U.P. TECHNICAL UNIVERSITY, LUCKNOW

STUDY & EVALUATION SCHEME

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

[Effective from Session 20016-17]

YEAR IV, SEMESTER-VII

S. No.	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Assessment			ESE		
						CT	TA	Total			
THEORY SUBJECT											
1	NOE-071 to 074	Open Elective -I	3	1	0	30	20	50	100	150	4
2	NME-701	CAD	3	1	0	30	20	50	100	150	4
3	NME-702	Automobile Engineering	3	1	0	30	20	50	100	150	4
4	NME-031 to NME-034	Departmental Elective – III	3	1	0	30	20	50	100	150	4
5	NME-041 to NME-044	Departmental Elective – IV	3	1	0	30	20	50	100	150	4
PRACTICAL/DESIGN/DRAWING											
5	NME-751	CAD/CAM Lab	0	0	2	10	10	20	30	50	1
6	NME-752	I. C. Engine and Automobile Lab.	0	0	2	10	10	20	30	50	1
7	NME-753	INDUSTRIAL TRG.	0	0	2	-	50	50	-	50	1
8	NME-754	PROJECT	0	0	3	-	50	50	-	50	2
	GP-701	GP	-	-	-	-	-	50	-	50	-
		TOTAL	15	5	9					1000	25

Note- Practical Training-1 & 2 (4-weeks each) done after 4th & 6th Semesters would be evaluated in 7th semester through report and viva voce etc.
Project should be initiated in 7th semester beginning **(End Semester Examination to be conducted for evaluation for 7th sem),** and should be complete by the end of 8th semester with good Report and power-point Presentation etc.

Open Electives – I

NOE-071 Entrepreneurship Development
NOE-072 Quality Management
NOE-073 Operations Research
NOE-074 Introduction to Biotechnology

Departmental Elective III

NME-031 Computer Aided Manufacturing
NME-032 Project Management
NME-033 Computational Fluid Dynamics
NME-034 Composite materials

Departmental Elective IV

NME-041 Total Quality Management
NME-042 Thermal Turbo Machines
NME-043 Mechanical System Design
NME-044 Automation and Robotics

U.P. TECHNICAL UNIVERSITY, LUCKNOW

STUDY & EVALUATION SCHEME

B. Tech. Production Engineering / Industrial & Production Engineering / Mechanical & Industrial Engineering
[Effective from Session 20016-17]

YEAR IV, SEMESTER-VIII

S. No.	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Assessment			ESE		
						CT	TA	Total			
THEORY SUBJECT											
1	NOE-081 to 084	Open Elective -II	3	1	0	30	20	50	100	150	4
2	NPI-801	Quality Control	3	1	0	30	20	50	100	150	4
3	NME-051 to NME-055	Departmental Elective –V	3	1	0	30	20	50	100	150	4
4	NME-061 to NME-065	Departmental Elective -VI	3	1	0	30	20	50	100	150	4
PRACTICAL/DESIGN/DRAWING											
5	NME-851	SEMINAR	0	0	3	-	50	50	-	50	2
6	NME-852	PROJECT	0	0	12	-	100	100	200	300	7
7	GP-801	GP	-	-	-	-	-	50	-	50	-
		TOTAL	12	4	15					1000	25

Open Electives – II

NOE-081 Non Conventional Energy Resources
NOE-082 Nonlinear Dynamic Systems
NOE-083 Product Development
NOE-084 Automation and Robotics

Departmental Elective V

NME-051 Operations Research
NME-052 Design of Thermal Systems
NME-053 Advance Synthesis of machines
NME-054 Industrial Automation
NME-055 Advance Welding Technology

Departmental Elective VI

NME-061 Experimental Stress Analysis
NME-062 Plant Layout and Material Handling
NME-063 Additive Manufacturing
NME-064 Computer Aided Process Planning
NME-065 Non Destructive Testing

U.P. TECHNICAL UNIVERSITY, LUCKNOW

STUDY & EVALUATION SCHEME

B. Tech. Mechanical Engineering
[Effective from Session 2016-17]

YEAR IV, SEMESTER-VIII

S. No.	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Assessment			ESE		
						CT	TA	Total			
THEORY SUBJECT											
1	NOE-081 to 084	Open Elective -II	3	1	0	30	20	50	100	150	4
2	NME-801	Power Plant Engineering	3	1	0	30	20	50	100	150	4
3	NME-051 to NME-055	Departmental Elective -V	3	1	0	30	20	50	100	150	4
4	NME-061 to NME-065	Departmental Elective -VI	3	1	0	30	20	50	100	150	4
PRACTICAL/DESIGN/DRAWING											
5	NME-851	SEMINAR	0	0	3	-	50	50	-	50	2
6	NME-852	PROJECT	0	0	12	-	100	100	200	300	7
7	GP-801	GP	-	-	-	-	-	50	-	50	-
		TOTAL	12	4	15					1000	25

Open Electives – II

NOE-081 Non Conventional Energy Resources
NOE-082 Nonlinear Dynamic Systems
NOE-083 Product Development
NOE-084 Automation and Robotics

Departmental Elective V

NME-051 Operations Research
NME-052 Design of Thermal Systems
NME-053 Advance Synthesis of machines
NME-054 Industrial Automation
NME-055 Advance Welding Technology

Departmental Elective VI

NME-061 Experimental Stress Analysis
NME-062 Plant Layout and Material Handling
NME-063 Additive Manufacturing
NME-064 Computer Aided Process Planning
NME-065 Non Destructive Testing.

NME-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,

Computer Graphics-I 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, Color CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters

8

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 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 .

8

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

8

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. Basic application commands for 2d drafting software like AutoCAD/Draftsight (any one)&3d solid modeling software Solidworks/Autodesk Inventor/PTC Creo /Catia (Any one)etc.

8

UNIT-V

Finite Element Analysis: Basic concept of the finite element method, comparison of FEM with direct analytical solutions; Steps in finite element analysis of physical systems, Finite Element analysis of 1-D problems like spring, bar, truss and beam elements formulation by direct approach; development of elemental stiffness equations and their assembly, solution and its post processing.

8

Books and References:

1. Computer Graphics, by Hearn & Baker, Prentice Hall of India

2. CAD/CAM, by Groover and Zimmers, Prentice Hall India Ltd.
3. CAD/CAM :Theory and Practice, by Zeid, McGraw Hill
4. CAD/CAM: Computer Aided Design and Manufacturing, by Groover, Pearson India
5. Mathematical Elements for Computer Graphics, buy Rogers and Adams, McGraw Hill
6. Finite Element Method By S S Rao
7. FE Analysis Theory and Programming, by Krishnamoorthy, Tata McGraw Hill

NME-702: AUTOMOBILE ENGINEERING **L T P**
3 1 0

UNIT-I

Introduction:

Basic concepts of Automobile Engineering and general configuration of an automobile, Power and Torque characteristics. Rolling, air and gradient resistance. Tractive effort. Gear Box. Gear ratio determination.

6

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, Independent front & rear suspension, Perpendicular arm type, Parallel arm type, Dead axle suspension system, Live axis suspension system,Air suspension & shock absorbers.

5

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

Emission standards and pollution control :

Indian standards for automotive vehicles-Bharat I and II, Euro-I and Euro-II norms, fuel quality standards, environmental management systems for automotive vehicles, catalytic converters, fuel additives and modern trends in automotive engine efficiency and emission control.

5

Maintenance system:

Preventive maintenance, break down maintenance and over hauling.

2

Books and References:

1. Automotive Engineering- Hietner
2. Automobile Engineering - Kripal Singh.
3. Automobile Engineering - Narang.
4. Automobile Engineering –TTTI, Pearson India
5. Automotive Mechanics- Crouse
6. Automobile Engineering - Newton and Steeds.
7. Automobile Engineering –Ramakrishna, PHI, India

NME: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, ubrication 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

Books and References:

1. Power Plant Engineering, by F.T. Morse, Affiliated East-West Press Pvt. Ltd
2. Power Plant Engineering by Hedge, Pearson India
3. Power Plant Technology, by Wakil, 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.
6. Power Plant Engineering by Gupta, PHI India
7. Power Plant Engineering. Mahesh Verma, Metropolitan Book Company Pvt. Ltd.

NPI- 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.

8

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

Books and Reference:

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

NME-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

NME-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.

DEPARTMENT ELECTIVE-III

NME-031: COMPUTER AIDED MANUFACTURING (CAM) **L T P**
3 1 0

UNIT-I

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

8

UNIT-II

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.
Definition and designation of control axes, Constructional details of Numerical Control Machine Tools, MCU structure and functions, Methods of improving accuracy and productivity using NC.

8

UNIT -III

Computer Numerical Control (CNC) : Features of CNC, Elements of CNC machines, the machine control unit for CNC , Direct Numerical Control(DNC) and Adaptive Controls.
System Devices: Drives, Feedback devices, Counting devices, DAC and ADCs, Interpolator systems, Control loop circuit elements in PTP system, Contouring system, Incremental and absolute systems.

8

UNIT -IV

NC Part Programming- (a) Manual (word address format) programming Examples Drilling, Turning and Milling; canned cycles, Subroutine, and Macro.
(b) Computer Assisted Part programming (APT) Geometry, Motion and Additional statements, Macro- statement.

8

UNIT-V

Computer Integrated manufacturing system , Group Technology, Flexible Manufacturing System, Computer aided process planning-Retrieval and Generative System. Types and generations of Robots, Structure and operation of Robot, Robot applications.

8

Books and References :

1. Automation, Production System and Computer Integrated Manufacturing, by Mikell P. Grover, Prentice Hall of India Pvt Ltd.
2. CAD/CAM – Theory and Practice, by Ibrahim Zeid, McGraw Hill
3. Computer Aided Manufacturing, by Cheng, Pearson India
4. CAD/CAM: Principles and Oerations, by P. N. Rao, McGraw Hill
5. CAD/CAM: Computer Aided Design and Manufacturing, by M. Groover, Pearson India.
6. CAD/CAM: Concepts and Applications by Alavala, PHI India
7. Computer Aided Manufacturing, by Srinivas, Oxford University Press.

NME-032: PROJECT MANAGEMENT **L T P**
3 1 0

UNIT-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

UNIT-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

UNIT-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

UNIT-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

UNIT-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 and References :

1. Project Management by Harvey Maylor, Pearson India
2. Project Management by Choudhury, McGraw Hill
3. Project Management by K. Nagarajan
4. Project Management: A Systems Approach to Planning, Scheduling and Controlling, by Kerzner, Willey
5. Project Management: A Life Cycle Approach by Kanda, PHI, India
6. Project Management and Appraisal, byKhatua, Oxford University Press.

NME-033: COMPUTATIONAL FLUID DYNAMICS **L T P**
3 1 0

UNIT- I
GOVERNING EQUATIONS AND BOUNDARY CONDITIONS:
Basics of computational fluid dynamics. Governing equations of fluid dynamics. Continuity, Momentum and Energy equations. Chemical species transport. Physical boundary conditions, Time-averagedequations for Turbulent Flow. Turbulent–Kinetic Energy Equations Mathematical behavior of PDEs onCFD. Elliptic, Parabolic and Hyperbolic equations.

8

UNIT -II
FINITE DIFFERENCE METHOD:
Derivation of finite difference equations. Simple Methods. General Methods for first and second orderaccuracy, solution methods for finite difference equations. Elliptic equations. Iterative solution Methods. Parabolic equations . Explicit and Implicit schemes. Example problems on elliptic and parabolic equations.

9

UNIT- III
FINITE VOLUME METHOD (FVM) FOR DIFFUSION:
Finite volume formulation for steady state One, Two and Three dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank. Nicolson and fully implicit schemes.

9

UNIT -IV
FINITE VOLUME METHOD FOR CONVECTION DIFFUSION:
Steady one-dimensional convection and diffusion. Central, upwind differencing schemes-properties ofdiscretization schemes. Conservativeness, Boundedness, Trasnportiveness, Hybrid, Power-law, QUICKSchemes.

10

UNIT- V
CALCULATION FLOW FIELD BY FVM:

Representation of the pressure gradient term and continuity equation. Staggered grid. Momentum equations. Pressure and Velocity corrections; Pressure Correction equation, SIMPLE algorithm and itsvariants. Turbulence models, mixing length model, Two equation (k-Є) models. High and low Reynoldsnumber models

9

Books and References:

1. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, by Versteeg, Pearson, India.
2. Numerical Heat Transfer and Fluid Flow, by Patankar, Tayers & Francis .
3. Computational Heat Transfer, by Jaluria ans Torrance, CRC Press
4. Computational Fluid Dynamics, by Anderson, Mc Graw Hill
5. Computational Fluid Dynamics, by Chung, Cambridge University Press.
6. Computer Simulation of flow and heat transfer, by Ghoshdastidar McGraw Hill.
7. Introduction to Computational Fluid Dynamics, by Prodip Niyogi. Pearson India.
8. Computational Fluid Flow and Heat Transfer, by Muralidhar and Sundararajan, Narosa Publishing House.
9. Computational Fluid Dynamics: Principles and Applications, by Blazek, Elsevier Science & Technology.

NME-034: COMPOSITE MATERIALS **L T P**
3 1 0

UNIT-1

Introduction: Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.

7

UNIT-II

Types of Reinforcements/Fibers: Role and Selection of reinforcement materials, Types of fibres, Glass fibers, Carbon fibers, Aramid fibers , Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc., Mechanical properties of fibres. Material properties that can be improved by forming a composite material and its engineering potential.

7

UNIT-III

Various types of composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites.

10

UNIT-IV

Fabrication methods: Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression molding, resin-transplant method, pltrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix

performs, Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films.

10

UNIT-V

Testing of Composites: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.

6

Books and References :

1. Materials characterization, Vol. 10, ASM hand book
2. Mechanical Metallurgy, by G. Dieter, McGraw Hill
3. Analysis and Performance of Fiber Composites, by Agarwal, McGraw Hill
4. Thermal Analysis of Materials, by R.F. Speyer, Marcel Decker
5. Engineering Mechanics and Composite Materials , by Daniels, Oxford University Press.
6. Engineering Materials: Polymers, Ceramics and Composites, by A.K Bhargava Prentice Hall India
7. Material Science and Engineering (SIE) with CD, by Smith, McGraw Hill

DEPARTMENT ELECTIVE-IV

NME-041: TOTAL QUALITY MANAGEMENT (TQM) **L T P**
3 1 0

UNIT -I

Quality Concepts

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

4

Control on Purchased Product

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

4

Manufacturing Quality

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

3

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.

5

Human Factor in Quality

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

3

UNIT -III

Tools and Techniques

Seven QC tools (Histogram, Check sheet, Ishikawa diagram, Pareto, Scatter diagram, Control chart, flow chart).

3

Control Charts

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

3

Attributes of Control Charts

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

3

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.

6

UNIT -V

IS0-9000 and its concept of Quality Management

ISO 9000 & ISO 14000 series, Quality information system and documentation, Auditing, Taguchi method, JIT in some details.

6

Books and References:

1. Total Quality Management, by Dale H. Besterfield, Pearson India
2. Beyond Total Quality Management, Greg Bounds, McGraw Hill.
3. TQM in New Product manufacturing, H. G. Menon, McGraw Hill.
4. Total Quality Management, by Suri, Wiley.
5. Total Quality Management, by Subburaj, McGraw Hill.
6. Total Quality Management, by Poornima Chantimath, Pearson India
7. Quality Management by Bedi, Oxford University Press.
8. Total Quality Management-Text and Cases, by Janakiraman & Gopal, PHI, India.
9. Total Quality Management, H. Lal, Eastern Limited.
10. Total Quality Management, A. Arivalagar , R. S. Naagarazan, New Age International.

NME-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 turbomachinery, Energy transfer in turbo machines, Euler's equation, Definition of variousefficiencies, 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, Velcoitydiagram for centrifugal compressor, Slip factor, Stage pressure rise, Loading coefficient,Diffuser, degree of reaction, Effect of impeller blade profile, Pre-whirl and inlet guidevanes, Centrifugal Compressor characteristic curves.

4

Axial flow compressor- Principle of operation and working, Energy transfer, Velocitydiagram for axial compressor, Factors affecting stage pressure ratio, Blockage incompressor 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, Velocitydiagram, 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 modificationdue to piston acceleration, Performance characteristics, Cavitation and its control,Miscellaneous types of pumps.

4

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

4

UNIT-V

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

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

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

8

Books and References:

1. Gas turbine theory : Cohen & Rogers, Addison Weslay Longman Ltd.
2. Fundamentals of Turbomachinery by Venkanna, PHI, India
3. Turbine, Compressors and Fans, S.M. Yahya, Tata Mc Graw Hill.

4. Gas Turbine- Ganeshan, Tata Mc Graw Hill.
5. Thermal Turbomachines, by Singh, Wiley
6. Fundamentals of Turbomachinery, by Venkanna, PHI, India.

NME – 043: MECHANICAL SYSTEM DESIGN **L T P**
3 1 0

UNIT-I

Engineering process and System Approach

Basic concepts of systems, Attributes characterizing a system, types of system, Application of system concepts, 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: Introduction, System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system.

4

System modeling

Introduction, 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.

4

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 single 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 and 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. Engineering Design, by Dieter, McGraw Hill
3. Design Engineering-JR Dixon, TMH, New Delhi
4. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi
5. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow
6. Optimization Techniques-SS Rao
7. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

NME-044: AUTOMATION AND ROBOTICS **L T P**
3 1 0

UNIT- I

AUTOMATION:

Definition, Advantages, goals, types, need, laws and principles of Automation. Elements of Automation.

Fluid power and its elements, application of fluid power, Pneumatics vs. Hydraulics, benefit and limitations of pneumatics and hydraulics systems, Role of Robotics in Industrial Automation.

7

UNIT- II

Manufacturing Automation:

Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multimodel and mixed model production lines. Programmable Manufacturing Automation CNC machine tools, Machining centers, Programmable robots, Robot time estimation in manufacturing operations.

7

UNIT- III

ROBOTICS

Definition, Classification of Robots - Geometric classification and Control classification, Laws of Robotics, Robot Components, Coordinate Systems, Power Source.

Robot anatomy, configuration of robots, joint notation schemes, work volume, manipulator kinematics, position representation, forward and reverse transformations, homogeneous

transformations in robot kinematics, D-H notations, kinematics equations, introduction to robot arm dynamics.

9

UNIT -IV

ROBOT DRIVES AND POWER TRANSMISSION SYSTEMS

Robot drive mechanisms: Hydraulic / Electric / Pneumatics, servo & stepper motor drives, Mechanical transmission method: Gear transmission, Belt drives, Rollers, chains, Links, Linear-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearings.

ROBOT END EFFECTORS

Classification of End effectors – active and passive grippers, Tools as end effectors, Drive system for grippers. Mechanical, vacuum and magnetic grippers. Gripper force analysis and gripper design.

9

UNIT- V

ROBOT SIMULATION

Methods of robot programming, Simulation concept, Off-line programming, advantages of off-line programming.

ROBOT APPLICATIONS

Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Limitation of usage of robots in processing operation.

Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference.

8

Books and Reference :

1. An Introduction to Robot Technology, by Coifet Chirroza, Kogan Page.
2. Robotics for Engineers, by Y. Koren, McGraw Hill.
3. Robotic: Control, Sensing, Vision and Intelligence, by Fu, McGraw Hill.
4. Introduction to Industrial Robotics, by Nagrajan, Pearson India
5. Robotics , by J.J. Craig, Addison-Wesley.
6. Industrial Robots , by Groover, McGraw Hill.
7. Robots & Manufacturing Automation, by Asfahl, Wiley
8. Fundamentals of Robotics: Analysis and Control, by Schilling, Pearson India
9. Automation & Robotics, byGhoshal, Oxford University Press.
10. Introduction to AI Robotics, by Murphy, PHI, India.

DEPARTMENT ELECTIVE-V

NME-051: OPERATIONS RESEARCH **L T P**

3 1 0

UNIT-I

Introduction: Basic of Operation Research, Origin & development of Operation Research,Applications.

2

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

7

UNIT-II

Transportation Problem: Methods of obtaining initial and optimum solution, degeneracy in transportation problems, unbalanced Transportation Problem.

4

Assignment Problem: Methods of obtaining optimum solution, Maximization problem, travelling salesman problem.

3

UNIT-III

Game Theory: two person Zero sum game, Solution with/without saddle point, dominance rule, Different methods like Algebraic, Graphical and game problem as a special case of Linear Programming.

4

Sequencing: Basic assumptions, n Jobs through 2-3 machines, 2 Jobs on m machines.

3

UNIT-IV

Stochastic inventory models: Single & multi period models with continuous & discrete demands, Service level & reorder policy.

4

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

4

UNIT-V

Queuing models: Characteristics of Queuing Model, M/M/1 and M/M/S system, cost consideration.

3

Project management: Basic Concept of network Scheduling, Rules for drawing network diagram, Applications of CPM and PERT techniques in Project planning and control; crashing of operations; resource allocation.

6

Books and References:

1. Operations Research: Principles and Practice, by- Ravindran, Phillips, Solberg, John Wiley & Sons.
2. Principal of Operation Research, by- Harvey M. Wagner, Prentice Hall.
3. Introduction to Operation Research, by- Gillett, McGraw Hill.
4. Operations Research - An Introduction, by- Hamdy A. Taha, Pearson India.
5. Operation Research, by- Wayne L. Winston, Thomsan Learning.
6. Problems in Operations Research by- Prem Kumar Gupta & D.S. Hira, S. Chand.
7. Operation Research Application and Algorithms, by- Wayne L Winston, Duxbury Press.
8. Operations Research, by Jha, McGraw Hill.
9. Operation Research, by Yadav & Malik Oxford University Press
10. Operations Research, by Panneerselvam, PHI, India

NME-052 : DESIGN OF THERMAL SYSTEMS **L:T:P**
3:1: 0

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

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

Books and References:

1. Thermal Environment Engg. by Kuhen, Ramsey & Thelked.
2. Refrigeration & Air Conditioning - By C.P. Arora, McGraw Hill
3. Refrigeration & Air Conditioning - By Manohar Prasad, New Age
4. Heating, Ventilating and Air Conditioning - By Mc Quistion, Parker & Spitler
5. Refrigeration & Air Conditioning Data Book – Manohar Prasad, New Age
6. ASHRAE Hand Book of Fundamentals-ASHRAE
7. Refrigeration & Air Conditioning-Stoecker & Jones, Mc Graw Hill
8. Design of High Efficiency Turbomachinery and Gas Turbine by Wilsonm and Korakianitis, PHI, India
9. Turbines compressors and Fans by Yahaya, Mc Graw Hill
10. Heat Transfer Equipment Design by Shah, CRC Press
11. Thermal System Design and Optimization by Balaji, Ane Books Pvt Ltd

NME-053: ADVANCE SYNTHESIS OF MECHANISMS

L T P
3 1 0

UNIT-I

Introduction:

Mechanisms: Classifications, Relative and absolute motion, degree of freedom, 4-barMechanisms, planar and spatial mechanisms, Inversion and equivalent linkage,Transmission angle.

4

Kinematic analysis of Planer motion: Relative velocity, Instantaneous centre, Poles and centrodes, Relative acceleration.

4

UNIT-II

Kinematic Synthesis: Type, number and dimensional synthesis, spacing of accuracy points, Chebyshev polynomials.

4

Four bar linkage, Equation of coupler curves, Double points and symmetry, RobertChebyshev theorem, Approximate and exact straight line mechanisms .

4

UNIT-III

Graphical Synthesis of Mechanisms:

Poles and relative poles of four bar linkage, Poles and relative poles of slider crankMechanism. Synthesis of four bar mechanisms.

8

UNIT IV

Analytical Synthesis:

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

8

UNIT-V

Analytical Synthesis:
Synthesis of slider crank mechanism with three accuracy points, Synthesis of slidercrank mechanism with four accuracy points, cam and follower mechanism, Analysis of mechanical errors in linkage.

8

Books and 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
5. Kinematics and Dynamics of machinery (SIE), by Norton, McGraw Hill

NME-054: INDUSTRIAL AUTOMATION –I **L T P**
3 1 0

Unit-I:
Historical perspective of Industrial Automation
- Origin, Evolution and Need / Demand of automation in industries, Current and future Trends
- Components of Industrial Automation System and their functionalities, Layers and Types of Automation

6

Unit -II:
Automation Controllers
- Introduction of Industrial Controllers
- Programmable Logic Controller: Constructions, Types, Programming Units, Memory, I/O Modules.
- Programming methodology
- Ladder Logic programming for Industrial Applications, Timers and Counters
- Selection criteria of PLC
- Examples of PLC application

10

Unit-III:
Industrial Switching Elements
- Electronic Logic gates
- Relays, Solenoids
- Pneumatic Valves and Actuators
- Hydraulic valves and Actuators
- Interfacing: Control of Hydraulics and Pneumatics with Electric Signals
- Comparison between different switching elements

10

Unit-IV:
Visualization: Human Machine Interface (HMI), Supervisory Control and Data Acquisition (SCADA) Systems:

- Need for HMI
- Hardware based HMI panels
- PC based HMI Systems – SCADA
- Different Functionalities
- Benefits of implementing SCADA systems
- Case Studies of SCADA implementation.

10

Unit V:

Case Study

- Hydraulic / Pneumatic Press
- Material handling System
- Machine Tool: NC/CNC Machine

4

Books and References :

1. Programmable Logic Controllers with Control Logix, by Jon Stenerson, Delmar Publishers, 2009.
2. Hand book of industrial Automation, by Richard L Shell and Ernest L Hall, Marcel Dekker Inc., 2000.
3. Practical SCADA for Industry, by David Bailey and Edwin Wright, Newness Publishers, 2003.
4. Automation network Selection, by Dick Caro, ISA – The Instrumentation Systems and Automation Society, 2004.
5. Getting Factory Automation Right (the first time), by Edwin H Zimmerman, Manufacturing Engineers, 2001.
6. Automation, Production Systems and Computer Integrated Manufacturing, by Groover, Pearson India.
7. Industrial Instrumentation and Control, by Singh, McGraw Hill.

NME-055: ADVANCED WELDING TECHNOLOGY **L T P**
3 1 0

UNIT-I

Introduction: Welding as compared with other fabrication processes,Importance and application of welding, classification of welding processes, Health & safety measures in welding.

3

Welding Power Sources: Physics of welding Arc**,** Basic characteristics of power sources for various arc welding processes, Transformer, rectifier and generators.

3

Physics of Welding Arc: Welding arc, arc initiation, voltage distribution along the arc, arc characteristics, arc efficiency, heat generation at cathode and anode, Effect of shielding gas on arc, isotherms of arcs and arc blow.

4

Metal Transfer: Mechanism and types of metal transfer in various arc welding processes.

3

UNIT-II

Welding Processes: Manual Metal Arc Welding (MMAW), TIG, MIG, Plasma Arc, Submerged Arc Welding, Electrogas and Electroslag, Flux Cored Arc Welding, Resistance welding, Friction welding, Brazing, Soldering and Braze welding processes, Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding, Underwater welding & Microwave welding.

11

UNIT-III

Heat Flow Welding: Calculation of peak temperature; Width of Heat Affected Zone (HAZ); cooling rate and solidification rates; weld thermal cycles; residual stresses and their measurement; weld distortion and its prevention.

5

UNIT-IV

Repair & Maintenance Welding: Hardfacing, Cladding, Surfacing, Metallizing processes and Reclamation welding.

2

Weldability: Effects of alloying elements on weld ability, welding of plain carbon steel, Cast Iron and aluminium. Micro & Macro structures in welding.

4

UNIT-V

Weld Design : Types of welds & joints, Joint Design, Welding Symbols, weld defects, Inspection/testing of welds, Introduction to Welding Procedure Specification & Procedure Qualification Record.

5

Books and References:

1. Welding and Welding Technology, by- Richard L. Little, McGraw Hill Education.
2. Welding Principals and Practices, by- Edwars R. Bohnart, McGraw Hill Education.
3. Welding Engineering and Technology, by- R. S. Parmar, Khanna Publishsers.
4. Welding Handbooks (Vol. I & II).

DEPARTMENT ELECTIVE-VI

NME- 061: EXPERIMENTAL STRESS ANALYSIS **L T P**
3 1 0

UNIT -I

Stress: Introduction, Two-Dimensional State of Stress, Equations of Equilibrium, Stress Transformation relations, principal Stresses, Special States of Stress.

4

Strain: Introduction, Displacement and Strain, Strain Transformation relations, principal strains, 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: Introduction, Coating Stresses, 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, Wheat-Stone Bridge, Bridge Sensitivity, Null Balance Bridges.Three Element Rectangular Rosette

4

UNIT- IV

Theory of Photoelasticity: Introduction, Temporary Double Refraction, Stress Optic Law, Relative Retardation, Stressed Model in Plane Polariscope, Stressed Model in Circular Polariscope.

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.

8

Books and References :

1. Experimental Stress Analysis, by U C Jindal, Pearson India
2. Experiment Stress Analysis, by James W. Dally and William F. Riley, McGraw-Hill International
3. Experiment Stress Analysis by Dr. Sadhu Singh, Khanna Publishers.
4. Advance Strength and Applied Stress Analysis, by Budynas, McGraw-Hill

NME- 062: PLANT LAYOUT AND MATERIAL HANDELING **L T P**
310

UNIT -I

Introduction

Criteria, Strategies/Tactics, Sustainability and Eco-Efficiency in Facility Design, Basic Planning, Alternative Machine Arrangements, Flow Lines, Location Models, Act/Building Details, Aisles and Security, Storage, Shipping and Receiving, Offices, Specialized Areas.

8

UNIT -II

Workstations, Unit Loads & Containers, Conveyors, Vehicles, Lifting Devices, Workstation Material Handling, Ethics in Facility Design

Facilities design procedure and planning strategies, Production, activity and materials flow analysis, Space requirements and personnel services design considerations.

8

UNIT -III

Layout construction techniques: systematic layout planning; activity relationship analysis, pair wise exchange, graph-based construction algorithmic.

Material Handling: Material handling principles; material handling equipment and material handling systems.

8

UNIT -IV

Computerized Layout and Analytical Methods: ALDEP, CORELAP, CRAFT, BLOCPLAN, etc. **Warehouse operations**: function, storage operations.

Manufacturing operation: JIT, TQM, AM, CIM, SCM, Facility systems,

Quantitative models: Layout model, waiting line, AS/RS, simulation model, etc.

8

UNIT -V

Assessment and evaluation of layout alternatives Projects, Use Spiral software to practice plant layout design, Apply mathematical and engineering techniques such as systematic layout planning approach, quantitative model, cost estimate to solve practical facility layout problem.

8

Books and References:

1. Plant Layout and Material Handling, by- James M. Apple, John Wiley & Sons.
2. Plant Layout and Material Handling, by- Fred E. Meyers, Prentice Hall.
3. Facility Layout and Location: An Analytical Approach, by Richard L, Francis, Pearson India.
4. Plant Layout and Material Handling, by- B. K. Aggarwal, Jain Brothers.
5. Plant Layout and Material Handling, by- S. C. Sharma, Jain Brothers.
6. Materials Handling Handbook, by- Raymond A. Kulwiec, John Wiley & Sons.
7. Plant Design and Economics, by- Peters, McGraw Hill Education.
8. Purchasing and Material Management, by- Gopalakrishnan, McGraw Hill Education.

NME-063: ADDITIVE MANUFACTURING

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UNIT-I

Introduction

History and Advantages of Additive Manufacturing, Distinction Between Additive Manufacturing and CNC Machining, Types of Additive Manufacturing Technologies, Nomenclature of AM Machines, **Direct and Indirect Processes;** Prototyping, Manufacturing and Tooling.

4

Layer Manufacturing Processes; Polymerization, Sintering and Melting, Extrusion, Powder-Binder Bonding, Layer Laminate Manufacturing, Other Processes; Aerosolprinting and Bioplotter.

4

UNIT-II

Development of Additive Manufacturing Technology

Computer Aided Design Technology, Other Associated Technology, Metal and Hybrid Systems.

3

Generalized Additive Manufacturing Process Chain; The Eight Steps in Additive Manufacturing, Variation from one AM Machine to Another, Metal System, Maintenance of Equipment, Material Handling Issue, Design of AM.

5

UNIT-III

Additive Manufacturing Processes

Vat Photopolymerization; Materials, Reaction Rates, Photopolymerization Process Modeling, Scan Patterns, **Powder Bed Fusion Processes;** Material, Powder Fusion Mechanism, Process Parameters and Modeling, powder Handling, **Extrusion Based System;** Basic principles, plotting and Path Control, Bioextrusion, Other Systems, **Material Jetting;** Materials, Material Processing Fundamentals, Material Jetting Machines, **Binder Jetting;** Materials, Process Variations, BJ Machines, **Sheet lamination Processes;** Materials, Ultrosonic Additive Manufacturing, **Directed Energy Deposition Processes;** General DED Process Description, Material Delivery, DED systems, Process Parameters, Processiong-Structure-Properties Relationships, **Direct Write Technologies;** Ink-Based DW, laser Transfer DW, Thermal Spray DW, Beam Deposition DW, Liquid Phase Direct Deposition, Hybrid Technologies.

8

UNIT-IV

Design & Software Issues

Additive Manufacturing Design and Strategies; Potentials and Resulting Perspectives, AM based New Strategies, Material Design and Quality Aspects for Additive Manufacturing; Material for AM, Engineering Design Rules for AM.

4

Software Issue for Additive Manufacturing; Introduction, Preperation of CAD Models: The STL file, Problem with STL file, STL file Manupulation, Beyond the STL file, Additional Software to Assist AM.

4

UNIT-V

Material Design & Quality Aspects

Machines for Additive Manufacturing, Printers, Secondary Rapid Prototyping processes, Intellectual Property, Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing, Business Opportunities

4

Applications

Aerospace, Automotive, Manufacturing, Architectural Engineering, Art, Jewelry, Toys, Medical, Biomedical, Dental, Bio-printing, Tissue & Organ Engineering and many others.

4

Books and References:

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, by- Ian Gibson , DSavid W. Rosen , Brent Stucker, Springer.
2. Understanding Additive Manufacturing, by- Andreas Gebhardt, Hanser.
3. Additive Manufacturing, by- Amit Bandyopadhyay, Susmita Bose, CRC Press.
4. Rapid Prototyping: Principles and Applications, by - Chee Kai Chua, Kah Fai Leong, Chu Sing Lim.

NME-064: COMPUTER AIDED PROCESS PLANNING **L T P**
3 1 0

UNIT-I

Introduction to CAPP: Principles, scope and information requirement for CAPP, Role of process planning, Manual and experienced based process planning, Advantages of CAPP over conventional process planning, Decision table and decision trees, process capability analysis, Tolerance analysis, Variant process planning, Generative approach, Forward and Backward planning.

8

UNIT-II

Computer Aided Process Planning: Logical design of process planning systems, Implementation considerations, Computer based process monitoring and control, Computer and process interfacing, Totally integrated process planning systems, Process planning for rotational and prismatic parts, Machining of curves and surfaces, Five axis machining, Process planning of freedom surfaces, Development of NC codes, Computer aided design of fixtures, Inspection policies and inspection planning, Expert systems and their use in developing process planning systems.

8

UNIT-III

Retrieval CAPP system: Significance, group technology, structure, relative advantages, implementation, and applications. Selection of manufacturing sequence: Significance, alternative-manufacturing processes, reduction of total set-up cost for a particular sequence, quantitative methods for optimal selection, examples. Generative CAPP system: importance, principle of Generative CAPP system, automation of logical decisions, Knowledge based systems, Inference Engine, implementation, benefits.

8

UNIT-IV

Determination of machining parameters: Reasons for optimal selection of machining parameters, effect of parameters on production, cost and surface quality, different approaches, advantages of mathematical approach over conventional approach, solving optimization models of machining processes, design and manufacturing tolerances, methods of tolerance allocation, sequential approach, integration of design and manufacturing tolerances.

8

UNIT-V

Generation of tool path: Simulation of machining processes, NC tool path generation, graphical implementation, determination of optimal index positions for executing fixed sequence, quantitative methods. Implementation techniques for CAPP: MIPLAN system, Computer programming languages tbr CAPP, criteria for selecting a CAPP system and benefits of CAPP. Computer integrated planning systems, and Capacity planning system.

8

Books and References:

1. Production Systems and Computer Integrated Manufacturing System, by- Mikell P Groover, Prentice Hall.
2. Computer Processing of Remotely Sensed Images: An Introduction, 3rd Edition, by- Mather Paul, Wiley.
3. Computer Aided Process Control, by- SK Singh, PHI Learning Pvt. Ltd.
4. Computer Aided Design and Manufacturing, by- M. Sarcar, K. L. Narayan, PHI Learning Pvt. Ltd.

NME-065: NON-DESTRUCTIVE TESTING **L T P**
3 1 0

Unit-I

Introduction

Scope and advantages of NDT, Comparison of NDT with Destructive Testing, 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). Uses of visual inspection tests in detecting surface defects and their interpretation, advantages & limitations of visual inspection.

6

Unit-II

Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrants and developers, Zyglo test, Illustrative examples and interpretation of defects.

5

Magnetic particle Inspection – scope and working principle, Ferro Magnetic and Non-ferromagnetic 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-III

Radiographic methods

Introduction to electromagnetic waves and radioactivity, various decays, Attenuation of electromagnetic radiations, Photo electric effect, Rayleigh's scattering (coherent scattering), Compton's scattering (Incoherent scattering), Pair production, Beam geometry and Scattering factor.

X-ray radiography: principle, equipment & methodology, applications, types of radiations and limitations. γ-ray radiography – principle, equipment., source of radioactive materials & technique, advantages of γ-ray radiography over X-ray radiography Precautions against radiation hazards. Case Study - casting and forging.

8

Unit-IV

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-V

Special NDT Techniques

Eddy Current Inspection: Principle, Methods, Equipment for ECT, Techniques, Sensitivity, advanced ECT methods. Application, scope and limitations, types of Probes and Case Studies. Introduction to Holography, Thermography and Acoustic emission Testing.

8

Books and References:

1. Non-Destructive Testing and Evaluation of Materials, by- Prasad, McGraw Hill Education.
2. Basics of Non-Destructive Testing, by Lari & Kumar, KATSON Books.
3. Practical Non-destructive Testing, by- Baldev Raj, T. Jayakumar, M. Thavasimuthu, Woodhead Publishing.
4. Non-Destructive Testing Techniques, by- Ravi Prakash, New Age International.
5. Nondestructive Testing Handbook,by Robert C. McMaster, American Society for Nondestructive.
6. Introduction to Nondestructive Testing: A Training Guide, by- Paul E. Mix, wiley.
7. Electrical and Magnetic Methods of Non-destructive Testing, by- J. Blitz, springer.