair, replacement, repair complexity, finding out most optimal Preventive Maintenance frequency, Numerical problems are required Diagnostic maintenance – wear monitoring, temperature monitoring, vibration monitoring, lubricant analysis.

7 Hours

UNIT 4


7 Hours

UNIT 5

System reliability - introduction, series, parallel, mixed configuration, series-parallel, parallel-series configurations, methods of solving complex systems. Reliability improvement – introduction, improvement of components, redundancy – types,
optimization, reliability cost trade off. Maintainability and Availability – introduction, reliability, and maintainability trade off.

Text books:


Reference books:


12ME723 – COMPUTER INTEGRATED MANUFACTURING (3-0-0)

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UNIT – 1


Computer Process Monitoring: Process control methods, direct digital control, supervisory computer control, steady state optimal control, on line search strategies, adaptive control.

UNIT – 2

Computer Aided Quality Control: The computer in Q.C, automated inspection principles and methods, Contact inspection methods, non-contact inspection methods, machine vision system, optical inspection method, sensors, coordinate, measuring machine, Computer-Aided testing, Integration of CAQL with CAD/CAM.

UNIT – 3


UNIT – 4

Analysis of Automated Flow Lines: Analysis of transfer lines without storage with storage buffer single stage, Double stage, Multistage with problems, Automated assembly systems,
Design for automated assembly, parts feeding devices, analysis of Multi station assembly machine, Analysis of Single stage assembly machine.  

UNIT – 5

Automated Material Handling Storage: Material functions, types of material handling equipment, analysis of material handling systems, design of system, conveyor system, automated guided vehicle systems, automated storage/retrieval systems, caroused storage systems work in process storage, interfacing handling & storage with manufacturing

TEXT BOOKS:


REFERENCE BOOKS:


Scheme Examination:

TWO questions to be set from each unit and students shall answer FIVE full questions choosing ONE question from each unit

12ME724– DESIGN FOR MANUFACTURE AND ASSEMBLY (3-0-0)

Hours per week : 3  
CIE Marks : 50
Credits : 3  
SEE Marks : 50
Examination Hrs: 03  
Total Marks : 100

UNIT – 1

Selection of materials and processes: Phases of design - General requirements, material and process selection, effect of material properties and manufacturing process on design-- The material selection process- DFM approach, DFM guidelines

UNIT – 2

Product design for manual assembly, automatic assembly and robotic assembly, Computer aided DFMA. Process capability, mean, variance, skewness, kurtosis, process capability metrics, Cp, Cpk, Cost aspects, feature, tolerances.

UNIT – 3

Geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law, Selective assembly. Datum systems-Feature location, Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance
zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout
gauging, compound assembly, examples. 10 Hours

UNIT – 4
Redesign of castings based on parting line considerations, minimizing core requirements,
redesigning cast members using weldments, use of welding symbols. Operation sequence for
typical shaft type of components, preparation of process drawings for different operations.
8 Hours

UNIT – 5
Tolerance worksheets and centrality analysis, examples. Design features to facilitate
machining, datum features - functional and manufacturing, component design machining
considerations, redesign for manufacture, examples. 8 Hours

TEXT BOOK:

REFERENCES:

1999.

12ME725– MATERIALS MANAGEMENT (3-0-0)

Hours per week : 3    CIE Marks : 50
Credits : 3           SEE Marks : 50
Examination Hrs: 03   Total Marks : 100

UNIT – 1
Introduction Meaning, definition, functions of materials management, Concept of integrated
material management, Relationship of material management with other Organizational
functions. 8 Hours

UNIT – 2
Material Planning & Budgeting: Need for material planning, Factors affecting material
planning, Techniques of material planning; Material classification, codification and
standardization; Material budgeting - meaning and need, techniques of material budgeting.
9 Hours
UNIT – 3
Inventory Control: Need and meaning of inventory, types of inventory, functions of inventory control, Inventory costs, Inventory control tool - ABC, VED, XYZ and FSN: Economic order Quantity and replenishment of stocks. Physical control of inventory: Fixed order, Two bin and Kardex systems - Material requirement planning (MRP-I) Spare parts control for maintenance purposes. Evaluation of inventory control performance. Concept of Just-in-Time (JIT). Use of computers for inventory control. 9 Hours

UNIT – 4
Purchasing: Purchasing principles, procedures and systems, Functions of purchasing, Make-or-buy decision, Vendor development and vendor rating. Factors affecting purchase decisions, Legal aspects of purchasing, Documentation and procedure for import. 8 Hours

UNIT – 5
Storage: Functions and importance of store keeping, types of stores, store accounting and store verification, Legal aspects of store keeping, Management of surplus, scrap and obsolete items. Importance of material handling in store keeping, handling equipment. 8 Hours

TEXT BOOKS:
1. Materials Management by M.M Verma, S. Chand and Sons

REFERENCE BOOKS:
2. Purchasing and materials management by Dobbler and Burt; Tata McGraw Hill
3. Inventory control by Starr and Miller

12ME726– PRODUCT DESIGN AND DEVELOPMENT (3-0-0)

Hours per week  : 3
Credits  : 3
Examination Hrs: 03
CIE Marks : 5
SEE Marks : 50
Total Marks : 100

UNIT - I
VISUAL DESIGN:
Basic elements and concept of visual design: line color, Balance proportion, Size shape mass, unity and variety, Special relationships and composition in two and three dimensions. 8 Hours

UNIT - II
FORM & COLOR Elementary forms their characteristics and significance in design. Form transition, Form in relation to ergonomics, material and manufacturing process, color as an element of design, color clarification dynamics, interrelation of colors, colors and traditions; Psychological use of color form and material. 9 Hours

UNIT - III
PRODUCT GRAPHICS: Meaning and objectives of product graphics. Basic principles of graphic design, Visual communication aspects of product graphics, Graphics of displays and control panels, 8 Hours

UNIT - IV

PRODUCT DETALING: Standard fastening and joining details in different materials; Temporary and permanent joints: Detailing for plastic products, Detailing for fabricated products in sheet metal, 9 Hours

UNIT - V

PRODUCTS DEVELOPMENT: Definition and objective, Role of designer in product development. Manufacturing and economic aspects of product development, Product promotions, product developments. 8 Hours

TEXT BOOK:

REFERENCE BOOKS:
2. Engineering Design- Svensson.
3. Engineering Design-Matousek

12ME727–Design of Aircraft Structure (3-0-0)

Hours per week : 3  CIE Marks : 50
Credits : 3  SEE Marks : 50
Examination Hrs: 03  Total Marks :100

UNIT -1

Chapter-1-Overview of the Aircraft Design Process
Airworthiness- Definition, Airworthiness Regulations, Regulatory Bodies, US FAR and Subparts of FAR Part 25, Type certification, General Requirements, Requirements Related to Aircraft Design - Performance and Stability Requirements, Airframe (strength) Requirements, Landing Requirements, Fatigue and Damage tolerance requirements, Emergency Provisions, Emergency Landing requirements. 4 hours

Chapter-2 -Aircraft Loads
Aerodynamic Loads, Inertial Loads, Loads due to engine, Actuator Loads, Maneuver Loads, V-n diagrams, Gust Loads, Ground Loads, Ground conditions, Miscellaneous Loads. Simple numerical examples. 2 hours

Chapter 3- Aircraft Structures Description
Types of Structural members of Fuselage and wing section and empennage, Splices, Types of structural joints, splices and fuselage floor structure. 1 hours

UNIT 2

Chapter 4-Aircraft Materials and properties
Introduction, Basic construction, Material forms-Metallic materials and forms. Alloy designations. Mechanical Properties- strength, static, stress strain curves, Fatigue properties, crack growth. 3hours

Chapter 5- Static and Fatigue Failures
Principal stresses, principal strains, Mohr’s circle for stress and strain, Fatigue Failures, Fatigue
theory, Introduction to Low cycle Fatigue, Stress Life and Strain Life Techniques, Mean stress effects,
Multi-axial Effects, Introduction to high cycle fatigue.

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<th>UNIT 3</th>
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<tr>
<td><strong>Chapter 6-Theory of bars ,Beams, Shafts and Columns</strong></td>
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<tr>
<td>Axially loaded structures, Methods of analysis-Method of joints and Method of sections, Space truss.</td>
<td>Beam theory, Section properties, Deflection of beams, Symmetric and Unsymmetric bending, Plastic bending, Shear stress in beams, Shear center, Torsion of Solid Sections, Torsion of Thin walled-open and closed sections, Columns Theory-Euler equation, Effective column length, Plasticity effects, Thin walled columns-Crippling, Beam columns.</td>
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<th>UNIT 4</th>
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<tr>
<td><strong>Chapter 7- Box Beams</strong></td>
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<tr>
<td>Box Beams- Introduction, Shear flow due to shear, Shear flow due to torsion-Bredt Baths, Single and Multicell Boxes.</td>
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<tr>
<td><strong>Chapter 8 Buckling of Thin Sheets</strong></td>
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<tr>
<td>Buckling of thin sheets, Buckling of flat plate in compression and shear, Buckling of curved plates in compression and shear, buckling of stiffened panels-post buckling, effective width, Concept of diagonal tension, buckling under combined loads.</td>
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<th>UNIT 5</th>
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<tr>
<td><strong>Chapter 9- Aircraft Structural Joints</strong></td>
<td>2 hours</td>
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<tr>
<td>Introduction, Fasteners, Splices, and Eccentric joints-Bolt Group Analysis, Lug Analysis(Lugs loaded axially only), Tension Fitting and clips, Welded joints, Bonded joints</td>
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<tr>
<td><strong>Chapter 10- Advanced materials, Vibrations and Flutter</strong></td>
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<tr>
<td>Introduction to Comp Materials, Matrices, Fibers, Forms, Characteristics of composite materials, Brief overview of static and dynamic aero elasticity (definition and importance only)</td>
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</table>

**Text Books:**

6. An Introduction to Aircraft Certification; A Guide to Understanding Jaa, Easa and FAA by Filippo De Florio, Butterworth-Heinemann

**Web resources**

4. [http://ameslib.arc.nasa.gov/randt/1999/aero/aero.html](http://ameslib.arc.nasa.gov/randt/1999/aero/aero.html)
5. [http://www.ctas.arc.nasa.gov/project_description/pas.html](http://www.ctas.arc.nasa.gov/project_description/pas.html)
7. [http://www.dcmt.cranfield.ac.uk/aeroxtra/e339.htm](http://www.dcmt.cranfield.ac.uk/aeroxtra/e339.htm)
12ME 801–HEAT & MASS TRANSFER (3-2-0)

Hours per week: 5  CIE Marks: 50
Credits: 4  SEE Marks: 50
Examination Hrs: 03  Total Marks: 100

UNIT-1

INTRODUCTORY CONCEPTS AND DEFINITIONS:
Modes of heat transfer; Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; Radiation heat transfer coefficient; combined heat transfer mechanism.

CONDUCTION-BASIC EQUATIONS:
General form of three dimensional heat conduction equation in rectangular, coordinate. Discussion (no derivation) on three dimensional conduction in cylindrical and spherical coordinate systems. Boundary conditions of first, second and third kinds.

ONE-DIMENSIONAL STEADY STATE CONDUCTION:
Steady state conduction in a slab, in a cylinder and in a sphere without heat generation. Overall heat transfer coefficient for a composite medium; thermal contact resistance; critical thickness of insulation

UNIT-2

HEAT CONDUCTION THROUGH FINNED SURFACES
Steady state conduction in fins of uniform cross section long fin, fin with insulated tip and fin with convection at the tip; fin efficiency.
Conduction in solids with variable thermal conductivity.

ONE-DIMENSIONAL TRANSIENT CONDUCTION:
Conduction in solids with negligible internal temperature gradients (Lumped system analysis); Use of transient Temperature charts (Heisler’s Charts) for transient conduction in slab, long cylinder and sphere; use of transient temperature charts for transient conduction in semi infinite solids.

UNIT-3

CONCEPTS AND BASIC RELATIONS IN BOUNDARY LAYERS:
Flow over a body-Velocity boundary layer; Critical Reynolds number; General expressions for drag coefficient and drag force; Thermal boundary layer; general expression for local heat transfer coefficient; Average heat transfer coefficient; Nusselt number. Flow inside a duct-velocity boundary layer hydrodynamic entrance length and hydro dynamically developed flow; expressions for friction factor for hydro dynamically developed laminar flow through tubes, growth of thermal boundary layer for constant wall temperature and constant wall heat flux conditions; thermal entrance length and thermally developed flow.
RADIATION HEAT TRANSFER:
Thermal radiation; Definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's Law and Wein's displacement law. Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces; Effect of radiation shield; Intensity of radiation and solid angle; Lambert's Law; Radiation heat exchange between two finite surfaces - configuration factor or view factor; properties of view factors; determination of view factors-view factor algebra; Hottel's cross string formula; Network method for radiation heat exchange in an enclosure.

10 Hours

UNIT-4

FORCED CONVECTION:
Application of dimensional analysis for forced convection problems. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro-dynamically and thermally developed flows; use of correlations for flow over a flat plate, over a cylinder and across.

FREE OR NATURAL CONVECTION:
Application of dimensional analysis for free convection- physical significance of Grashoff number; Use of correlations for free convection from or to vertical, horizontal and inclined flat plates, vertical and horizontal cylinders.

10 Hours

UNIT-5

CONDENSATION AND BOILING:
Types of condensation; Nusselt's theory for laminar condensation on a vertical flat surface-expressions for film thickness and heat transfer coefficient; use of correlations for condensation on inclined flat surfaces, horizontal tube and horizontal tube banks; Reynolds number for condensate flow; Regimes of pool boiling-Pool boiling correlations.

HEAT EXCHANGERS:
Classification of heat exchangers; overall heat transfer coefficient, Fouling and fouling factor; LMTD and NTU methods of analysis of heat exchangers.

INTRODUCTION TO MASS TRANSFER:
Similarity between Heat and Mass Transfer, Fick's Law of diffusion

12 Hours

TEXT BOOKS:

REFERENCE BOOKS:

**Scheme Examination:**
Two questions to be set from each unit and Students shall answer Five full questions choosing at least One question to be answered from each unit.

**12ME 802 – HEAT TRANSFER LAB (0-0-2)**

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<td>Examination Hrs: 03</td>
<td>Total Marks: 100</td>
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The students are required to carry out any 10 experiments from the following list.
1. Determination of Thermal conductivity of a Metal rod.
2. Determination of overall heat transfer coefficient of a Composite Wall.
3. Determination of Effectiveness on a metallic fin.
5. Determination of Heat Transfer co-efficient in a forced convention flow through a pipe.
7. Determination of Stefan Boltzman constant.
12. Experiment on Transient conduction Heat Transfer.

**Scheme of Examination:**
Students are required to carry out Two experiments in Semester End Exam
Experiment 1: 20 marks
Experiment 2: 20 marks
Viva Voce: 10 marks
Total: 50 Marks

**12ME 803–PROJECT – II (0-0-8)**

<table>
<thead>
<tr>
<th>Hours per week: 12</th>
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<td>SEE Marks: 50</td>
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<td>Examination Hrs: 03</td>
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</table>

The project work involves the following:

- A report highlighting the design finalization [based on functional requirements & standards (if any)]
Fabrication, assembly, testing and performance analysis of the designed project

A presentation including the following:
  - Implementation Phase (Hardware / Software / both)
  - Testing & Validation of the developed system
  - Learning in the Project

Consolidated report preparation

Objectives of the course on project work:
To expose engineering students to technology development at workplaces and appraise them regarding shop-floor problems. To provide practical experience in solving open ended problems in real work setting so as to cause transfer of college based knowledge and skills to solve practical problems and thereby develop confidence in the students in the analysis, synthesis and evaluation of practical problems leading to creative thinking Programme.

During this work bench involvement, students will be given 3-4 practical problems. The problems assigned should be of mutual interest to the students and the industry. The problem may belong to 3 or 4 different functional areas. To illustrate, following are some of the suggestions:

Design of a prototype, Programming of CNC machines, Calibration and testing of instruments, Productivity Improvement Studies, Pollution control related problems, Capacity Planning and Capital Budgeting, Safety Management, Optimum utilization of resources, Conflict Management methodology. The industrial organizations where students are to be sent for problem solving project-oriented work bench involvement may be selected well in advance. The faculty of the department is expected to visit the selected industries and identify suitable problems to be handled by students. It will be desirable that problems be matched with the interests of students. It is recommended that a group of 5-6 students be guided by one faculty member during this period.

SCHEME OF EVALUATION: Project demonstration, Viva voce
Total marks: 200 Marks
The distribution of marks shall be proportioned based on the type of the project and it is based on fulfilling the following requisites.

The evaluation of students is proposed to be done by internal faculty with active involvement of industrial personnel. The evaluation may be based on following criteria:

- Punctuality and Attendance
- Interpersonal relations
- Sense of Responsibility
- Clarity of concepts, principles and procedures
- Self expression/communication skills
- Report Writing Skills
- Creativity/conceiving new and unusual ideas
- Problem-solving skills

At the end of the project work course students are required to submit a working model of the equipment they have designed and developed or if it is a theoretical or experimental work, they are expected to study a detailed analysis and findings from their work.

**ELECTIVES**

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<tr>
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<th>Sub. Code</th>
<th>Subject</th>
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<tr>
<td>1</td>
<td>12ME811</td>
<td>Industrial Tribology</td>
<td>3</td>
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<td>2</td>
<td>12ME812</td>
<td>Tool Engineering and Design</td>
<td>3</td>
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<td>12ME813</td>
<td>Non-destructive Testing</td>
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<td>12ME814</td>
<td>Composite Materials Technology</td>
<td>3</td>
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<td>12ME815</td>
<td>Marketing Management</td>
<td>3</td>
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<td>6</td>
<td>12ME816</td>
<td>Corrosion Engineering</td>
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**12ME 811–INDUSTRIAL TRIBOLOGY (3-0-0)**

- **Hours per week**: 3
- **Credits**: 3
- **Examination Hrs**: 03
- **CIE Marks**: 50
- **SEE Marks**: 50
- **Total Marks**: 100

**UNIT 1**

Introduction: introduction to Tribology, industrial significance, introduction to micro/nano tribology
7 hours

**UNIT 2**

8 hours
UNIT 3
Lubrication and lubricants – types and properties of lubricants, viscosity, Newton’s Law of viscosity, Hagen-Poiseuille law

UNIT 4
Bearing materials – commonly used bearing materials, properties of typical bearing materials.  

UNIT 5
Hydrostatic lubrication – introduction, systems, step bearing – load carrying capacity, oil flow, design for max stiffness, numerical problems
Tribological components and applications – gears, cams, piston rings, cutting tools, industrial applications at least one.
Micro / nano tribology – introduction, AFM / FFM – description, measurements -10 hrs

Text books:
1. Introduction to Tribology of Bearings – B.C.Majumdar, S. Chand & Company Ltd., New Delhi, 2008.

Reference books:

12ME 812 – TOOL ENGINEERING DESIGN (3-0-0)

Hours per week : 3
Credits : 3
Examination Hrs: 03
CIE Marks : 50
SEE Marks : 50
Total Marks : 100

UNIT 1
Theory of Metal cutting – Mechanics of chip formation, nomenclature of single point tool, designation of cutting tools, orthogonal and oblique cutting, types of chips produced, tool wear and tool life
Cutting tools – materials, properties, classification, selection, multipoint cutting tools – milling cutters, drills.  

10 hours
UNIT 2
Design of Single point tool – types of cutting tools, chip breakers, design of shank section for single point tool to account for strength and rigidity
Design of multipoint tools – milling cutter, drill and reamer

UNIT 3
Design of Jigs and Fixtures – difference between a jig and a fixture, function of jigs and fixtures, design procedures for drill jig and fixtures, principles of location, different types of locators, principles of clamping, types of clamps, drill bushes and plates, types of drill bushes, bush materials.

UNIT 4
Design of drill jigs – types of drill jigs, jig and machine relationship, jig body and jig feet
Design of fixtures – milling fixture, turning fixture, grinding fixture and broaching fixture

UNIT 5
Design of Press tools – press operations, press tool components, press working terminology, types of dies, design of blanking die, design of drawing die, design of bending die

Text books:
3. ASTME – Fundamentals of Tool Design

Reference books:
2. Jigs and Fixtures – Kempster, ELBS

12ME 813 – NON DESTRUCTIVE TESTING (3-0-0)
Hours per week : 3
Credits : 3
Examination Hrs: 03
CIE Marks : 50
SEE Marks : 50
Total Marks : 100

UNIT 1
Introduction to Non Destructive Testing, Selection of ND methods, Visual Inspection, Leak testing – brief introduction, Liquid Penetrant Inspection – principle, advantages, limitations and applications, Magnetic Particle Inspection – methods of generating magnetic fields, types of magnetic particles, suspension liquids, steps in inspection, advantages, limitations and applications.

9 hours
UNIT 2
Eddy Current Inspection – principle, operation, operating variables, procedure, inspection coils, detectable discontinuities, advantages and limitations.
Industrial Computed Tomography – basic principles, capabilities and comparison with other NDT methods, applications
Thermal inspection – principles, equipment, inspection methods, applications 11 hours

UNIT 3
Ultrasonic Inspection – basic equipment, advantages, limitations, applications, characteristics of ultrasonic waves, major variables in ultrasonic inspection, basic inspection methods – pulse echo, transmission, transducer elements, couplants, search units, inspection standards 10 hours

UNIT 4
Radiographic Inspection – principles, limitations, radiation sources – X rays, y rays, recording media, film types and selection, interpretation of radiographs, image quality, penetrators
Electron radiography, Neutron radiography, Xero-radiography, application of radiographic inspection in industry 8 hours

UNIT 5
Acoustic Emission Inspection – principle, comparison of AE with other inspection methods, applications, AE waves and propagation, AE sensors and preamplifiers, instrumentation principles, applications 7 hours

Text books:

12ME814 – COMPOSITE MATERIALS TECHNOLOGY (3-0-0)

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UNIT - I
INTRODUCTION
Limitations of conventional materials - Definition of composite materials – Types of composites, properties and characteristics of different types of composites, Reinforcement of matrix materials, Applications of different types of composites

UNIT - II
MATERIALS
Types of Fibres materials – Types of polymer matrix- Metal matrix and Ceramic matrix - Coupling agents, fillers and additives - Metal Matrix and Ceramic matrix materials, Coupling agents, Fillers and additives. Techniques used to manufacture Metal matrix and ceramic composites.

UNIT - III

MANUFACTURING
Fundamentals - bag moulding - compression moulding pultrusion-filament winding - other manufacturing process - quality inspection and non-destructive testing.

UNIT - IV

DESIGN
Fabrication of Composites, cutting, machining, drilling, joint design, mechanical and adhesive bonding, joining, tooling, fabrication equipment.

UNIT - V

MECHANICS AND PERFORMANCE
Introduction to micro-mechanics-unidirectional lamina - laminates - interlaminar stresses - static mechanical properties - fatigue properties - impact properties - enviromental effects - fracture mechanics and toughening mechanisms, damage prediction, failure modes.

Total No of periods: 42

Text Books:

References:

12ME815 – MARKETING MANAGEMENT (3-0-0)

Hours per week : 3               CIE Marks : 50
Credits : 3                         SEE Marks : 50
               Examination Hrs: 03            Total Marks : 100

UNIT – I

BASICS
UNIT – II

BUYING BEHAVIOUR & MARKET SEGMENTATION
Cultural, Demographic factors, Motives, types, Buying decisions, segmentation factors, Demographic, Psychographic & Geographic Segmentation, Process, Patterns.

UNIT - III

PRODUCT PRICING & MARKETING RESEARCH

UNIT - IV

MARKETING PLANNING & STRATEGY FORMULATION
Components of a marketing plan, strategy formulations and the marketing process, implementation, Portfolio analysis, BCG, GEC grids.

UNIT - V

ADVERTISING, SALES PROMOTION & DISTRIBUTION

Text Book:

References:

12ME816-CORROSION ENGINEERING

Hours per week : 3
Credits : 3
Examination Hrs: 03

CIE Marks : 50
SEE Marks : 50
Total Marks : 100
UNIT 1. INTRODUCTION
Definition; Significance; Costs of corrosion; Corrosion Science & Engg; Corrosion damage; Classification of corrosion; Electrochemical aspects of corrosion; Polarization and passivity; Environmental effects; Corrosion rate expressions; Electrode potentials; Potential – pH (Pourbaix diagrams).

UNIT 2. FORMS OF CORROSION
Uniform corrosion and Atmospheric corrosion; Galvanic corrosion; Crevice corrosion; Filiform corrosion; Pitting corrosion; Inter granular corrosion; Selective leaching; Erosion-Corrosion Cavitation damage; Stress corrosion; Impingement Attack; Inlet tube corrosion; Corrosion fatigue; Hydrogen blistering; Hydrogen Embrittlement.

UNIT 3.
a) High Temperature Corrosion
Mechanism and kinetics; High Temperature materials

b) Corrosion in mineral acids;
Corrosion of steel, stainless steels, Cu, Ni; Al.

UNIT 4. CORROSION PREVENTION METHODS
Materials Selection; Design; Alteration of the environment; Cathodic and Anodic protection; Protective coatings.

UNIT 5. CORROSION TESTING
Planned Interval Tests, A few specific tests for corrosion rate measurement; Tafel extrapolation test; Linear polarization test; AC impedence.

Text Book / Reference Books:
12ME821 – WIND AND SOLAR POWER ENGINEERING (3-0-0)

Hours per week : 3  
Credits : 3  
Examination Hrs: 03

CIE Marks : 50  
SEE Marks : 50  
Total Marks : 100

UNIT - I

PRINCIPLE OF SOLAR RADIATION

UNIT – II

SOLAR THERMAL ENERGY CONVERSION

UNIT - III

SOLAR PHOTO VOLTAICS

UNIT – IV

WIND ENERGY

UNIT – V


Text Books:

References:

12ME 822 - ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS (3-0-0)

Hours per week : 3  
Credits : 3  
Examination Hrs: 03  
CIE Marks : 50  
SEE Marks : 50  
Total Marks : 100

UNIT – 1

ARTIFICIAL INTELLIGENCE: Introduction, definition, underlying assumption, importance of AI, AI and related fields.


10 Hours

UNIT – 2

KNOWLEDGE REPRESENTATION ISSUES: Representations and Mappings, Types of knowledge – Procedural Vs Declarative, Logic programming. Forward Vs Backward reasoning, Matching.

USE OF PREDICATE LOGIC: Representing simple facts, Instance and Isa relationships, Syntax and Semantics for Prepositional logic, FQPL and properties of Wffs, Conversion to Clausal form, Resolution, Natural deduction.

10 Hours

UNIT – 3

STATISTICAL AND PROBABILISTIC REASONING: Symbolic reasoning under uncertainty, Probability and Bayes’ theorem, Certainty factors and Rule based systems, Bayesian Networks, Shafer Theory, Fuzzy Logic

8 Hours.
UNIT – 4


7 Hours

UNIT – 5

TYPICAL EXPERT SYSTEMS: MYCIN, Variants of MYCIN, PROSPECTOR, DENDRAL, PUFF, ETC.

8 Hours

TEXT BOOKS:


REFERENCE BOOKS:


Scheme Examination:
TWO questions to be set from each unit and students shall answer FIVE full questions choosing ONE question from each unit

12ME 823 – FLUID POWER SYSTEMS (3-0-0)

Hours per week: 03
Credits: 3
Examination Hrs: 03

CIE Marks: 50
SEE Marks: 50
Total Marks: 100

UNIT 1:

FLUID POWER PRINCIPLES AND FUNDAMENTALS

8 Hours
UNIT 2

PUMPS: Types, classification, principle of working & constructional details of vane pump, gear pumps, radial & axial piston pumps, Power and efficiency calculations, characteristic curves, selection of pumps for hydraulic power transmission.

ACTUATORS: Linear & Rotary actuators, Hydraulic motors, - Types, vane, gear, axial piston, & radial piston. Types of cylinder & its mountings, calculations of piston velocity, thrust under static applications. Design consideration for cylinders.  

8 Hours

UNIT 3

CONTROL OF FLUID POWER: Necessity of pressure control, directional control, flow control valves, Principle of pressure control valves, direct operated, pilot operated, relief valves pressure reducing valve, sequence valve. FLOW CONTROL VALVES: Principle of operation, pressure compensated, temperature compensated flow control valves, meter in & meter out flow control circuits, bleed off circuits. DIRECTION CONTROL VALVES: Check valves, types of D.C. Valves : Two way two position, four way three position, four way two position valves, open center, closed center, tandem center valves, method of actuation of valves, manually operated, solenoid operated, pilot operated etc.  

8 Hours

UNIT 4

ACCUMULATORS & INTENSIFIERS: Types & functions of accumulators, intensifiers, applications,  

DESIGN OF HYDRAULIC CIRCUITS: Meter in, meter out circuits, Pressure control for cylinders, Flow divider circuits. Circuit illustrating use of pressure reducing valves, sequencing valve, counter balance valves, unloading valves with the use of electrical controls, accumulators etc.  

8 Hours

UNIT 5


8 Hours

TEXT BOOKS:


REFERENCE BOOKS:
1. **Pneumatics Basic Level TP 101** - by Peter Croser & Frank Ebel, Festo Didactic publication - 1999.


**Scheme Examination:**
TWO questions to be set from each UNIT and Students shall answer FIVE full questions choosing at least ONE question from each UNIT.

**12ME 824 – Energy Conservation and Management (3-0-0)**

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**UNIT-1**

Chapter 1: Energy scenario
Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, Indian energy scenario.  
5 Hours

Chapter 2: Energy conservation
4 Hours

**UNIT-2**

Chapter 3: Pollution due to power plants, green house effect, global warming, renewable energy sources.  
4 Hours

Chapter 4: Energy Auditing: Elements and concepts, Types of energy audits, Instruments used in energy auditing.  
4 Hours

**UNIT-3**

Chapter 5 : Energy conservation in Boilers and furnaces, Energy conservation in steam and condensate system.  
4 Hours

Chapter 6: fuels and combustion, stoichiometric air calculations and heat balance calculations for boilers and furnaces.  
4 Hours

**UNIT-4**

4 Hours

UNIT-5
Chapter 9 Energy management: Organizational set up for energy management, functions of energy manager, energy management information systems.
Chapter 10 Latest developments: Kyoto protocol, carbon trading, carbon fund, energy rating, green rating, life cycle assessments, role of bureau of energy efficiency in India.

TEXT BOOK:

REFERENCES:
3. Energy Engineering and Management- Amlan Chakrabarti-Prentice hall India 2011
5. Bureau of energy efficiency Hand outs New Delhi

12ME 825 – BIO MASS ENERGY SYSTEMS (3-0-0)

Hours per week : 3
Credits : 3
Examination Hrs: 03

CIE Marks : 50
SEE Marks : 50
Total Marks : 100

UNIT - 1


BIOMASS CONVERSION METHODS: Agrochemical, Thermochemical, Biochemical (flowchart) & Explanation.
UNIT - 2

PHYSICAL & AGROCHEMICAL CONVERSION: Briquetting, Pelletization, Agrochemical, fuel Extraction, Thermo chemical Conversion: Direct combustion for heat, Domestic cooking & heating. 4 Hours

BIOMASS GASIFICATION: Chemical reaction in gasification, Producergas& the constituents, Types of gasifiers. Fixed bed gasifiers, Fluidized bed gasifiers. Liquefaction: Liquefaction through pyrolysis & Methanol synthesis, application of producer gas in I C Engines. 4 Hours

UNIT - 3

BIO METHANIZATION: Anaerobic digestion, Basic principles, factors influencing Biogas yield, classification of Biogas digester, floating gasholder & fixed dome type. (Working Principle with diagram). Calculations for sizing the Biogas plant. 4 Hours

BIOGAS FOR POWER GENERATION: Ethanol as an automobile fuel, Ethanol production & its use in engines. 4 Hours

UNIT - 4

BIO - DIESEL: Bio Diesel from edible & non-edible oils, Production of Bio diesel from Honge & Jatropha seeds, use of bio diesel in I C engines, Engine power using Bio diesel, Blending of Bio diesel, Performance analysis of diesel engines using bio diesel. Effect of use of bio diesel in I C engines. 8 Hours

UNIT - 5

BIO POWER PLANTS: Bio Power generation routes, Basic Thermodynamic cycles in Bio power generation; Brayton cycle, Sterling cycle, Rankine cycle, Co-generation cycle. Biomass based steam power plant. 9 Hours

TEXT BOOKS:

REFERENCE BOOKS:
12ME 826 – MICRO-ELECTRO-MECHANICAL SYSTEMS (3-0-0)

Hours per week : 3  
Credits : 3  
Examination Hrs: 03  

CIE Marks : 50  
SEE Marks : 50  
Total Marks : 100  

UNIT – 1
Micro-Electro-Mechanical Systems, introduction and overview, Principles of MEMS, Silicon as a Mechanical Material, Benefits of MEMS, Scaling and performance, Cost reduction, complexity, Issues to consider, MEMS Markets, Overview of MEMS applications,  

UNIT – 2
Micromachining Techniques – Overview, Capabilities and limitations of micromachining, Materials for micromachining, Substrates, Additive films and materials, Micromachining terms, General properties of common semiconductors, Mechanical properties, Native oxides of silicon, Typical silicon wafer types, Micromachining Techniques – Bulk Micromachining, Wet etching of silicon, Isotropic etching, Anisotropic etching, EDP, KOH, TMAH, Etch stop layers, Masking, Mask erosion around edges, bulk micromachining process flow, Electrochemical etching, Etch stop, Porous silicon, One-sided wafer etching. Vapor phase etching (XeF₂), Dry etching, SF₆, DRIE, Bosch process, Cryogenic dry etching, Sidewall roughness, Etch lag, Combined isotropic and anisotropic dry etching, SCREAM, ASIP.  

UNIT – 3

UNIT – 4
Micro-Mechanics, Basic Mechanics, Axial stress & strain, Shear stress & strain, Poisson’s Ratio, Commonly used deflection equations, Static beam equations, Static torsion equations, Static plate equations, Cantilever beams, Clamped-clamped beams, Membranes, Springs – folded, torsional, Dynamics, Spring-mass-damper system, resonance, Test structures, Elastic properties, Bent Beam Method for determining Young’s modulus, Resonant beam structures - Cantilever beam, Comb drive resonator, Stress/Strain Gauges - Bent beam strain sensor, Cantilever beams, Buckling beam structures, Substrate analysis; Stoney Equation, Basic mechanisms and structures, In-plane rotary mechanisms, Out-of-plane mechanisms, Bistable mechanisms, Mechanical Sensors, Resistive and piezoresistive strain sensors, Semiconductor strain gauges, Capacitive sensing, Micromachined mechanical sensors, Accelerometers - Basic accelerometer concepts, Force-balanced accelerometer concepts, Strain guage
accelerometers, Capacitive accelerometers, Gyroscopes, Pressure sensors, Piezoresistive pressure sensors, Capacitive pressure sensors.  

UNIT – 5

**Electrostatics**, Actuation mechanisms, Electrostatic actuation, Parallel plate actuators, Torsional electrostatic actuators, Electrostatic comb drives, Electrostatic cantilever actuators, Electrostatic linear micromotors (scratch drive), Electrostatic rotary micromotors.


TEXT BOOKS:


REFERENCE BOOKS:


Scheme Examination:

TWO questions to be set from each unit and students shall answer FIVE full questions choosing ONE question from each unit

OPEN ELECTIVES OFFERED BY THE DEPARTMENT OF MECHANICAL ENGINEERING

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<td>1</td>
<td>12ME8X08</td>
<td>Industrial Pollution Control</td>
<td>3</td>
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<tr>
<td>2</td>
<td>12ME8X09</td>
<td>Operations Management &amp; Entrepreneurship</td>
<td>3</td>
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# 12ME 8X08 – INDUSTRIAL POLLUTION CONTROL (3-0-0)

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## UNIT 1

1. **Introduction to Pollution**

Man and the environment, environmental degradation due to energy generation, consequences of pollution, sustainable industrial growth, air water and soil pollution, carbon audit.

Ill effects of pollutants, Photochemical Smog, permissible concentrations

8 Hours

## UNIT 2

2. **Meteorology**

Meteorology, Wind rose, plume dispersion studies & Numerical problems

8 Hours

## UNIT 3

3. **Separation techniques**

Particulates and fly ash separation techniques. Sources of Particulates Matter, fly ash properties, theory of settling processes- (problems), Single & parallel plate ESP- (problems), Bag House, Cyclone separator, Spray Tower, Scrubbers & Venturi Scrubber, merits and demerits of each.

8 Hours

## UNIT 4

4. **Smoke and gaseous pollutants**

Smoke and gaseous pollutants: formation, measurement and control techniques T.T.T.O principle-(Ringlemann Chart, Smokescope, Bosch smoke meter), Coal firing- Under feed and overfeed stocker, Domestic

7 Hours
and Industrial Incinerators, Pollutant gaseous (So2, Co, UBHC & NOx)

Their sources, measurement and control

So2-Colorimetric, scrubbing & lime stone injection method. CO-
Colorimetric, IR CO analyzer & control by oxidation. UBHC- Gas
chromatography, Control by after burning & floating tanks. NOx- Iso-
kinetic sampling, colorimetric method, control methods in brief for Low
peak combustion temperature.

UNIT 5

5. Water, soil, noise, plastic and odor pollution, their control methods

6. Pollution control Acts, Legal aspects of pollution control

Reference Books:

2. “Air Pollution control”, W. L. Faith, John Wiley
3. “Environmental Pollution Control Engineering, Wiley Eastern Ltd.,

Scheme Examination:
TWO questions to be set from each UNIT and Students shall answer FIVE full questions choosing at least ONE question from each UNIT.

12ME8X09 – OPERATIONS MANAGEMENT & ENTREPRENEURSHIP

Hours per week : 3
Credits : 3
Examination Hrs: 03

CIE Marks : 50
SEE Marks : 50
Total Marks : 100

UNIT I

Introduction to Production/ Operations Management: Concept of production,
Classification of production systems, Production Management, Concept of operations,
Distinction between Manufacturing Operations and Service Operations, Objectives of
Operations Management (Customer Service and Resource utilization/ Competitive
advantage through Quality-Delivery-Cost), Scope of Operations Management.
UNIT II


UNIT III

Control charts for variables: Control Charts for X-Bar and R- Charts, Type I and Type II errors, Simple Numerical Problems, Process capability: The foundation of process capability, Natural Tolerance limits, $c_p$ – process capability index, $c_{pk}$, $p_p$ – process performance index, summary of process measures. Numerical problems. Concept of Six sigma. Introduction to reliability, Mean time to failure, Mean time between failures, Bath tub curve. Reliability of series and parallel systems.

UNIT IV


UNIT V

SMALL SCALE INDUSTRIES: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start and SSI, Government policy towards SSI; Different Policies of SSI, Impact of Liberalization, Privatization, Globalization on SSI. Effect of WTO/GATT on SSI, Supporting Agencies of Government for SSI, Ancillary Industry and Tiny Industry (Definition Only) INSTITUTIONAL SUPPORT: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.
TEXT BOOKS:

REFERENCE BOOKS: