U.P. TECHNICAL UNIVERSITY, LUCKNOW

STUDY & EVALUATION SCHEME

B. Tech. Mechanical Engineering / Production Engineering / Industrial & Production Engineering / Mechanical & Industrial Engineering

[Effective from Session 20011-12]

YEAR IV, SEMESTER-VII

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY											
1.	EOE-071-EOE-074	Open Elective-I**	3	1	0	30	20	50	100	150	4
2.	EME-031 to EME-036	Departmental Elective-III	3	1	0	30	20	50	100	150	4
3.	EME-041 to EME-046	Departmental Elective-IV	3	1	0	30	20	50	100	150	4
4.	EME-701	Computer Aided Design	3	1	0	30	20	50	100	150	4
5.	EME-702	Automobile Engineering	3	1	0	30	20	50	100	150	4
6	*EHU-111*	**Human values & professional Ethics*	*2*	*0*	*0*	*15*	*10*	*25*	*50*	*75*	
PRACTICAL/TRAINING/PROJECT											
7.	EME-751	CAD/CAM Lab	0	1	2	10	10	20	30	50	1
8.	EME-752	I.C.Engine & Automobile Lab	0	0	2	10	10	20	30	50	1
9	EME-753	Project	0	0	3	-	50	50	-	50	2
10	EME-754	Industrial Training I & II Evaluation and viva-	0	0	2		50	50	-	50	1
11.	GP 701	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**15**	**6**	**9**	**-**	**-**	**-**	**-**	**1000**	**26**

Note-***Practical Training-1 & 2 (4-weeks each) done after 4th & 6th Semesters would be evaluated in 7th semester through Report and viva voice etc.

* Project should be initiated in 7th semester beginning, and should be completer by the end of 8th semester with good Report and power-point Presentation etc.

Paper Code	**Open Electives – I**
EOE-071	Entrepreneurship Development
EOE-072	Quality Management
EOE-073	Operations Research
EOE-074	Introduction to Biotechnology

DEPARTMENTAL ELECTIVES:

Department Elective - III

1. EME-031 Computer Aided Manufacturing
2. EME-032 Project Management
3. EME-033 Advanced Fluid Mechanics
4. EME-034 Experimental Stress Analysis
5. EME-035 Advanced Dynamics of Machines
6. EME-036 Management Information System

Department Elective - IV

1. EME-041 Total Quality Management
2. EME-042 Thermal Turbo Machines
3. EME-043 Mechanical System Design
4. EME-044 Tribology
5. EME-045 Industrial Ergonomics
6. EME-046 Concurrent Engineering

U.P. TECHNICAL UNIVERSITY, LUCKNOW

STUDY & EVALUATION SCHEME

B. Tech. Mechanical Engineering
[Effective from Session 2011-12]
YEAR IV, SEMESTER-VIII

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
		THEORY									
1.	EOE-081-EOE-084	Open Elective-II**	3	1	0	30	20	50	100	150	4
2.	EME-051 to EME-056	Departmental Elective - V	3	1	0	30	20	50	100	150	4
3.	EME-061 to EME-066	Departmental Elective – VI	3	1	0	30	20	50	100	150	4
4.	EME-801	Power Plant Engineering	3	1	0	30	20	50	100	150	3
7	*EHU*	**Human values & professional Ethics*	*2*	*0*	*0*	*15*	*10*	*25*	*50*	*75*	-
		PRACTICAL/TRAINING/PROJECT									
6.	EME-851	Project	0	0	12	-	100	100	250	350	8
10.	GP-601	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**12**	**3**	**12**	-	-	-	-	**1000**	

Paper Code	**Open Electives – II**
EOE-081	Non Conventional Energy Resources
EOE-082	Nonlinear Dynamic Systems
EOE-083	Product Development
EOE-084	Automation and Robotics

DEPARTMENTAL ELECTIVES:

Department Elective-V

7.	EME-051	Operations Research
8.	EME-052	Maintenance Engineering & Management
9.	EME-053	Design of Thermal Systems
10.	EME-054	Advanced Synthesis of Mechanisms
11.	EME-055	Six Sigma Methods & Applications
12.	EME-056	Concepts of Modern Physics

Department Elective-VI

7.	EME-061	Finite Element Method
8.	EME-062	Non-Destructive Testing
9.	EME-063	Advanced Materials Technology
10.	EME-064	Production & Operations Management
11.	EME-065	Energy Management
12.	EME-066	Fundamentals of Bio Medical Engineering

Note: (1) The students who had taken Open elective EME-073 Operations Research in VII Sem. can not take the course EME-051 Operations Research as a Departmental Elective in VIII Sem.

(2) The students who had taken departmental elective EME 021 Non Conventional Energy Resources & Utilization in VI Sem. can not take the open elective course EOE-081 Non Conventional Energy Resources in VIII Semester.

EME-701 : COMPUTER AIDED DESIGN (CAD)

L	T	P
3	1	0

UNIT-I

Introduction:

Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications

Computer Graphics-I

CAD/CAM systems, Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display devices-Cathode Ray Tube, Random & Raster scan display, Colour CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters

UNIT-II

Computer Graphics-II

Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives- Bresenham's line drawing algorithm and Bresenham's circle generating algorithm **4**

Geometric Transformations:

World/device Coordinate Representation, Windowing and clipping, 2 D Geometric transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations, multiple transformation **4**

UNIT-III

Curves:

Curves representation, Properties of curve design and representation, Interpolation vs approximation, Parametric representation of analytic curves, Parametric continuity conditions, Parametric representation of synthetic curves-Hermite cubic splines-Blending function formulation and its properties, Bezier curves-Blending function formulation and its properties, Composite Bezier curves, B-spline curves and its properties, Periodic and non-periodic B-spline curves

UNIT-IV

3D Graphics:

Polygon surfaces-Polygon mesh representations, Quadric and Superquadric surfaces and blobby objects; Solid modeling-Solid entities, Fundamentals of Solid modeling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Color models

Application commands for AutoCAD & ProE software

UNIT-V

Numerical Methods:

Introduction, Errors in numbers, Binary representation of numbers, Root finding-Bisection method, Newton Raphson method, Curve fitting-Least square method, Numerical differentiation-Newton's interpolation, Numerical Integration-Trapezoidal and Simpson method

Finite Element Method:

Introduction, Principles of Finite elements modeling, Stiffness matrix/displacement matrix, Stiffness matrix for spring system, bar & beam elements, bar elements in 2D space (truss element)

Books & References:

1. Computer Graphics	Hearn & Baker	Prentice Hall of India
2. Computer Aided Engineering Design	Anupam Saxena & B. Sahay	Anamaya Publishers
3. CAD/CAM	HP Groover & EW Zimmers, Jr.	Prentice Hall India Ltd.

4. CAD/CAM Theory and Practice	Ibrahim Zeid & R Sivasubramaniam	McGraw Hill
5. Computer Aided Design	RK Srivastava	Umesh Publications
6. Mathematical Elements for Computer Graphics	DF Rogers & JA Adams	McGraw Hill
7. Finite Element Method	SS Rao	
8. FE Analysis Theory and Programming	CS Krishnamoorthy	Tata McGraw Hill
9. Numerical Method for Engg Computation	MK Jain, SRK Iyenger & RK Jain	Wiley Eastern Limited
10. Computer Oriented Numerical Methods	V Rajaraman	Prentice Hall of India

EME -702

AUTOMOBILE ENGINEERING

L T P
3 1 0

Unit-I

Power Unit and Gear Box:

Principles of Design of main components. Valve mechanism. Power and Torque characteristics. Rolling, air and gradient resistance. Tractive effort. Gear Box. Gear ratio determination. Design of Gear box. 7

Unit-II

Transmission System:

Requirements. Clutches. Toque converters. Over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle, wheel camber & Toe-in, Toe-out etc.. Steering geometry. Ackerman mechanism, Understeer and Oversteer. 8

Unit-III

Braking System:

General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes. Vacuum and air brakes. Thermal aspects. 5

Chasis and Suspension System:

Loads on the frame. Strength and stiffness. Various suspension systems. 3

Unit-IV

Electrical System :

Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Battery etc. 5

Fuel Supply System:

Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburetor etc. MPFI. 4

Unit-V

Automobile Air Conditioning:

Requirements, Cooling & heating systems. 2

Cooling & Lubrication System:

Different type of cooling system and lubrication system. 2

Maintenance system:

Preventive maintenance, break down maintenance and over hauling. 2

References-

1. Automotive Engineering- Hietner
2. Automobile Engineering - Kripal Singh.
3. Automobile Engineering - Narang.
4. Automotive Mechanics- Crouse
5. Automobile Engineering - Newton and Steeds.

EME-751 : CAD/CAM LAB

L	T	P
0	1	2

Total TEN Experiments are to carried out. FIVE Experiments each from CAD and CAM.

A. CAD Experiments

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modeling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modeling of a machine component
6. Writing a small program for FEM for 2 spring system and validation of program or using a fem Package
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of computer program.

B. CAM Experiments

1. To study the characteristic features of CNC machine
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine
5. Experiment on Robot and programs
6. Experiment on Transfer line/Material handling
7. Experiment on difference between ordinary and NC machine, study or retrofitting
8. Experiment on study of system devices such as motors and feed back devices
9. Experiment on Mecatronics and controls

EME-752 : I.C. ENGINES AND AUTOMOBILE LAB

L	T	P
0	0	2

Experiments : Say minimum 10 experiments out of following in depth and details.

1. Performance Analysis of Four stroke S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
2. Determination of Indicated H.P. of I.C. Engine by Morse Test.
3. Performance Analysis of Four stroke C.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
4. Study & experiment on Valve mechanism.
5. Study & experiment on Gear Box.

6. Study & experiment on Differential Gear Mechanism of Rear Axle.
7. Study & experiment on Steering Mechanism.
8. Study & experiment on Automobile Braking System.
9. Study & experiment on Chassis and Suspension System.
10. Study & experiment on Ignition system of I.C. Engine.
11. Study & experiment on Fuel Supply System of S.I. Engines- Carburetor, Fuel Injection Pump and MPFI.
12. Study & experiment on Fuel Supply System of C.I. Engines- Injector & Fuel Pump.
13. Study & experiment on Air Conditioning System of an Automobile.
14. Comparative study of technical specifications of common small cars (such as Maruti Swift, Hyundai i20, Cheverlet Aveo, Tata Indica, Ford Fusion etc.
15. Comparative study & technical features of common scooters & motorcycles available in India.
16. Visit of an Automobile factory.
17. Visit to a Modern Automobile Workshop.
18. Experiment on Engine Tuning.
19. Experiment on Exhaust Gas Analysis of an I.C. Engine.

EME-801 : POWER PLANT ENGINEERING

L T P
3 1 0

Unit-I

Introduction

Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. 3

Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units. 2

Power plant economics and selection

Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection. 3

Unit-II

Steam power plant

General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizers and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating , flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant. 8

Unit-III

Diesel power plant

General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant. 2

Gas turbine power plant

Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant 6

Unit-IV

Nuclear power plant

Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants. 3

Hydro electric station

Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems. 4

Non Conventional Power Plants

Introduction to non-conventional power plants (Solar, wind, geothermal, tidal)etc. 2

Unit-V

Electrical system

Generators and generator cooling, transformers and their cooling, bus bar, etc. 2

Instrumentation

Purpose, classification, selection and application, recorders and their use, listing of various control rooms. 3

Pollution

Pollution due to power generation 2

References

1. "Power Plant Engineering" F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.
2. "Power Plant Engineering" Mahesh Verma, Metropolitan Book Company Pvt. Ltd. New Delhi.
3. "Power Plant Technology" El-Vakil, McGraw Hill.
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
5. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.

EPI- 801 : QUALITY CONTROL

L	T	P
3	1	0

UNIT-I

Introduction : Concept and evaluation of quality control. Measurement & Metrology, precision vs accuracy. Process capability, standrdisation & Interchangeability. 3

Inspection and Gauges : Inspection methods. Types of Gauges. Limits Fits and Tolerances. Non-Destructive Testings & Evaluation. 5

UNIT-II

Control Charts for SQC : Statistical Quality Control (SQC). Control charts for variables such as X, R charts and control charts for attributes such as p-chart, c-chart. Construction & use of the control charts. Process capability.

UNIT-III

Acceptance Sampling for SQC : Principle of acceptance sampling. Producer's and consumer's risk. Sampling plans –single, double & sequential. Sampling by attributes and variables. 7

UNIT-IV

Reliability : Introduction to reliability, bath-tub curve. Life expectancy. Reliability based design. Series & Parallel System. 3

Defect Diagnosis and prevention : Basic causes of failure, curve/control of failure. **MTBF.** Maintainability, Condition monitoring and dignostic techniques. 4

Value Engineering : Elements of value analysis, Techniques. 2

Unit-V :

TQM : Basic Concept, Quality control , Quality Assurance and Quality Management and Total Quality Management. Implementation of TQM . ISO 9000 and its series, Zero defect. . Taguchi method, Six Sigma concepts. 6

Other Factors in Quality : Human Factors such as attitude and errors. Material-Quality, Quality circles, Quality in sales & service. 2

Reference:

1. Statistical Quality Control by Grant and Leavarworth, McGraw Hill
2. Maintenance for Reliability by Rao.

DETAILS OF DEPARTMENTAL ELECTIVES

ELECTIVE-1

EME-011 : FLUID MACHINERY

UNIT-I

Introduction:

Classification of Fluid Machines & Devices, Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation. 4

Impact of jet:

Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat *&* curve), Effect of inclination of jet with the surface.

Hydraulic Turbines:

Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel. 4

UNIT-II

Reaction Turbines:

Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines. 8

UNIT-III

Centrifugal Pumps:

Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation & separation and their control, Performance characteristics. 7

UNIT-IV

Positive Displacement Pumps:

Reciprocating pump theory, Slip and coefficient of discharges, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison of centrifugal and reciprocating pumps, Positive rotary pumps, Gear and Vane pumps, Performance characteristics. 6

UNIT-V

Other Machines:

Hydraulic accumulator, Special duty pumps, Intensifier, Hydraulic press, Lift and cranes, Theory of hydraulic coupling and torque converters, Performance characteristics. 5

Water Lifting Devices :

Hydraulic ram, Jet pumps, Air lift pumps.

BOOKS:

Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.
Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub.
Applied Hydraulics by Addison
Hydraulic Machines by R K Rajput, S.Chand & co Ltd.
Hydraulic Machines by D S Kumar

EME-012 : UNCONVENTIONAL MANUFACTURING PROCESSES

L	T	P
3	1	0

Unit-I

Introduction: Limitations of conventional manufacturing processes, need of unconventional manufacturing processes & its classification and its future possibilities. 5

Unit-II

Unconventional Machining Process: Principle and working and applications of unconventional machining process such as Electro-Discharge machining, Electro-chemical machining, ultrasonic machining, Abrasive jet machining etc. 8

Unit-III

Unconventional Machining Process (continued) : Principle and working and application of unconventional machining processes such as Laser beam machining, Electron beam machining, Ultrasonic machining etc. (these can also be used for welding). 8

Unit-IV

Unconventional welding processes: Explosive welding, Cladding etc. Under water welding, Metalizing, Plasma are welding/cutting etc. 7

Unit-V

Unconventional Forming processes: Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro-Discharge forming, water hammer forming, explosive compaction etc. 7

Electronic-device Manufacturing: Brief description of Diffusion and Photo- Lithography process for electronic-device manufacturing. 3

Books

1. Modern Machining Processes – P.C. Pandey
2. Unconventional Machining – V.K. Jain

EME -013 : **PRODUCT DEVELOPMENT AND DESIGN**

L T P
3 1 0

Unit-I: Introduction to Product Design

Introduction to PDD, Applications, Relevance, Product Definition, Scope, Terminology. Design definitions, the role and nature of design, old and new design methods, Design by evolution. Examples such evolution of bicycle, safety razor etc. Need based development, technology based developments. Physical reliability & Economic feasibility of design concepts. 7

UNIT II: Morphology of Design

Divergent, transformation and convergent phases of product design. Identification of need, Analysis of need. Design for what? Design criteria, functional aspects. Aesthetics, ergonomics, form (structure). Shape, size, color. Mental blocks, Removal of blocks, Ideation Techniques. Creativity, Checklist. 7

UNIT III: Transformations

Brainstorming & Synectics. Morphological techniques. Utility concept, Utility value, Utility index. Decision making under multiple criteria. Economic aspects of design. Fixed and variable costs. Break-even analysis. 9

UNIT IV: Reliability

Reliability considerations, Bath tub curve, Reliability of systems in series and parallel. Failure rate, MTTF and MTBF. Optimum spares from reliability consideration. Design of displays and controls, Man-Machine interface, Compatibility of displays and controls. Ergonomic aspects. Anthropometric data and its importance in design. Applications of Computers in product design. **7**

UNIT IV: Product Appraisal

Information and literature search, patents, standards and codes. Environment and safety considerations. Existing techniques such as work-study, SQC etc. which could be used to improve method & quality of product. Innovation versus Invention. Technological Forecasting. **8**

Recommended Books:

1. Product Design & Manufacturing - A.K.Chitab & R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P. Crewford – Prentice Hall

3. The Art of Thought – Grohem Walls – Bruce & Co., New York
4. Product Design & Decision Theory - M.K. Starr - Prentice Hall
5. Engg . Product Design -C .D. Cain, Bussiness Books.
6. Industrial design for Engineers –W .H. Mayall, Itiffe.
   Design Methods – seeds of human futures – J. Christopher Jones, John Wiley & Sons.
7. Human Factor Engg. – Mccormick E.J., Mc GrawHill.
8. Engineering: An Introduction to Creative profession – G.C. Beakley Hw leach, Macmillan.
9. Industrial Design In Engineering – A marriage of Techniques – Charles H . Flurscheim, The Design Council - London.
10. Quality Control & Reliability Analysis – Bijendra Singh, Khanna Publications.

EME-014 : RELIABILITY ENGINEERING

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3	1	0

1. Introduction:
Definition of reliability, types of failures, definition and factors influencing system effectiveness, various parameters of system effectiveness.

2. Reliability Mathematics:
Definition of probability, laws of probability, conditional probability, Bay's theorem; various distributions; data collection, recovery of data, data analysis Procedures, empirical reliability calculations.

3. Reliability:
Types of system- series, parallel, series parallel, stand by and complex; development of logic diagram, methods of reliability evaluation; cut set and tieset methods, matrix methods event trees and fault trees methods, reliability evaluation using probability distributions, Markov method, frequency and duration method.

4. Reliability Improvements:
Methods of reliability improvement, component redundancy, system redundancy, types of redundancies-series, parallel, series - parallel, stand by and hybrid, effect of maintenance.

5. Reliability Testing:
Life testing, requirements, methods, test planning, data reporting system, data reduction and analysis, reliability test standards.

Books Recommended :
1. R.Billintan & R.N. Allan,"Reliability Evaluation of Engineering and Systems", Plenum Press.
2. K.C. Kapoor & L.R. Lamberson,"Reliability in Engineering and Design", John Wiely and Sons.
3. S.K. Sinha & B.K. Kale,"Life Testing and Reliability Estimation", Wiely Eastern Ltd.
4. M.L. Shooman, "Probabilistic Reliability, An Engineering Approach", McGraw Hill.
5. G.H.Sandler,"System Reliability Engineering", Prentice Hall.

EME-021 : NON-CONVENTIONAL ENERGY RESOURCES AND UTILISATION

L:T:P
2:1:0

UNIT-1

Energy resources and their utilization :
Indian and global energy sources, Energy exploited, Energy planning, Energy parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation. 3

Solar radiations:
Extra terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, Flux on a plane surface, Latitude, Declination angle, Surface azimuth angle, Hour angle, Zenith angle, Solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India. 4

UNIT-2

Solar energy:
Solar thermal power and it's conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors, Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing . 2
Solar thermal energy storage, Different systems, Solar pond. 2
Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants. 2

Solar photovoltaic system:
Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system. 2

UNIT-3

Biogas:
Photosynthesis, Bio gas production Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Biomass gasification, Energy recovery from urban waste, Power generation from liquid waste, Biomass cogeneration, Energy plantation, Fuel properties, Biomass resource development in India. 5

Wind energy:
Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent development. 3

UNIT-4

Electrochemical effects and fuel cells:
Principle of operation of an acidic fuel cell, Reusable cells, Ideal fuel cells, Other types of fuel cells, Comparison between acidic and alkaline hydrogen-oxygen fuel cells,

Efficiency and EMF of fuel cells, Operating characteristics of fuel cells, Advantages of fuel cell power plants, Future potential of fuel cells . 3

Tidal power:

Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy Limitations of tidal energy conversion systems. 2

Hydrogen Energy:

Properties of hydrogen in respect of it's use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use.. 3

UNIT-5

Thermoelectric systems:

Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators.

Geothermal energy:

Structure of earth's interior, Geothermal sites, earthquakes & volcanoes, Geothermal resources, Hot springs, Steam ejection, Principal of working, Types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion. 2

Ocean energy;

Principle of ocean thermal energy conversion, Wave energy conversion machines, Power plants based on ocean energy, Problems associated with ocean thermal energy conversion systems, Thermoelectric OTEC, Developments of OTEC, Economics . 2

Impact of renewable energy generation on environment, Kyoto Protocol, Cost of electricity production from different energy sources, Energy options for Indian economy. 2

Books / Reference:

Bansal Keemann, Meliss," Renewable energy sources and conversion technology", Tata Mc Graw Hill.

Kothari D.P., "Renewable energy resources and emerging technologies", Prentice Hall of India Pvt. Ltd.

Rai G.D, "Non-Conventional energy Sources", Khanna Publishers.

Ashok V. Desai, "Nonconventional Energy", New Age International Publishers Ltd.

EME-022 : ADVANCED WELDING TECHNOLOGY

Unit-I

Introduction : Importance and application of welding, classification of welding process. Selection of welding process. 2

Brief review of conventional welding process : Gas welding, Arc welding, MIG, TIG welding. Resistance welding. Electroslag welding, Friction welding etc. Welding of MS.CI, Al, Stainless steel & Maurer/Schaefflar Diagram. Soldering & Brazing. 5

Unit-II

Advanced welding Techniques- Principle and working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc. 7

Unit-III

Advanced welding Techniques (continued) : Principle and working and application of advanced welding techniques such as explosive welding/ cladding, Underwater welding, Spray-welding / Metallising, Hard facing. 7

Unit-IV

Weld Design : Welding machines/equipments and its characteristics and arc-stability, Weld defects and distortion and its remedies, Inspection/testing of welds, Weld Design, Welding of pipe-lines and pressure vessels. Life predication. 4

Thermal and Metallurgical consideration.: Thermal considerations for welding, temperature distribution, Analytical/Empirical analysis/formulae, heating & cooling curves. Metallurgical consideration of weld, HAZ and Parent metal, micro & macro structure. Solidification of weld and properties. 4

Books
Welding Hand Book

EME-023 : OPTIMISATION TECHNIQUES IN ENGINEERING

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Unit-I
Unconstrained Optimization: Optimizing Single-Variable Functions, conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions. **4**

Unit-II
Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn – Tucker Sufficient Conditions. **8**

Unit-III
Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss-Newton, Levenberg- Marquartd, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Liner Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratics Programming (SQP), Constrained Optimization, SQP Implementation, Multi-Objective Optimization, Branch and Bound Approaches, Genetic Algorithms and Genetic Programming, Singular Based Optimization, On-Line Real-Time Optimization, Optimization in Econometrics Approaches – Blue. **10**

Unit-IV
Optimization and Functions of a Complex Variable and Numerical Analysis: The Finite Difference Method for Poisson's Equation in two Dimensions and for the Transient Heat Equation, Eulers Method, The Modified Euler Method and the Runga-Kutta Method for Ordinary Differential Equations, Gaussian Quardative Tranzoidal Rule and Simpson's 1/3 and 3/8 Rules, the Newton Raphson in one and two Dimensions, Jacobi's Iteration Method. **10**

Unit-V
Optimization in Operation Research: Dynamic Programming, Transportation – Linear Optimization Simplex and Hitchcock Algorithms, Algorithms, Minimax and Maximum Algorithm, Discrete Simulation, Integer Programming – Cutting Plane Methods, Separable Programming, Stochastic Programming, Goal Programming, Integer Linear Programming, Pure and Mixed Strategy in theory of Games, Transshipment Problems, Heuristic Methods. **8**

Books.
1. Winston W L: Operations Research: Applications and Algorithms
2. Rao S.S., Optimization: Theory and Applications.
3. Walsh G R: M methods of Optimization.
4. Williams H.P.: Model Building in Mathematics Programming.
5. Williams H.P.: Model Solving in Mathematics Programming
6. G.L. Nemhauser and L.A. Wolsey: Intger and Combinational Optimization.
7. R.G. Parker and R.L. Rardin:Discrete Optimization.

EME-024 : MECHANICAL VIBRATION

L	T	P
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UNIT - I

Introduction

Periodic motion, harmonic motion, superposition of simple harmonic motions, beats, Fourier analysis **3**

Single Degree Freedom System

Free vibration, Natural frequency, Equivalent systems, Energy method for determining natural frequency, response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement **5**

UNIT - II

Single Degree Freedom: Forced Vibration

Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments **8**

UNIT- III

Two Degree Freedom systems

Introduction, Principal modes, Double pendulum, Torsional system with damping, coupled system, undamped dynamic vibration absorbers, Centrifugal pendulum absorbers, Dry friction damper **8**

UNIT- IV

Multi Degree Freedom system: Exact Analysis

Undamped free and forced vibrations of multi-degree freedom systems, influence number, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Torsional vibrations of circular shafts **8**

UNIT- V

Multi Degree Freedom system: Numerical Analysis

Rayleigh's, Dunkerely's, Holzer's ad Stodola methods, Rayleigh-Ritz method **5**

CRITICAL SPEED OF SHAFTS

Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed. **3**

Books and References:

1. Mechanical Vibrations – P. Srinivasan, TMH
2. Mechanical Vibrations – G. K. Groover, Jain Brothers, Roorkee
3. Mechanical Vibrations – W. T. Thomson
4. Mechanical Vibrations – JS Rao & K Gupta, New Age
5. Mechanical Vibrations – Tse, Morse & Hinkle
6. Mechanical Vibrations – V. Rama Murthy, Narosa Publications

EME-031 : COMPUTER AIDED MANUFACTURING (CAM)

L	T	P
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UNIT-I

Automation

Introduction to CAM; Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends. **4**

Features of NC Machines-

Fundamental of Numerical Control, elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system, Methods for improving Accuracy considering the factors such as tool deflection and chatter and Productivity. **3**

UNIT-II

NC Part Programming-

(a) Manual (word address format) programming. Examples Drilling, Turning and Milling; Canned cycles, Subroutine, and Macro. **5**

(b) APT programming. Geometry, Motion and Additional statements, Macro- statement. **4**

UNIT-III

System Devices

Introduction to DC motors, stepping motors, feed back devices such as encoder, counting devices, digital to analog converter and vice versa. **3**

Interpolators

Digital differential Integrator-Principle of operation, exponential decelarion; DDA Hardware Interpolator- Linear, Circular; DDA Software Interpolator. **4**

Control of NC Systems

Open and closed loops. Control of point to point systems- Incremental open loop control, Incremental close loop, Absolute close loop; Control loop in contouring systems; Adaptive control. **3**

UNIT-IV

Computer Integrated Manufacturing system

Group Technology, Flexible Manufacturing System, CIM, CAD/CAM, Computer aided process planning-Retrieval and Generative, Concept of Mechatronics, Computer aided Inspection. **6**

UNIT-V

Robotics

Types and generations of Robots, Structure and operation of Robot, Robot applications. Economics, Robot programming methods. VAL and AML with examples. **6**

Intelligent Manufacturing

Introduction to Artificial Intelligence for Intelligent manufacturing. **2**

Books/References-

1. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover
2. Computer Aided Manufacturing by Kundra and Rao
3. Computer control of Manufacturing systems by Koren
4. NC Machine Tools by S.J. Martin.
5. NC Machines by Koren
6. CAD/CAM by Groover.

EME-032 : Project Management L T P
3 1 0

I- Project Management Concepts:
Introduction, project characteristics, taxonomy of projects, project identification and formulation. Establishing the project and goals. Nature & context of project management; phases of PM, A framework for PM issues, PM as a conversion process, project environment & complexity. Organizing human resources, organizing systems & procedures for implementation. Project direction. 8

II- Project Organization & Project Contracts:
Introduction, functional organization, project organization, matrix organization, modified matrix organization, pure project organization, selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors. 8

III- Project Appraisal & Cost Estimation:
Introduction, technical appraisal, commercial appraisal, economic appraisal, financial appraisal, management appraisal, social cost/benefit analysis, project risk analysis. Cost analysis of the project, components of capital cost of a project, modern approach to project performance analysis. 8

IV- Project Planning & Scheduling:
Introduction to PERT & CPM, planning and scheduling networks, time estimation, determination of critical path, CPM model, event slacks & floats, PERT model, expected time for activities, expected length of critical path, calculating the project length and variance, PERT & CPM cost accounting systems, lowest cost schedule, crashing of networks, linear programming formulation of event oriented networks, updating of networks, LOB technique. 8

V- Modification & Extensions of Network Models:
Complexity of project scheduling with limited resources, resource leveling of project schedules, resource allocation in project scheduling - heuristic solution.
Precedence networking- examples with algorithm, decision networks, probabilistic networks, computer aided project management- essential requirements of PM software, software packages for CPM. Enterprise- wide PM, using spread sheets for financial projections. 8

Books:

1. Project Management by K. Nagarajan
2. Project Management by Harvey Maylor

EME-033 : ADVANCED FLUID MECHANICS

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UNIT-I
Review of kinematics of fluid motion, method of describing fluid motion, translation, rate of deformation, the material derivatives, acceleration, vorticity in cartesian & polar coordinates, Reynolds transport theorem, Stress at a point, velocity profile, wall shear stress. 7

UNIT-II
Non-viscous incompressible flow- Equation of continuity, Euler's equation of motion, Bernoulli's equation, circulation and its theorem, stress function, velocity potential, irrotational flow, two dimensional source, sink, source-sink pair, doublet vortex, superposition of source-sink with rectilinear flow, Rankine body, Superposition of rectilinear flow and doublet, flow around a spinning circular cylinder, Magnus effect, lift & Drag, Skin friction. Lift of aerofoils. 9

UNIT-III

Boundary layer Concept-Introduction to boundary layer formation, Novier-stokes equation, Boundary layer thickness, momentum thickness, energy thickness, Boundary layer equations, Momentum-Integral equation - Von Korman, Blasius solution of boundary layer on a flat plate without pressure gradient, Flow with very small Reynolds number, Hogen poisseuille flow, Plane Couette flow, Hydrodynamic theory of lubrication. 8

UNIT-IV

Compressible flow- Propagation of pressure change, sound velocity, elastic waves, Mach number, Mach cone, isentropic flow relations in terms of sonic velocity and mach number, Stagnation properties, Regions of flow, Energy equation, Effect of Mach number on compressibility. Propagation of infinitesimal waves, Non-steep finite pressure wave and steep finite pressure waves, Expansion waves Isentropic flow with variable area, Mach number variation and its effect on Flow through nozzles and diffusers. Area ratio, impulse function, Use of Gas/Air tables. 8

UNIT-V

Flow with normal shock waves- Development of shock wave, rarefaction wave, governing equations, Prandtle-Meyer relation. Thermodynamic properties across shock. Wind tunnels. 3

Flow in constant area duct with friction-Fanno curves, Fanno flow equations, Solution of fanno flow equations. Variation of flow properties. Tables & charts for Fanno flow. 3

Flow in constant area duct with heat transfer- Rayleigh line, Fundamental equations, Rayleigh flow relation, Variation of flow properties. Tables & Charts for Rayleigh flow. 2

Books/ References:

1. Fluid Mechanics by White.
2. Fluid Mechanics by Streeter
3. Fluid Mechanics by Som & Biswas
4. Fluid Mechanics by K.L. Kumar
5. Fluid Mechanics by A.K. Jain
6. Fluid Mechanics by Robert W. Fox & Alan T. Mc Donald, Wiley Students Edition
7. Fundamentals of Compressible flow by S.M. Yahya
8. Gas Dynamics by Z. Hussain
9. Viscous fluid flow by White
10. Computational Fluid Dynamics by Anderson
11. Gas Dynamics by E. Radhakrishnan
12. Fluid Mechanics by Kundu & Cohen, Academic Press, Elsevier

EME-034 : EXPERIMENTAL STRESS ANALYSIS

L:T:P
3:1:0

UNIT I

Elementary Elasticity:

Stress: Introduction, Stress Equations of Equilibrium, Laws of Stress Transformations, principal Stresses, Two-Dimensional State of Stress, Stresses Relative to Principal Co-ordinate System, Special States of Stress. **4**

Strain: Introduction, Displacement and Strain, Strain Transformation Equation, Principal Strains, Compatibility, Volume Dilation, Stress Strain Relations, Strain Transformation Equations and Stress Strain Relations for Two-Dimensional State of Stress. **4**

UNIT II

Strain Measurements: Introduction, Properties of Strain Gage Systems, Types of Strain Gages, Grid- Method of Strain Analysis. **4**

Brittle Coating Method: Coating Stresses, Failure Theories, Brittle Coating Crack Patterns, Resin and Ceramic Based Brittle Coating, Test Procedure, Analysis of Brittle Coating Data. **4**

UNIT III

Electrical Resistance Strain Gages: Introduction, Strain Sensitivity in Alloys, Strain Gage Adhesives, Gage Sensitivity and Gage Factor. **4**

Strain Gage Circuit: Potentiometer and its Application, Wheat-Stone Bridge, Bridge Sensitivity, Null Balance Bridges. **3**

Analysis of Strain Gage Data: Three Element Rectangular Rosette, Delta Rosette, Stress Gage, Plane Shear-Gage. **3**

UNIT IV

Theory of Photoelasticity: Introduction, Temporary Double Refraction, Stress Optic Law, Relative Retardation, Stressed Model in Plane Polariscope, Effect of Principal Directions, Effect of Principal Stress Difference, Stressed Model in Circular Polariscope, Light and Dark Field arrangements, Tardy Compensation, Fringe Sharpening and Multiplication by Partial Mirrors. **8**

UNIT V

Two Dimensional Photoelasticity : Introduction, Isochromatic Fringe Patterns, Isoclinic Fringe Patterns, Compensation Techniques, Calibration Methods, Separation Methods, Shear Difference Method, Electrical Analogy Method, Oblique Incidence Method, Materials for Two-Dimensional Photoelasticity. **7**

Text Books:

1. Experiment Stress Analysis by James W. Dally and William F. Riley, International Student Edition, McGraw-Hill Book Company.
2. Experiment Stress Analysis by Dr. Sadhu Singh, Khanna Publishers.

^ Applicable only to those institutes which have the facility for Stress Analysis Lab

EME-036 : ADVANCED DYNAMICS OF MACHINERY

L T P
3 1 0

UNIT I

Dynamic Analysis of Mechanisms and Machines: Introduction, Motion of Rigid Body under a System of Forces, Principle of Virtual Work, D'Alembert's Principle and Dynamic Equilibrium, Dynamic Force Analysis, Stresses in Moving Members, Motion Analysis, Equivalent Force and Mass Method. **8**

UNIT II

Dynamics of Direct Acting Engine Mechanisms: Introduction, Piston Motion, Turning Moment on Crank-Shaft, Dynamically Equivalent Link, Approximate Expression for Turning Moment, Correction to the Approximate Expression, Turning Moment Diagram, Fluctuation of Crank-Shaft Speed, Flywheel Analysis. **8**

UNIT III

Balancing of Inertia Force and Moments in Machines: Introduction, Balancing of Rotating Masses, Two-Plane Balancing, Determination of Balancing Masses, Balancing of Internal Combustion Engines. **7**

UNIT IV

Gyroscopic action in Machines: Introduction, Motion of a Rigid Body in Three-Dimensions, Principal Axes, Angular Velocity and Momentum about Principal Axes, Euler's Equation of Motion, Euler's Modified Equation, Simple Precession of a

Symmetrical Gyroscope in Angular Precession, Gyroscopic Effects in Machines, Gyroscopic Stabilization.

UNIT V

Dynamics of Rotating Shafts: Introduction, Critical Speed, Shaft with an Unbalanced Disc at Mid-Span, Generalized Forces, Lagrange's Equation of Motion, Gyroscopic Effect on Critical Speed.

Text Book:

1. Theory of Mechanisms and Machines by Amitabh Ghosh and Ashok Kumar Malik, Affiliated East- West Press Pvt. Ltd, New Delhi.
2. Theory of Machines and Mechanisms by Joseph Edward Shigley and John Joseph Uicker, J.R. International Student Edition, Mc-Graw Hill International Company.

EME-036 : MANAGEMENT INFORMATION SYSTEM

L:T:P: 3:1:0

Unit-I

Organisation & Types, Decision Making, Data & information, Characteristics & Classification of information, Cost & value of information, Various channels of information & MIS. 6

Unit-II

Foundation of Information System : Introduction to Information System in Business Fundamentals of Information System, Solving Business Problems with Information System, Concept of Balanced MIS, Effectiveness & Efficiency Criteria. Tool and Techniques of MIS- dataflow diagram, flow chart etc. 10

Unit-III

Business application of information technology, electronic commerce, Internet, Intranet, Extranet & Enterprise Solutions, Information System for Business Operations, Information system for managerial Decision Support, Information System for Strategic Advantage. 8

Unit-IV

Managing Information Technology, Enterprise & Global Management, Security & Ethical Challenges, Planning & Implementing Change.

Reports: Various types of MIS reports, GUI & Other Presentation tools. 6

Unit-V

Advanced concepts in information system: Enterprise Resource Planning: introduction, various modules like Human Resources, Finance, Accounting, Production & Logistics. Supply Chain Management, CRM, Procurement Management System Object Oriented modeling case studies. 10

Books

1. O.Brian, "Introduction to Information System", Mc-Graw Hill.
2. O.Brian, "Management Information System", TMH.
3. Alter, "Information Systems : A Management Perspective", Addison Wesley.
4. Arora & Bhatia, "Information Systems for Managers", Excel
5. Bansal, "Information System Analysis & Design", TMH.
6. Jawadegar, "Management Information System", TMH.
7. Murdick, "Information System for Modern Management", PHI.
8. Alexis Leon, "Enterprise Resource Planning", TMH.

Departmental Elective IV

EME-041 :TOTAL QUALITY MANAGEMENT (TQM)

Unit-I

Quality Concepts

Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design, Review off design, Evolution of proto type.

Control on Purchased Product

Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality

Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

Unit-II

Quality Management

Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.

Human Factor in Quality

Attitude of top management, co-operation, of groups, operators attitude, responsibility, causes of operators error and corrective methods.

Unit-III

Control Charts

Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts.

Attributes of Control Charts

Defects, construction and analysis off-chart, improvement by control chart, variable sample size, construction and analysis of C-chart.

Unit-IV

Defects Diagnosis and Prevention

Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

Unit-V

IS0-9000 and its concept of Quality Management:

ISO 9000 series, Taguchi method, JIT in some details

References:

1. Lt. Gen. H.Lal, "Total Quality management", Wiley Eastern Limited, 1990. .
2. Greg Bounds. “Beyond Total Quality Management”. McGraw Hill, 1994.
3. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992

EME-042: THERMAL TURBOMACHINES

L:T:P
3:1:0

UNIT-I

Brief history of turbo machinery, introduction to blowers, pumps, compressors, steam & gas turbines, turbojet, Review of laws of thermodynamics & SFEE in reference to turbo machinery, Energy transfer in turbo machines, Euler’s equation, Definition of various efficiencies, Preheat factor, Reheat factor, Blade classification, Blade terminology, Cascade testing, Velocity diagrams for axial and radial turbomachinery and pumps. 8

UNIT-II

Centrifugal compressors- Principle of operation, work done and pressure rise, Velcoity diagram for centrifugal compressor, Slip factor, Stage pressure rise, Loading coefficient, Diffuser, degree of reaction, Effect of impeller blade profile, Pre-whirl and inlet guide vanes, Centrifugal Compressor characteristic curves. 4

Axial flow compressor- Principle of operation and working, Energy transfer, Velocity diagram for axial compressor, Factors affecting stage pressure ratio, Blockage in compressor annulus, Degree of reaction, 3-D flow, Design process, blade design, calculation of stage performance, Axial compressor performance characteristic curves. 4

UNIT-III

Axial flow turbines-Elementary theory of axial flow turbine, Energy transfer, Velocity diagram, Types of blades, Vortex theory, Choice of blade profile, pitch and chord, Estimation of stage performance, Characteristic curves. 4

UNIT-IV

Steam turbines- Constructional details, working of steam turbine. 4

Pumps : Classification of Pumps, Main components, indicator diagram and modification due to piston acceleration, Performance characteristics, Cavitation and its control, Miscellaneous types of pumps. 4

Radial flow turbines: Elementary theory of radial flow turbines, Enthalpy- Entropy diagram, State losses, Estimation of stage performance, Performance characteristics. 4

UNIT-V

Gas Turbine Starting & Control Systems: Starting ignition system, Combustion system types, Safety limits & control.

Turbine Blade coding: Different cooling techniques, Types of coolants, Comparative evaluation of different cooling techniques.

Mechanical Design consideration: Overall design choices, Material selection, Design with traditional materials. 8

Books-

1. Gas turbine theory : Cohen & Rogers, Addison Weslay Longman Ltd.
2. Design of high efficiency turbomachinery and gas turbines, David Gordon Wilson, Theodosios Korakianitis, Prentice Hall International.
3. Turbomachinery : S.M. Yahya.
4. Turbine, Compressors and Fans, S.M. Yahya, Tata Mc Graw Hill.
5. Gas Turbine- Ganeshan, Tata Mc Graw Hill.

EME-043 : MECHANICAL SYSTEM DESIGN

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UNIT-I

Engineering process and System Approach

Basic concepts of systems, Attributes characterizing a system, system types, Application of system concepts in Engineering, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing **4**

Problem Formulation

Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system **4**

UNIT-II

System Theories

System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system. **4**

System modeling

Need of modeling, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system **4**

UNIT-III

Graph Modeling and Analysis

Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system **4**

Optimization Concepts

Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminium extrusion system. **3**

UNIT-IV

System Evaluation

Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system **4**

Calculus Method for Optimization

Model with one decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system. **4**

UNIT-V

Decision Analysis

Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery **4**

System Simulation

Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: Inventory control in production plant **5**

Books/References-

1. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse
2. Design Engineering-JR Dixon, TMH, New Delhi
3. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi
4. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow
5. Optimization Techniques-SS Rao
6. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

Department Elective-IV

EME-044: **TRIBOLOGY**

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3 1 0

Unit-I: Introduction to Tribology

Definition, Scope, Applications, Friction, Definition, Scope, Laws of friction. Friction theories. Surface contaminants, Effect of sliding speed on friction.

5

Unit-I: Wear

Definition, Scope, wear of metals, Types, Classification. Mechanism of wear, Quantitative laws. Hypothesis of Holm. Hypothesis of Burwell and Strang. Hypothesis of Archard, Rawe, Rabinowicz. Quantitative law for Abrasive wear, Bayerku surface fatigue theory. Delamination theory & Fatigue theory of wear, wear resistant materials. Introduction to wear of Polymers and Ceramics. Wear reduction by Surface Improvements, Pitting, Erosion & Stress Corrosion.

10

Unit-III: Surface Interactions

Elastic & Plastic deformation of surfaces. Contact of Solids, Contact of Ideally Smooth Surfaces. Distribution of Pressure over elastic contact of two curvilinear bodies. Formulae for calculation of contact area. Physico-Mechanical properties of surface layers, Characteristics of Surface Geometry. Classes of surface roughness. Contact of rough surfaces. Interaction of surface peaks. Real and contour area of contact.

10

Unit-IV: Lubrication

Definition & Scope. Generalized Reynold's equation. Flow and shear stress, energy equation. Mechanism of pressure development in bearings. Concept of Boundry Layer.

5

Unit-IV: Bearing design considerations & characteristics

Bearing design procedure & steps. Plain slider bearing. Step (Rayleigh step) bearing. Infinitely long journal bearing. Infinitely short journal bearing. Future scope and applications.

8

REFERENCE BOOKS:

1. Introduction to Tribology of bearings by - B. C. Majumdar., S Chand & Co.
2. Hand Book of Tribology -- WHILEY
3. Fundamentals of Fluid film lubrication by – Bernard Hamrock, Mc Graw Hill International Edition.
4. Tribology in Industries by Sushil. K. Srivastava, S Chand & Publications.
5. Basic Lubrication theory by Alastair Cameron.

EME-045

INDUSTRIAL ERGONOMICS

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Unit-I

1. **Introduction:** Importance applications and principles of occupational ergonomics. 2
2. **Physiological Principles:** Muscular work, Nervous control of movements, Improving working efficiency. Optimal use of muscle strength. /Guidelines for work layout. 4
3. **Skilled work:** Acquiring skill, control of skilled movements. Design of tools and equipments for skilled work. 3

Unit-II

4. **Heavy work:** Energy consumption, Efficiency, Heart rate as a measure of workload. 2

5. **Work-station Design:** Anthropometric data, Reach and clearance dimensions. Percentiles to be accommodated. 5

Unit-III

6. **Working Heights:** Comfortable working postures. Room to grasp or move things, and operate controls. Sedentary work. Its advantages, disadvantages and limitation. Sedentary workplace design. Design of VDT workstations, Design of Key board. 5

7.Handling Lads: The Human spine, back troubles associated with industrial work, Intervertebral disc, disc pressure, slip of disc, Bio-mechanical models of lower back. Recommendations for handling loads. 3

8.Man-Machine System: Display equipment, Controls, Relation between control and display instruments, Mental activity, Fatigue, Occupational stress, Job design in monotonous task. 3

Unit-IV

9.Human Visual System: Accommodation, Aperture of the pupil, Adaptation of reline, eye movements Visual capacity, Visual strain, Physiology of reading. 3

10.Ergonomic Principles of Lighting: Light sources, measurement, physiological requirements of artificial lighting, arrangement of light. Light for fine work and for VDT offices. 3

Unit-V

11.Noise and Violation: Sound perception, Noise load, damage to hearing, physiological and psychological effects of noise. Protection against noise, Vibrations and their effect on performance. 3

12.Working Environment: Thermo-regulation in human body, comfort indoors, Air quality and its dryness, Air pollution and ventilation. Heat in industry Recommendations for comfort indoors.

Daylight, colours and music for pleasant work environment. 4

Books

1. Fitting the task to the Man, E. Gandjean, Taylor and Francis.
2. A guide to Ergonomics of Manufacturing, Helander, M., East-West Press.
3. Human Factor in Engineering and Design, Sanders, M.S., and Mc Cormik, E.J., Mc Graw.Hill

DEPARTMENT ELECTIVE-IV

EME-046

CONCURRENT ENGINEERING

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Unit-I

Introduction:

Background and challenges faced by modern production environment, sequential engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs. 4

Support for CE

Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process. 4

Unit-II

Design Product for Customer

Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD). 3

Modeling of Concurrent Engineering Design

Compatibility approach, Compatibility index, implementation of the Compatibility model, integrating the compatibility Concerns. 4

Unit-III

Design for Manufacture (DFM)

Introduction, role of DFM is CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms, Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assemblability. 9

Unit-IV

Quality by Design

Quality engineering & methodology for robust product design, parameter and Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach. 9

Unit-V

Design for X-ability

Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies. 7

Books

1. Concurrent Engineering Kusiak John Wiley
2. Concurrent Engineering Menon Chapman & hall

Departmental Elective – V

EME-051 : OPERATIONS RESEARCH

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Unit-I

Introduction: Basics of Operations Research **1**

Linear Programming- **7**

Introduction & Scope, Problem formulation, Graphical Method, Simplex methods, primal & dual problem sensitivity analysis.

Unit-II

Transportation & Assignment problems. **4**

Deterministic Dynamic Programming- **4**

Multistage decision problems & solution, Principle of optimality.

Unit-III

Decision theory- **4**

Decision under various conditions.

Game Theory- **2**

Two Person Zero sum game, Solution with / without Saddle point, Dominance Rule, Different Methods like Algebraic, Graphical, Liner Programming

Sequencing- **2**

Basic assumption**,** n Jobs through two / three machines, 2 Jobs on m machines.

Unit-IV

Stochastic inventory models- **5**

Single & multi period models with continuous & discrete demands, Service level & reorder policy

Simulations- **3**

Use, advantages& limitations, Monte-carlo simulation, Application to queuing, inventory & other problems.

Unit-V

Queuing models- **3**

Characteristics of Queuing Model, M/M/1 & M/M/S system, cost consideration

Project Management: **6**

Basic concept, Rules for drawing the network diagram, Applications of CPM and PERT techniques in Project planning and control; crashing of operations; resource allocation.

Text Books

Operations Research by : Wangner
Operations Research by : Taha
Introduction to Management Science by: Hiller & Hiller
Operations Research by : Wayne L. Winston

EME-052 : MAINTENANCE ENGINEERING & MANAGEMENT

L:T:P
3:1:0

Unit-I

Introduction, operating life cycle, reliability, Failure data analysis, failure rate curve, hazard models, elements in series, parallel, mix, logic diagrams, improving reliability, redundancy-element, unit, standby, maintainability, availability, reliability and maintainability trade off. **8**

Unit-II
Maintenance Strategies: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, zero break down, preventive inspection of equipment used in emergency. **8**

Unit-III
Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure. **8**

Unit-IV
Break down maintenance planning, assignment model, waiting time models expected waiting time, minimum cost service rate, PERT. **8**

Unit-V
Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management. **8**

Books:
1. Management of systems – R.N. Nauhria & R. Prakash.
2. Operations Research – Wangner.

EME-053 : DESIGN OF THERMAL SYSTEMS

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Unit-I
Psychrometry of Air Conditioning Processes, Design Conditions & Load Calculations
Psychrometric Processes in Air Conditioning Equipments, Analysis of Air Conditioning systems for summer & winter conditions, Inside & out side design conditions for comfort, Industrial Air Conditioning.
Cooling & Heating Load calculations- Heat transfer through building structures, solar heat gain, Infiltration & ventilation air, Internal heat gain, Occupancy & Product load, Room sensible heat factor, Effective sensible heat factor & Grand sensible heat factor, capacity of the plant. 5
Design & Selection of Air conditioning Apparatus
Heat & moisture transfer in Air conditioning apparatus, Enthalpy potential, Analysis of Coil & Spray Equipments Design of Cooling & Dehumidifying coils, Design of Air Washer & Cooling Towers. 3

Unit-II
Analysis of Complete Vapour Compression System – Design and Balancing of System Components
Type of Refrigerant Compressors, Condensers, Evaporators & Expansion devices used in Vapour Compression Refrigeration Cycles, Design and Selection of individual components and their performance characteristics, Use of P-H charts for different Refrigerants in performance predication of the cycle.
Analysis of the complete vapour-compression-system and determination of 'Balance Points' using Graphical and Analytical methods, system simulation.
Layout & selection of Refrigerant, water and Brine pipings for the designed system.
Selection of Refrigeration and Air conditioning Controls for the system. 8

Unit-III

Design of Turbomachines:

Principles of Design of turbo machines, Design of axial flow turbine stage, Design of axial flow compressor stage, Design of centrifugal compressor. 8

Unit-IV

Design of Heat Exchanger :

Study of design aspects, fluid flow and heat transfer characteristics, Material requirement of heat exchange equipments, Liquid – to liquid and Liquid – to – gas heat exchange systems, Familiarity with use of design related standards and codes, Design of Heat exchanger. 8

Unit-V

Optimization of design of thermal systems like condenser, evaporator, cooling tower for minimum cost and maximum performance, Development of computer program for design, Environmental consideration in design of thermal systems, Analysis of thermal systems using FEM. 8

References

1. Refrigeration & Air Conditioning - By C.P. Arora
2. Refrigeration & Air Conditioning - By Manohar Prasad
3. Principles of Refrigeration (S.I.Units) - By Roy J.Dossat
4. Air Conditioning Engineering - By W,P.Jones
5. Heating, Ventilating and Air Conditioning - By Mc Quistion, Parker & Spitler
6. Refrigeration & Air Conditioning Data Book – Manohar Prasad
7. Ashrae hand Book – Fundamentals
8. Refrigeration & Air Conditioning-Stoecker & Jones
9. Refrigeration & Air condioning – By P.L.Ballaney

EME-054 : ADVANCED SYNTHESIS OF MECHANISM

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UNIT-I

Introduction:

Mechanisms, Classifications, Relative & absolute motion, degree of freedom, 4-bar mechanisms-planar & spatial mechanisms, Inversion and equivalent linkage, Transmission deviation and pressure angles **4**

Kinematic analysis of Planer motion

Relative velocity and velocity difference, Instantaneous centre, Poles and centrodes, Relative acceleration, acceleration difference

UNIT-II

Kinematic Synthesis

Type, number and dimensional synthesis, spacing of accuracy points, Chebyshev polynomials **4**

Four bar coupler point curves:

Four bar linkage, Equation of coupler curves, Double points and symmetry, Robert Chebyshev theorem, Approximate and exact straight line mechanisms **4**

UNIT-III

Geometrical Method of Synthesis:

Poles and relative poles of four bar linkage, Poles and relative poles of slider crank mechanism, Synthesis with three accuracy points, Pole triangle, Four position synthesis, Examples **7**

UNIT-IV

Algebraic Methods of Synthesis-I:

Displacement equation of four bar linkage, Crank and follower synthesis with three accuracy points, Four bar function generator with three accuracy points, Crank and follower synthesis: angular velocities and accelerations **8**

UNIT-V

Algebraic Methods of Synthesis-II:

Synthesis of slider crank mechanism with three accuracy points, Synthesis of slider crank mechanism with four accuracy points, Five accuracy points synthesis of crank and follower mechanism, Analysis of mechanical errors in linkage, Mechanical error in four bar linkage **8**

Books & References:

1. Kinematic Synthesis of Linkages	RS Hartenberg and J Denavit	McGraw Hill, New York
2. Kinematic and Linkage Design	AS Hall Jr	Prentice Hall India Ltd.
3. Mechanism and Machine Theory	Amitabh Ghosh and AK Mallick	
4. Mechanism Design: Analysis & Synthesis	Erdman & Sandor	Prentice Hall of India

EME-055 : Six Sigma Methods & Application

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Unit 1

Quality Perception; Quality in Manufacturing, Quality in Service Sector; Differences between Conventional and Six Sigma concept of quality; Six Sigma success stories.
Statistical foundation and methods of quality improvement.
Descriptive statistics: Data Type, Mean, Median, Mode, Range, Variation, Standard Deviation, Skewness, Kurtosis.
Probability Distribution: Normal, Binomial, Poisson Distribution

Unit 2

Basics of Six Sigma: Concept of Six Sigma, Defects, DPMO, DPU, Attacks on X'S, Customer focus, Six Sigma for manufacturing, Six Sigma for service. Z score,
Understanding Six Sigma organization, Leadership council, Project sponsors and champions, Master Black Belt, Black Belt, Green Belts.

Unit 3

Methodology of Six Sigma, DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects.

Unit 4

Six Sigma Tools: Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments.

Unit 5

Sustenance of Six Sigma, Communication plan, Company culture, Reinforcement and control, Introduction to softwares for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots.

References:

1. Six Sigma: SPC and TQM in manufacturing and service, Geoff Tennant, Gower Publishing Co.
2. Six Sigma for managers, Greg Brue, TMH
3. What is Six Sigma, Pete Pande, TMH
4. The Six Sigma Way, Peter S. Pande, TMH Team Field book
5. The Six Sigma way, Peter S. Pande, TMH

EME-056 : CONCEPTS OF MODERN PHYSICS

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Unit-I

Atomic & Quantum Physics: Wave-Particle Duality. Atomic-models. Quantum Physics-Planck, Bohr, de-Brogli, Schrödinger, Heisenberg, Born. Quantum and Wave Mechanics. X-ray, Laser etc. 8

Unit-II

Particle Physics & Dynamics: Molecule, Atom and Nucleus. Elementary Particles (& antiparticles) and
its characteristics & historical development. Conservation laws. Quarks and quark-model. Simple particle interaction /dynamics. Feynman Diagrams & rules. 8

Unit-III

Relativistic Mechanics : Special-Relativity. Relativity as a bridge of electricity and magnetism.
Minikowaskian space-time. Introduction to General-Relativity (almost without Tensors), concept of curved
space-time and gravity as curvature. Tests of Special & General Relativity. 9

Unit-IV

Astro-physics and Cosmo-Dynamics: Brief review of universe big-bang to black-hole including nucleo-synthesis, solar-system and galaxy. Hubble's law. Critical density, space- from closed, flat, open. Recent
studies on Dark-matter and Dark-energy and its possible candidates. 8

Unit-V

Unification of forces: Fundamental forces- gravitational, electrical, magnetic, strong-nuclear & weak nuclear. Maxwell (& Faraday) unification of electric & magnetic field as electromagnetic. Brief
introduction (with Feynman diagram) to GSW Electro-weak unification, and Standard-model. Brief
mention of GUT, and String/M-theory. 7

Books

1. Stephen Hawking- Brief History of Time
2. Besier- Concept of Modern Physics
3. Krane- Modern Physics
4. Kaku- Beyond Einstein
5. Griffith- Quantum Electrodynamics
6. Griffith- Elementy Particles
7. Hartle- Gravity
8. Bryan Greene- Elegant Universe

EME-061: FINITE ELEMENT METHOD

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UNIT-I

Introduction

Introduction to finite difference method and finite elements method, Advantages and limitations, Mathematical formulation of FEM, Different approaches in Finite Element Method - Direct Stiffness approach, simple examples, Variational approach, Elements of variational calculus - Euler Lagrange equation, Rayliegh Ritz method, Weighted Residual methods, Point Collocation method, Galarkin method - Steps involved in FEM.

UNIT-II

Types of Elements Used

Interpolation Polynomials - Linear elements Shape function - Analysis of simply supported beam - Element and Global matrices - Two-dimensional elements, triangular and rectangular elements - Local and Natural Co-ordinate systems.

UNIT-III

Finite Element Formulation of Field Problems

1-D and 2-D heat transfer, fluid flow (incompressible and non viscous fluid) in ducts, Simple electrical and magnetic field problems. Simple Numerical examples

UNIT-IV

Finite Element Formulation of Solid Mechanics Problems

1-D problem of shaft; Truss element analysis of pinned truss, Plane stress/strain problems, Axi-symmetric problems, thin plate problems; Vibration of shafts & beams.

UNIT-V

Numerical Methods in FEM

Evaluation of shape functions - One dimensional & triangular elements, Quadrilateral elements, Isoperimetric elements - Numerical Integration, Gauss Legendre quadrature - Solution of finite element equations – Gauss Elimination Method, Cholesky decomposition.

Books:

1.	The Finite Element Method	O.C. Zienkiewicz and R.L. Taylor	McGraw Hill
2.	An Introduction to Finite Element Method	J. N. Reddy	McGraw Hill
3.	Finite Element Procedure in Engineering Analysis	K.J. Bathe	McGraw Hill
4.	Finite Element Analysis	C.S. Krishnamoorthy	Tata McGraw Hill
5.	Concepts and Application of Finite Element Analysis	R.D. Cook, D.S. Malcus and M.E. Plesha	John Wiley
6.	Introduction to Finite Elements in Engineering	T.R Chandragupta and A.D. Belegundu	Prentice Hall India
7.	Finite Element and Approximation	O.C. Zenkiewicy & Morgan	-
8.	Numerical Methods	E Balagurusamy	Tata McGraw Hill

EME-062 : NON-DESTRUCTIVE TESTING

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Unit-1: Introduction
Scope and advantages of NDT. Comparison of NDT with DT. Some common NDT methods used since ages, Terminology. Flaws and Defects, Visual inspection, Equipment used for visual inspection. Ringing test chalk test (oil whitening test). Attractive uses of above tests in detecting surface cracks, bond strength & surface defects. **6**

Unit-2: Common NDT methods
Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrant and developers. Illustrative examples – Heavy castings of large size, frame of jet engine, porosity testing of nickel alloys, leak testing. Zyglo test **6**
Magnetic particle Inspection – Scope , principle, Ferro Magnetic and Non-ferro magnetic materials, equipment & testing. Advantages, limitations Interpretation of results. DC & AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing, different methods to generate magnetic fields, Applications. **5**

Unit-3: Radiographic methods
X-ray radiography principle, equipment & methodology. Applicability, types of radiations, limitations. Interpretation of Radiographs, limitations of γ-ray radiography – principle, equipment. Attenuation of electro magnetic radiations, source of radioactive materials & technique. Photo electric effect, Rayleigh's scattering (coherent scattering), Compton's scattering (Incoherent scattering). Pair production, Beam geometry, Scattering factor. Advantages of γ-ray radiography over X-ray radiography Precautions against radiation hazards. Case Study ─ X-ray of human body. **9**

Unit-4: Ultrasonic testing methods
Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques, advantages, Limitation & typical applications. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements. Case Study – Ultrasonography of human body. **8**

Unit-5: Eddy Current Inspection
Principle, Methods, Advantages, Scope and limitations. Types of Probes. Case Studies. **4**

Suggested References:

(1) ASM Handbook Vol. 11, 8th Edition – Non-destructive Testing & Evaluation
(2) Research Techniques in NDT Vol.3, R.S. Shah, Academic
(3) Industrial Quality Control, Webstar
(4) Bray, Don E. and Stanley, Roderic K., Nondestructive Evaluation: A Tool in Design, Manufacturing, and Service. Revised Edition 1997, CRC Press New York.

EME-063 : ADVANCED MATERIALS TECHNOLOGY

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UNIT-I: Introduction to Ferrous Materials
Plain carbon steels, their properties and application: plain carbon steels, effects of alloying elements in plain carbon steels. Alloy steels, tools steels, stainless steels, low and high temperature resisting steels, high strength steels, selections, specifications, form and availability of steel. Cast irons-white, grey, modular malleable and alloy cast irons. Recognised patterns of distribution of graphite flakes in grey cast iron. **10**

UNIT-II: Heat Treatment of Steels
TTT diagrams, annealing, normalizing, hardening and tempering of steel. Austempering and martempering of steel. Surface hardening of steel-Carbonising nitriding carbonitriding cyniding, flues and inducation hardenirng microscopic determination of case depth and depth of hardening. **5**

Unit-III: Nonferrous materials
Ultra light materials. Properties and application, brasses, bronzes, cupro-nickel alloys, aluminum, magnesium and titanium alloys, bearing materials. Heat treatment of nonferrous materials– soputionizing, Aging and precipitations hardening.
Composites
Polymer – polymer, metal-metal, ceramic –ceramic, ceramic-polymer, metal-ceramic, metal-polymer composites. Dispersion reinforced, particle reinforced, laminated and fiber reinforced composites.
Refractory materials and coatings for high temperature applications.
Smart Materials-introduction, types and applications. Thin film shape memory alloys. **10**

Unit-IV: Biomaterials
Classes and application of materials in medicine and dentistry. Stress strain behaviour of bone. The mechanical properties including elasticity, hardness, viscoelasticity, surface and fatigue properties of skin; soft tissues; bone; metals; polymers and ceramics. Biocompatible materials and its applications. The effects of degradation and corrosion. **8**
Unit-V: Nuclear Materials
Introduction to nuclear materials. Materials for nuclear fuel in fission and fusion reactors, Fissile and fertile materials. Control & Construction Materials for Nuclear reactors, Moderators, Heat Exchangers. Radiation proof materials. Brief discussion of safety and radioactive waste disposal. **7**
References:
1. Biomaterials Science- An Introduction to Materials in Medicine. Buddy D.Rattner, A.S. Hoffman, F.J. Sckoen, and J.E.L Emons, Academic Press, second edition, 2004.
2. Biomaterials: An Introduction (second edition) Joon B.Park & Roderic S.Lakes, Plenum Press, 1992.
3. Handbook of Materials for Medical Devices, Edited by J. R. Davis, ASM international, 2003.
4. Introduction to Nuclear Engineering, by J.R Lamarsh.
5. W.D. Callister, Jr, - Material Science & Engineering Addition-Wesly Publishing Co.
6. Van Vlash - Elements of Material Science & Engineering John Wiley & Sons.

EME-064 : PRODUCTION & OPERATIONS MANAGEMENT

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Unit –I (6 sessions)
Managing Operations
Operations Management – Function, Evolution, Definition, Systems view of P&OM; Operations Strategies for Competitive Advantage;

Unit –II (9 sessions)
Planning (Designing) the conversion System
Designing Products, Services and Processes; Operations Capacity; Locating Production and Service facilities; Layout Planning.

Unit-III (7 sessions)
Organizing the conversion System
Job design, Production and Operations standards, and work measurement; Project Management.

Unit-IV (8 sessions)
Scheduling Production and Service System
Scheduling systems, Aggregate Planning for Production and service system; Operations Scheduling.

Unit-V (10 sessions)
Material Requirements Planning
Planning for needs, applying MRP, Detailed capacity planning, MRP II.
Managing for World class Competition
World class Manufacturing practices; Managing for Quality; Conversion Process in change.

SUGGESTED READINGS
1) Adam Jr Everett E. R J – Production and Operations Management (Prentice-Hall, 2000, 5th Edition)
2) Russell & Taylor III – Operations Management (Pearson, 4th Edition)
3) Hill T- Operations Management (Palgrave, 2000)
4) McGregor D – Operations Management (McGraw-Hill, 1960)
5) Morton - Production and Operations Management (Vikas)
6) Gaither & Frazier - Operations Management(Cengage Learning, 9th edition)

EME-065 : ENERGY MANAGEMENT

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UNIT-1
Introduction to energy, Sources of energy, Forms of energy, Energy reserves, renewable energy sources, Unites of energy and the laws of thermodynamics,, Energy consumption and GDP, energy database , Energy demand analysis, Costs of exploration and utilization of depletable resources, energy pricing, National energy plan. 7

UNIT-2
Energy audit concepts, Energy audit based on 1st law and 2nd law of thermodynamics, Mass and Energy balances, Availability analysis, Evaluation of energy conserving opportunities, Economic analysis and life cycle costing. 7

UNIT-3
Energy conservation areas, Energy transmission and storage, Plant wide energy optimization Models, Data base for energy management , Energy conservation through controls, Computer aided energy management, Program organization and methodology. 7

UNIT-4
Electrical energy conservation in building lighting, heating, ventilating and air conditioning, Energy efficient motor, power factor improvement in power systems, Energy audit of Combustion process, Boilers, Turbines, compressors, Pumps, Heat exchangers, Condensers, Use of industrial, wastes. 9

UNIT-5
Energy environment interaction, Environmental issues, Global warning, Carbon dioxide emissions, Depletion of ozone layer, Government's regulations, Energy economy interaction. 7

BOOKS:

1. Energy Management and condevtion, by Clive Beggs, Butterwoth- Heinemann Elsevier Science.
2. Optimising Energy Efficiency in the Industry, By Rajan, Tata Mc Graw Hill Publishers.
3. Guide to energy Management , By C.L Capehart, Fairmont Press.

4. Renewable Energy Sources and their Environment Impact, by Abbasi & Abbasi, Prentice Hall of India.
5. Environmental Risks and Hazards by Cutter, Prentice Hall of India.
6. Energy and Power Risk Management: New Developments in Modeling, Pricing and Hedging, buy Alexander Eydeland, John Wiley & Sons.
7. Energy Management Handbook by, Wayne C. Turner.
8. Thermodynamics, By Kenneth Wark, Tata Mc Graw Hill Publishers.
9. Exergy Analysis of Thermal, Chemical and Metallurgical Process, By Jan Szargut, David R. Morris, Frank R. Steward, Hemisphere Pub, Springer Verlag Publisher

EME-066 : FUNDAMENTALS OF BIOMEDICAL ENGINEERING

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UNIT I : **Biomechanics**

Statics and dynamics of the musculoskeletal system, forces and moments. Acting in the skeletal system and the various techniques used to describe them. Forces and moments with in the body such as forces acting at hip and knee joint and in the extremities. Analysis of pathological situations of human joints. **9**

UNIT II: Biomaterials

Stress strain behaviour of bone. The mechanical properties including elasticity, hardness, viscoelasticity, surface and fatigue properties of skin; soft tissues; bone; metals; polymers and ceramics. Biocompatible materials and its applications. The effects of degradation and corrosion. **8**

UNIT III : Bio Fluid Flow

Fluids-laminar and turbulent flow, boundary layer, non-newtonian and pulsatile models, blood rheology, circulatory system, blood-flow in arteries, veins and heart, synovial fluid, joint friction. **6**

UNIT IV : Bioinstrumentation

Fundamentals of producing a medical image, image collection techniques, image reconstruction algorithms, detailed examination of the four main areas of medical imaging : Nuclear Medicine and positron Emission Tomography, Ultrasound, Diagnostic Radiology, Magnetic Resonance and its clinical applications. Physiological signals, noise, and available sensors and transducers and their characteristics. **9**

UNIT V

Computing for Biomedical Engineers

Health care information and communications, Including telemedicine, medical informatics, networks and privacy. Data Collection, Medical coding and classification. Standards for medical data interchange. Aspects of database design, client/server topologies. **6**

Reference:

1. Basic orthopedic biomechanics, Editors-VC Mow & Wc Hayes, Lippincott Raven Publishers.
2. Biomaterials Science- An Introduction to Materials in Medicine. Buddy D.Rattner, Allan S.Hoffman, Frederick J.Schoen, Jack E.Lemmons, Editors, Academic Press.
3. Biomaterials: An Introduction(second edition) Joon B.Park & Roderic S.Lakes, Plenum Press, 1992.
4. Biofluid Mechanics, Jagan N.Mezumdar; World Scientific Pub.Co.,NJ 1992
5. Handbook of Biomedical Instrumentation, RS Khandpur.
6. Mthematical models in biology and medicine- J.N.Kapur, Affliated East West Press Pvt. Ltd., NewDelhi-India
7. Bone Mechanism – W.C.Heys, CRC Press
8. Computers in Medicine- Lele.