

U.P. TECHNICAL UNIVERSITY, LUCKNOW



Syllabus

3rd Year

[Effective from session 2015-16]

- 1. B. Tech. Mechanical Engineering**
- 2. B. Tech. Production Engineering**
- 3. B. Tech. Industrial & Production Engineering**
- 4. B. Tech. Mechanical & Industrial Engineering**

U.P. TECHNICAL UNIVERSITY, LUCKNOW
STUDY & EVALUATION SCHEME
B. Tech. Mechanical Engineering
[Effective from Session 2015-16]
YEAR III, SEMESTER-V

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	NME-501	Machine Design-I	2	1	0	15	10	25	50	75	3
2	NME-502	Kinematics of Machines	3	1	0	30	20	50	100	150	4
3	NME-503	Manufacturing Science & Technology-II	3	1	0	30	20	50	100	150	4
4	NME-504	Heat & Mass Transfer	3	1	0	30	20	50	100	150	4
5	NME-505	I.C. Engines & Compressors	3	1	0	30	20	50	100	150	4
6	NHU-501	Engineering Economics	2	0	0	15	10	25	50	75	2
PRACTICAL/DESIGN/DRAWING											
7	NME-551	Machine Design-I Lab	0	0	2	10	10	20	30	50	1
8	NME-552	Seminar	0	0	2	--	--	50	--	50	1
9	NME-553	Manufacturing Technology-II Lab	0	0	3	10	10	20	30	50	1
10	NME-554	Heat & Mass Transfer Lab	0	0	3	10	10	20	30	50	1
11	NGP-501	General Proficiency	--	--	--	--	--	50	--	50	
		TOTAL	16	5	10					1000	25

U.P. TECHNICAL UNIVERSITY, LUCKNOW
STUDY & EVALUATION SCHEME
B. Tech. Mechanical Engineering
[Effective from Session 2015-16]
YEAR III, SEMESTER-VI

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	NME-602	Machine Design-II	3	1	0	30	20	50	100	150	4
2	NME-603	Dynamics of Machines	3	1	0	30	20	50	100	150	4
3	NME-604	Refrigeration & Air-conditioning	3	1	0	30	20	50	100	150	4
4	NME-011 to NME-014	Departmental Elective - I	3	1	0	30	20	50	100	150	4
5	NME-021 to NME-024	Departmental Elective - II	2	1	0	15	10	25	50	75	3
6	NHU-601	Industrial Management	2	0	0	15	10	25	50	75	2
PRACTICAL/DESIGN/DRAWING											
7	NME-651	Fluid Machinery Lab	0	0	3	10	10	20	30	50	1
8	NME-652	Machine Design-II Lab	0	0	2	10	10	20	30	50	1
9	NME-653	Theory of Machines Lab	0	0	2	10	10	20	30	50	1
10	NME-654	Refrigeration & Air Conditioning Lab	0	0	3	10	10	20	30	50	1
11	NGP-601	General Proficiency	--	--	--	--	--	50	--	50	
		TOTAL	16	5	10					1000	25

Note- 4 to 6 Weeks Industrial Training-II after VI semester also to be evaluated in VII semester

Departmental Electives:

Department Elective - I

1. NME-011 Engineering Optimization
2. NME-012 Finite Element Methods
3. NME-013 Mechanical Vibrations
4. NME-014 Mechatronics

Department Elective - II

1. NME-021 Fluid Machinery
2. NME-022 Product Design & Development
3. NME-023 Reliability Engineering
4. NME-024 Unconventional Manufacturing Processes

U.P. TECHNICAL UNIVERSITY, LUCKNOW

STUDY & EVALUATION SCHEME

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

[Effective from Session 20015-16]

YEAR III, SEMESTER-V

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	NME-501	Machine Design-I	2	1	0	15	10	25	50	75	3
2	NME-502	Kinematics of Machines	3	1	0	30	20	50	100	150	4
3	NME-503	Manufacturing Science & Technology-II	3	1	0	30	20	50	100	150	4
4	NME-504	Heat & Mass Transfer	3	1	0	30	20	50	100	150	4
5	NPI-501	Production Planning & Control	3	1	0	30	20	50	100	150	4
6	NHU-501	Engineering Economics	2	0	0	15	10	25	50	75	2
PRACTICAL/DESIGN/DRAWING											
7	NME-551	Machine Design-I Lab	0	0	2	10	10	20	30	50	1
8	NME-552	Seminar	0	0	2	--	--	50	--	50	1
9	NME-553	Manufacturing Technology-II Lab	0	0	3	10	10	20	30	50	1
10	NME-554	Heat & Mass Transfer Lab	0	0	3	10	10	20	30	50	1
11	NGP-501	General Proficiency	--	--	--	--	--	50	--	50	
		TOTAL	16	5	10					1000	25

U.P. TECHNICAL UNIVERSITY, LUCKNOW

STUDY & EVALUATION SCHEME

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

[Effective from Session 2015-16]

YEAR III, SEMESTER-VI

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	NME-602	Machine Design-II	3	1	0	30	20	50	100	150	4
2	NME-603	Dynamics of Machines	3	1	0	30	20	50	100	150	4
3	NPI-601	Principles of Machine Tool Design	3	1	0	30	20	50	100	150	4
4	NME-011 to NME-015	Departmental Elective - I	3	1	0	30	20	50	100	150	4
5	NME-021 to NME-024	Departmental Elective - II	2	1	0	15	10	25	50	75	3
6	NHU-601	Industrial Management	2	0	0	15	10	25	50	75	2
PRACTICAL/DESIGN/DRAWING											
7	NME-651	Fluid Machinery Lab	0	0	3	10	10	20	30	50	1
8	NME-652	Machine Design-II Lab	0	0	2	10	10	20	30	50	1
9	NME-653	Theory of Machines Lab	0	0	2	10	10	20	30	50	1
10	NPI-651	Machine Tool Design Lab	0	0	3	10	10	20	30	50	1
11	NGP-601	General Proficiency						50		50	
		TOTAL	16	5	10					1000	25

Note- 4 to 6 Weeks Industrial Training-II after VI semester also to be evaluated in VII semester

Departmental Electives:

Department Elective - I

1. NME-011 Engineering Optimization
2. NME-012 Finite Element Methods
3. NME-013 Mechanical Vibrations
4. NME-014 Mechatronics

Department Elective - II

1. NME-021 Fluid Machinery
2. NME-022 Product Design & Development
3. NME-023 Reliability Engineering
4. NME-024 Unconventional Manufacturing Processes

UNIT I**Introduction**

Definition, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Selection of materials for static and fatigue loads.

3

Design for Static Load

Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure.

4

UNIT II

Design for Fluctuating Loads Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria.

4

Riveted Joints

Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint.

4

UNIT III**Shafts**

Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity.

4

Keys and Couplings

Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings, Design of rigid and flexible couplings.

4

UNIT IV**Mechanical Springs**

Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading.

4

Power Screws

Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack

3

Note: Design data book is allowed in the examination

Books and References:

1. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill Co.
2. Machine Design-Sharma and Agrawal, S.K. Kataria & Sons.
3. Machine Design, U C Jindal, Pearson Education.
4. Design of Machine Elements, Sharma and Purohit, PHI.
5. Design of Machine Elements-M.F. Spott, Pearson Education

6. Machine Design-Maleev and Hartman, CBS Publishers.
7. Mechanical Engineering Design, 9e – Joseph E. Shigely, McGraw Hill Education.
8. Elements of Machine Component Design, Juvinal&Marshek, John Wiley & Sons.

NME-502 : KINEMATICS OF MACHINES

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Unit I

Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs and their classification, types of constraint, degrees of freedom of planar mechanism, Grubler's equation, mechanisms, inversion of four bar chain, slider crank chain and double slider crank chain.

4

Velocity analysis:

Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, rubbing velocity at a pin joint, instantaneous center method, types and locations of instantaneous center, Kennedy's theorem, velocities in four bar mechanism and slider crank mechanism.

4

Unit II

Acceleration analysis:

Introduction, acceleration of a point on a link, acceleration diagram, Corioli's component of acceleration, crank and slotted lever mechanism, Klein's construction for slider crank mechanism and four bar mechanism, analytical method for slider crank mechanism.

4

Kinematic synthesis of mechanism:

Introduction, dimensional synthesis of mechanisms, motion, path and function generation, Chebyshev spacing, three position synthesis, graphical approach for four link mechanisms, straight line mechanisms, special mechanisms – indicator diagram mechanisms, steering mechanisms, Hook's Joint

4

Unit III

Cams

Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration, simple harmonic and cycloidal motions of follower. Analytical methods for cam profile.

8

Unit IV

Gears and gear trains

Introduction, classification of gears, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact, contact ratio, interference and undercutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train.

8

Unit V

Friction drives

Introduction, belt and rope drives, open and crossed belt drives, velocity ratio, slip, power transmission, effect of mass of belt on power transmission, maximum power transmission, initial tension and maximum tension, pivots and collars, uniform pressure and uniform wear, clutches.

8

Books:

1. Theory of Mechanisms and Machines: A Ghose and A K Malik, East West Press Pvt Ltd.
2. Theory of Mechanisms and Machines: J J Uicker, G R Pennock and J E Shigley, Oxford University Press.
3. Kinematics and dynamics of machinery: C E Wilson and J E Sadler: PEARSON
4. Kinematics and dynamics of machinery: R L Norton, McGraw Hill
5. Theory of Machines: S S Rattan, McGraw Hill
6. Theory of Machines: Thomas Bevan, Pearson

NME-503: MANUFACTURING SCIENCE& TECHNOLOGY-II

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Unit I

Metal Cutting-

Mechanics of metal cutting. Geometry of tool and nomenclature .ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Heat generation and cutting tool temperature, Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Dynamometer, Brief introduction to machine tool vibration and surface finish. Economics of metal cutting.

9

Unit-II

Machine Tools

(i) Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout

2

(ii) Shaper, slotter, planer: Construction, operations & drives.

1

(iii) Milling: Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required.

2

(iv) Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills.

2

Unit-III

Grinding & Super finishing

(i) Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding. Centerless grinding

4

(ii) Super finishing: Honing, lapping and polishing.

1

Limits, Fits & Tolerance and Surface roughness:

Introduction to Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness.

3

Unit-IV

B. Metal Joining (Welding)

Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. Adhesive bonding. Thermodynamic and Metallurgical aspects in welding and weld, Weldability, Shrinkage/residual stress in welds. Distortions & Defects in welds and

remedies. Weld decay in HAZ.

10

Unit-V

C. Introduction to Unconventional Machining and Welding

Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding applications such as LBW, USW, EBW, Plasma-arc welding, Diffusion welding, Explosive welding/cladding. Introduction to Hybrid machining processes

6

Books and References:

1. Manufacturing Science – A. Ghosh and A.K. Mallik, Affiliated East-West Press
2. Fundamentals of Metal Machining and Machine Tools – Geoffrey Boothroyd, CRC Press
3. Production Technology - R.K. Jain Khanna Publishers.
4. Introduction to Manufacturing Processes – John A. Schey ,McGraw-Hill
5. Production Engineering Science - P.C. Pandey, Standard Publishers Distributors,
6. Modern Machining Processes - P.C. Pandey & H.S. Shan, McGraw-Hill
7. Degarmo's Materials and Processes in Manufacturing - Ernest P. De Garmo, J. T. Black, Ronald A. Kohser, Wiley
8. Fundamentals of Metal Cutting & Machine Tools – B.L. Juneja & G.S. Shekhon Wiley
9. Process & Materials of Manufacturing – R.A. Lindburg, Pearson Education
10. Advanced Machining Process - VK Jain ,Allied Publishers
11. Manufacturing Engineering & Technology, -Kalpakjian, Pearson
12. Manufacturing Technology Part I and Part II, -Rao, PN, McGraw-Hill

NME-504 : HEAT & MASS TRANSFER

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UNIT-1

Introduction to Heat Transfer:

Thermodynamics and Heat Transfer. Modes of Heat Transfer: Conduction, convection and radiation. Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism.

2

Conduction :

General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems. Initial and boundary conditions.

3

Steady State one-dimensional Heat conduction :

Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Concept of thermal resistance. Analogy between heat and electricity flow; Thermal contact resistance and overall heat transfer coefficient; Critical radius of insulation.

3

UNIT-2

Fins:

Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells.

3

Transient Conduction:

Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts.

UNIT-3	5
Forced Convection:	
Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Thermal entrance region, Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer.	
	5
Natural Convection :	
Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere, Combined free and forced convection.	
	3
UNIT-4	
Thermal Radiation :	
Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; ; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect.	
	8
UNIT-5	
Heat Exchanger :	
Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers.	
	3
Condensation and Boiling:	
Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convection boiling.	
	3
Introduction to Mass Transfer:	
Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion through a stagnant gas film.	
	2
Books:	
1. Fundamentals of Heat and Mass Transfer, by Incropera & DeWitt, John Wiley and Sons	
2. Heat and Mass Transfer by Cengel, McGraw-Hill	
3. Heat Transfer by J.P. Holman, McGraw-Hill	
4. Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education	
5. Heat Transfer by Ghoshdastidar, Oxford University Press	
6. A text book on Heat Transfer, by Sukhatme, University Press.	
7. Heat Transfer by Venkateshan, Ane Books Pvt Ltd	
8. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill	
9. Heat and Mass Transfer by R Yadav, Central Publishing House	

Unit-1

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram.

Thermodynamic analysis of Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle, Ericsson cycles, Comparison of Otto, Diesel and Dual cycles

Fuel air cycle, factors affecting the fuel air cycle, Actual cycle.

8**Unit-II**

SI Engines: Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and its control, combustion chamber design for SI engines.

Carburetion, Mixture requirements, Carburetors and fuel injection system in SI Engine

Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition, Scavenging in 2 Stroke engines, Supercharging and its effect

9**Unit-III**

CI Engine: Combustion in CI engines, Ignition delay, Knock and its control, Combustion chamber design of CI engines.

Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings

Exhaust emissions from SI engine and CI engine and its control

9**Unit-IV**

Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans, Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation.

Fuels: Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines.

Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines

9**Unit V**

Compressors: Classification, Reciprocating compressors, Single and Multi stage compressors, Intercooling, Volumetric efficiency.

Rotary compressors, Classification, Centrifugal compressor, Axial compressors, Surging and stalling, Roots blower, Vaned compressor.

7**BOOKS:**

1. Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing CO.

2. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India

3. A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.

4. I.C Engine Analysis & Practice by E.F Obert.

5. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.

6. I.C Engine, by R. Yadav, Central Publishing House, Allahabad

7. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications, Czechoslovakia

8. Turbines, Compressors and Fans, by S.M. Yahya, Tata McGraw Hill Pub.

9. Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek, Pearson Education

NPI-501: PRODUCTION PLANNING & CONTROL

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Unit-I

Introduction:

Types and characteristics of Manufacturing systems and Production systems, Objective and functions of Production, Planning & Control, organization

4

Preplanning:

Forecasting & Market Analysis. Factory Location & Layout, Equipment policy and replacement. Preplanning production, capacity planning

4

Unit-II

Production Planning:

Product development and design. BEP, profit volume chart, Material Resource Planning, Selection of material, methods, machines & manpower. Routing, Loading, Scheduling, Job shop scheduling, sequencing of production operation, line balancing

9

Unit-III

Production Control:

Dispatching rules, dispatching of work card, move card, inspection card and reports, Control boards and charts. Expediting, progress reporting, corrective action, change in schedules.

6

Unit-IV

Evaluation and Analysis:

Elements of network and its development, Introduction to CPM and PERT techniques.

7

UNIT-V

Material Planning and Control:

Field and scope, material planning, inventories, types and classification, ABC analysis, economic lot (batch) size, lead time and reorder point, modern trends in purchasing, store keeping, store operations, Introduction to manufacturing resource planning (MRP) and enterprise resource planning (ERP)

10

Books and References:

1. Elements of Production Planning & Control by Samuel Eilon, Universal Publishing Corporation.
2. Production Planning & Control & Industrial Management by K.C. Jain and L.N. Agarwal, Khanna Publishers.
3. Modern Production/Operations Management by E.S. Buffa , Wiley.
4. Production System: Planning, Analysis, and Control by J.L. Riggs, Wiley.
5. Production Planning and Inventory Management by J.F. Magee & David Morris BOODMAN, McGraw Hill.
6. Industrial Engg & Management by O.P. Khanna, Dhanpat Rai & Sons.

NME-551 : MACHINE DESIGN-I Lab

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Minimum eight experiments out of the following are to be performed.

Students are advised to use design data book for the design. Drawing shall be made wherever necessary on small drawing sheets

1. Design & drawing of Cotter joint.
2. Design & drawing of Knuckle joint
3. Design of machine components subjected to combined steady and variable loads
4. Design of eccentrically loaded riveted joint
5. Design of boiler riveted joint
6. Design of shaft for combined constant twisting and bending loads
7. Design of shaft subjected to fluctuating loads
8. Design and drawing of flanged type rigid coupling
9. Design and drawing of flexible coupling
10. Design and drawing of helical spring
11. Design and drawing of screw jack

NME-553 : MANUFACTURING TECHNOLOGY -II – LAB

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0 0 3

Minimum eight experiments out of the following along-with study of the machines / processes

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses
11. Gas welding experiment
12. Arc welding experiment
13. Resistance welding experiment.
14. Soldering & Brazing experiment

15. Experiment on unconventional machining.
16. Experiment on unconventional welding.
17. Experiment on TIG/MIG Welding.
18. Macro and Microstructure of welding joints.

NME-554 : HEAT & MASS TRANSFER – LAB

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Minimum eight experiment of the following

1. Conduction – Experiment on Composite plane wall
2. Conduction – Experiment on Composite cylinder wall
3. Conduction - Experiment on critical insulation thickness
4. Conduction – Experiment on Thermal Contact Resistance
5. Convection - Pool Boiling experiment
6. Convection - Experiment on heat transfer from tube-(natural convection).
7. Convection - Heat Pipe experiment.
8. Convection - Heat transfer through fin-(natural convection) .
9. Convection - Heat transfer through tube/fin-(forced convection).
10. Convection - Determination of thermal conductivity of fluid
11. Experiment on Stefan's Law, on radiation determination of emissivity, etc.
12. Experiment on solar collector, etc.
13. Heat exchanger - Parallel flow experiment
14. Heat exchanger - Counter flow experiment

NME-602: MACHINE DESIGN-II

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UNIT I

Principle of transmission and conjugate action

Spur Gears

Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards.

Helical Gears

Terminology, Proportions for helical gears, Forces components on a tooth of helical gear, Virtual number of teeth, Beam strength& wear strength of helical gears, Dynamic load on helical gears, Design of helical gears.

6

UNIT II	6
Bevel gears	
Terminology of bevel gears, Force analysis, Virtual number of teeth, Beam strength and wear strength of bevel gears, Effective load of gear tooth, Design of a bevel gear system.	
	4
Worm Gears	
Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing system.	
	4
UNIT III	
Sliding Contact Bearing	
Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing,	
	6
UNIT IV	
Rolling Contact Bearing	
Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing	
	6
UNIT V	
IC ENGINE parts,	
Selection of type of IC engine, General design considerations, Design of cylinder and cylinder head; Design of piston and its parts like piston ring and gudgeon pin etc.; Design of connecting rod; Design of crankshaft	
	10

Note: Design data book is allowed in the examination

Books and References:

1. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.
2. Machine Design-Sharma and Agrawal, S.K. Kataria& Sons.
3. Machine Design, U C Jindal, Pearson Eductaion.
4. Design of Machine Elements, Sharma and Purohit, PHI.
5. Design of Machine Eesign-M.F. Spott, Pearson Eductaion
6. Machine Design-Maleev and Hartman, CBS Publishers.
7. Mechanical Engineering Design, 9e – Joseph E. Shigely, McGraw Hill Education.
9. Elements of Machine Component Design, Juvinal&Marshek, John Wiley & Sons.

NME-603 : DYNAMICS OF MACHINES

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Unit I

Force analysis:

Static force analysis of mechanisms, D'Alembert's Principle, dynamics of rigid link in plane motion, dynamic force analysis of planar mechanisms, piston force and crank effort. Turning

moment on crankshaft due to force on piston, Turning moment diagrams for single cylinder double acting steam engine, four stroke IC engine and multi-cylinder engines, Fluctuation of speed, Flywheel.

7

Unit II

Gyroscope:

Space motion of rigid bodies, angular momentum, gyroscopic couples, gyroscopic stabilization, ship stabilization, stability of four wheel and two wheel vehicles moving on curved paths.

4

Mech. Vibrations:

Types of Vibration, Degrees of freedom. Longitudinal Vibration: Single degree free and damped vibration. Forced vibration of single degree under harmonic excitation. Vibration isolation. Whirling of shaft and critical speed.

5

Unit III

Balancing:

Introduction, static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of reciprocating masses, balancing of single cylinder engine, balancing of multi cylinder inline engines.

8

Unit IV

Governors:

Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors. Effort and Power of governor, Controlling force diagrams for Porter governor and spring controlled governors.

8

Unit V

Brakes and dynamometers:

Introduction, Law of friction and types of lubrication, types of brakes, effect of braking on rear and front wheels of a four wheeler, dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer

8

Text/Reference Books:

1. Kinematics and dynamics of machinery: Wilson and Sadler, Third edition, Pearson.
2. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press.
3. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Oxford University Press
4. Kinematics and dynamics of machinery: R L Norton, McGraw Hill
5. Theory of Machines: S.S. Rattan, McGraw Hill
6. Theory of Machines: Thomas Bevan, CBS Publishers.

Unit-1**Refrigeration:**

Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P.

Air Refrigeration cycle:

Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

8**Unit-2****Vapour Compression System:**

Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage system, Cascade system.

8**Unit-3****Vapour Absorption system;**

Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison. Three fluid system.

5**Refrigerants:**

Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. Ozone layer depletion and global warming considerations of refrigerants

3**Unit-4****Air Conditioning:**

Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). Air Washers, Cooling towers & humidifying efficiency.

9**Unit-5****Refrigeration Equipment & Application:**

Elementary knowledge of refrigeration & air conditioning equipmentse.g compressors, condensers, evaporators & expansion devices, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning.

7

Books:

1. Refrigeration and Air conditioning by C.P Arora, McGraw-Hill
2. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd.Pub.
3. Refrigeration and Air conditioning by R. C. Arora, PHI
4. Principles of Refrigeration by Roy J. Dossat. Pearson Education
5. Refrigeration and Air conditioning by stoecker& Jones. McGraw-Hill
7. Refrigeration and Air conditioning by Arora&Domkundwar. DhanpatRai
7. Thermal Environment Engg. byKuhlen, Ramsey &Theked.

NPI- 601 : PRINCIPLES OF MACHINE TOOL DESIGN**L T P
3 1 0****Unit-I**

Introduction: Developments in machine tools, types of machine tools surface, profiles and paths produced by machine tools. Features of construction and operations of basic machine tools e.g. lathe, drill, milling shapes and planers, grinding machine etc. General requirement of machine tool design. Machine tool design process. Tool wear, force Analysis.

9**Unit-II**

Machine Tools Drives: Classification of machine tool drives, group Vs individual drives, election of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives, slider-crank mechanism, cam mechanism, nut & Screw transmission, Devices for intermittent motion, reversing & differential mechanisms. Couplings and clutches Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc. Fundamentals of Kinematics structure of machine tools.

8**Unit-III**

Regulation of Speed and Feed rates: Laws of stepped regulation, selection of range ratio, standard progression ratio, selection of best possible structural diagram, speed chart, Design of feed box, Developing gearing diagrams. Stepless regulation of speed and feed in machine tool, speed and feed control.

7**Unit-IV**

Design of Machine Tool Structure: Requirements and design criteria for machine tool structures, selection of material Basic design procedure for machine tool structures, design of bed, column and housing, Model technique in design.

3

Design of guideways and power screws: Basic guideway profiles, Designing guideway for stiffness a wear resistance & hydrostatic and antifriction guideways. Design of sliding friction power Screws. Design of spindler & spindle supports.

3

Layout of bearings, selection of bearings machine tools

2**Unit-V**

Dynamics of machine tools: General procedure for assessing the dynamic stability of cutting process, closed loop system, chatter in machine tools.

5

Control Systems: Functions, requirements & types of machine tool controls, controls for speed & feed change. Automatic and manual Controls. Basics of numerical controls. Machine tool testing.

Books :

1. Machine Tools Design & Numerical Controls by N.K. Mehta, McGraw-Hill
2. Design of Machine Tools by S.K. Basu Allied Publishers.
3. Principles of Machine Tools by Bhattacharya and Sen. New Central Book Agency.
4. Machine Tool Design Handbook by CMTI, McGraw-Hill.

NME-011 : ENGINEERING OPTIMIZATION

L T P
3 1 0

UNIT I

Introduction:

Historical Developments, and Review of Engineering applications of Optimization Techniques

Linear Programming:

Simplex method, Revised simplex method, Two phase method, Duality, Dual simplex method, Integer linear programming, 0-1 integer linear programming, solution by branch and bound method.

9

UNIT II

Classical Optimization Techniques: Introduction, Review of single and multivariable optimization methods with and without constraints, Non-linear one-dimensional minimization problems, Examples.

8

UNIT-III

Constrained Optimization Techniques: Introduction, Direct methods - Cutting plane method and Method of Feasible directions, Indirect methods - Convex programming problems, Exterior penalty function method, Examples and problems

8

UNIT-IV

Unconstrained Optimization Techniques: Introduction, Direct search method - Random, Univariate and Pattern search methods, Rosenbrock's method of rotating co-ordinates, Descent methods - Steepest Decent methods-Quasi-Newton's and Variable metric method, Examples.

8

UNIT-V

Geometric Programming: Introduction, Unconstrained minimization problems, solution of unconstrained problem from arithmetic-geometric inequality point of view, Constrained minimization problems, Generalized polynomial optimization, Applications of geometric problems, Introduction to stochastic optimization.

Books and References:

1. Engineering Optimization by Ravindran, Wiley India
2. Engineering Optimization: Theory and Application by S SRao, Wiley India
3. Linear and Non Linear Programming by Luenberger, Narosa

Unit 1

Introduction, exact solution vs approximate solution, principle of FEM, general procedure for finite element analysis, pre-processing, solution, post processing, various approximate methods, weighted residual method, variational or Rayleigh Ritz method, principle of minimum potential energy.

Review of matrices, definition, types, addition or subtraction, multiplication, inverse of a matrix, calculus of matrix.

8**Unit II**

Direct stiffness methods, linear spring as finite element, direct formulation of uni-axial bar, truss and beam elements, local and global coordinates, nodes and elements, stiffness matrix, formulation of global stiffness matrix, application of boundary conditions and forces, essential and natural boundary conditions, elimination method, penalty methods, calculation of element stresses and strains.

8**Unit III**

Finite element formulation of 1-d problems, method of weighted residuals, strong and weak form, the Galerkin finite element method, application of Galerkin's method to uni-axial bar and truss elements, Galerkin method for one dimensional heat conduction problems like heat transfer through wall, heat transfer through fin etc., one dimensional conduction with convection.

8**Unit IV**

Interpolation or shape functions, compatibility, completeness and convergence requirements, shape functions for one and two dimensional elements, finding shape function using Lagrange polynomials.

Application of FEM in scalar field problems, heat transfer in two dimensions, time dependent heat transfer.

8**Unit V**

Concepts of plane stress and plain strain, displacement relation, stress-strain relations, equilibrium and compatibility equations, vector field problems, derivation of constant strain triangular element stiffness matrix and equations, treatment of body and surface forces, stress and strain computation.

Practical considerations in finite element application, programming aspects, commercially available FEM packages, desirable features of a FEM packages, problem solving on a general purpose FEM software package like ANSYS, ABAQUS, NISA etc.

8**Books and References:**

1. Fundamentals of Finite Element Analysis by David V Hutton, McGraw-Hill Learning
2. A First Course in Finite Element Method 5e by Daryl L Logan, Cengage Learning
3. Finite Element Analysis by G L Narasaiah, BS Publications.
4. An Introduction to Finite Element Method, 3e by J N Reddy, McGraw-Hill
5. Finite Element Method with Application in Engineering by Desai, Eldho and Shah, Pearson Education.
6. Introduction to Finite Element Analysis and Design by Kim & Shankar, John Wiley & Sons.
7. Introduction to Finite Elements in Engineering by Chandrupatla&Belagundu, Pearson Education.

NME-013 : MECHANICAL VIBRATIONS

L T P

3 1 0

UNIT - I

Introduction, Classification of Vibration Systems, Harmonic motion, Vector representation of harmonic motion, Natural frequency & response, Effects of vibration, superposition of simple harmonic motions, beats, Fourier analysis-analytical and numerical methods.

3

Single Degree Freedom System, Equation of motion, Newton's method, D'Alembert's principle, Energy method etc., Free vibration, Natural frequency, Equivalent systems, Displacement, Velocity and acceleration, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement, Energy dissipation in viscous damping.

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, Principle of vibration absorber, Undamped dynamic vibration absorbers, Torsional vibration absorber, Centrifugal pendulum absorbers, Vibration isolators and Dampers.

8

UNIT- IV

Multi-degree Freedom system: Exact Analysis, Undamped free and forced vibrations of multi-degree freedom systems, influence coefficients, 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 by Rayleigh's method, Dunkerely's, Holzer's and Stodola methods, Rayleigh-Ritz method

5

Critical speed of shafts, Whirling of uniform shaft, Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed.

3

Books and References:

1. Mechanical Vibrations – G. K. Groover, Jain Brothers, Roorkee.
2. Mechanical Vibrations-Theory & Practice, S Bhave, Pearson Education.
3. Mechanical Vibrations-Theory & Applications, Singhal, Katson Books.
4. Theory of Vibrations with Applications, Thomson&Dahleh, Pearson Education.
5. Elements of Vibration Analysis, L Meirovitch, McGraw-Hill Education.
6. Mechanical Vibrations – Tse, Morse & Hinkle
7. Mechanical Vibrations – V. Rama Murthy, Narosa Publications
8. Mechanical Vibrations – D. Nag, Wiley

Unit 1

Introduction, synergy of systems, definition of mechatronics, applications of mechatronics in design and modeling, actuators and sensors, intelligent controls, robotics, manufacturing etc., objectives, advantages and disadvantages of mechatronics, examples of mechatronics systems in industry.

Mechanical components in mechatronics, force, friction and lubrication, materials, mechanical behavior of materials, mechanisms used in mechatronics, lever and four bar mechanisms, bearing, belt, chain, cam, slider crank, clutches etc.

8

Unit II

Electronics elements in mechatronics, conductors, insulators and semi conductors, passive electrical components, resistors, capacitor and inductor, transformer, active elements, semi conductor devices, transistors and integrated circuits, digital electronics components like logic gates, flip-flops, shift register, multiplexer and counter.

Computing elements in mechatronics, analog computer, timer, analog to digital converter, digital to analog converter, digital computer, microprocessor and its architecture, micro-controllers, programming logic controllers, their basic structures, mnemonics.

8

Unit III

System modeling and analysis, control system concepts, transfer function of physical systems, block diagrams representation of systems, transfer function of a system, standard input signals, time response of a first and second order systems to a step input, frequency response analysis, automatic control systems, digital control systems.

Motion control devices, actuator types & application areas, hydraulic and pneumatic actuators, electrical actuators, DC servomotor, AC servomotor and stepper servomotor, micro-actuators, drive selection and applications.

8

Unit IV

Sensors and transducers, their static and dynamic performance characteristics, internal sensors, external sensors and micro-sensors, sensors for displacement, position and proximity; velocity, motion, force, fluid pressure, liquid flow, liquid level, temperature, light sensors, selection of Sensors.

Stages in designing mechatronics systems, traditional and mechatronic design, possible design solutions, case studies of mechatronics systems, pick and place robot, automatic car park systems, engine management systems etc.

8

Unit V

Mechatronics in industry, autotronics, bionics and avionics and their various applications, mechatronics in manufacturing, features of mechatronics in manufacturing, flexible manufacturing systems, manufacturing automatic protocol, computer integrated manufacturing, just in time production systems, CNC machines, adaptive control machine system, CNC machine operations, challenges in mechatronics production units.

8

BOOKS & REFERENCES:

1. A Kuttan, "Introduction to Mechatronics, Oxford University Press, 2010.
2. Alciatore&Hiland, "Introduction to Mechatronics & Measurement Systems, 4e", McGraw-Hill Education, 2014.
3. M Jouaneh, "Fundamentals of Mechatronics", Cengage Learning, 2013.
4. W. Bolton, "Mechatronics", Pearson Education, Second Edition, 1999.

5. Bradley D. A., Dawson D., Buru N.C. and Loader A.J, "Mechatronics", Chapman and Hall, 1993.
6. Dan Neculescu, "Mechatronics", Pearson Education Asia, 2002 (Indian Reprint).
7. NitaigourPremchandMahadik, "Mechatronics", McGraw-Hill Education, 2015.
8. Lawrence J. Kamm, "Understanding Electro – Mechanical Engineering, An Introduction to Mechatronics", Prentice – Hall of India Pvt., Ltd., 2000.
9. Ramachandran K. P., Vijayaraghavan G. K., Balasundaram M.S. "Mechatronics: Integrated Mechanical Electronic Systems", Wiley

NME-021 : FLUID MACHINERY

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2 1 0

UNIT-I

Introduction: Impulse of Jet and Impulse Turbines:

Classification of Fluid Machines & Devices, Application of momentum and moment of momentum equation to flow through hydraulic machinery, Euler's fundamental equation. Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curve), Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel

8

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 impeller, Efficiencies of centrifugal pumps, Specific speed, Cavitation & separation, Performance characteristics.

8

UNIT-IV

Positive Displacement and other Pumps:

Reciprocating pump theory, Slip, Indicator diagram, Effect of acceleration, air vessels, Comparison of centrifugal and reciprocating pumps, Performance characteristics. Hydraulic ram, Jet pumps, Air lift pumps.

8

BOOKS:

1. Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.
2. Hydraulic Machines by K Subramanya, Tata McGraw Hill
3. Fluid Mechanics and Machinery by C.S.P.Ojha, R. Berndtsson, P.N. Chandramouli, Oxford University Press
4. Fluid Mechanics and Fluid Power Engineering by D S Kumar, S K Kataria & Sons
5. Fluid Mechanics and Turbo machines by Das, PHI
6. Fluid Power with Applications, by Esposito, Pearson
7. Fluid Mechanics and hydraulic machines by Modi & Seth, Standard Book House
8. Fundamentals of Turbomachinery by Venkanna B.K., PHI
9. Hydraulic Machines: Theory & Design, V.P. Vasandhani, Khanna Pub.

10. Fluid Mechanics and Hydraulic Machines by SukumarPati, Tata McGraw Hill

NME -022: PRODUCT DESIGN & DEVELOPMENT

L T P
2 1 0

UNIT I:

Introduction to Product Design, Applications, Relevance, Product Definition, Scope, Design definitions, The role and nature of design, Old and new design methods, Design by evolution vs design by innovation. Examples such evolution of bicycle, safety razor etc. Need based development, Technology based developments. Physical realisability & Economic feasibility of design concepts.

8

UNIT II:

Morphology of Design, Divergent, Transformation and Convergent phases of product design, Identification of need, Analysis of need, Design criteria, Functional aspects, Aesthetics, ergonomics, form (structure). Shape, size, color, Creativity, Mental blocks in creativity, Removal of blocks, Ideation Techniques.

8

UNIT III:

Transformations stage of design, Brainstorming & Synectics, Morphological techniques, Utility concept, Utility value, Utility index, Economic aspects of design, Fixed and variable costs, Break-even analysis, Product Appraisal Information and literature search, patents, standards and codes, Environment and other safety considerations in product design.

8

UNIT IV:

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

8

Books and references:

1. Product Design & Manufacturing - A.K.Chitale & R.C.Gupta, Prentice Hall.
2. Engg . Product Design -C .D. Cain, Bussiness Books.
3. Product Design by Otto and Wood- Pearson
4. Industrial design for Engineers –W .H. Mayall, Itiffe.
5. Product Design & Decision Theory - M.K. Starr - Prentice Hall
6. The Technology of Creation Thinking - R.P. Crewford – Prentice Hall.
7. Design Methods – seeds of human futures – J. Christopher Jones, John Wiley & Sons.
8. Human Factor Engg. – McCormick E.J., McGraw-Hill.
9. Industrial Design In Engineering – A marriage of Techniques – Charles H .Flurscheim, The Design Council - London.

NME-023: RELIABILITY ENGINEERING**L T P
2 1 0****UNIT-I**

Introduction: Definition of reliability, Failures & failures modes, Failure rates, MTTF, MTBF, Bath tub curve, Definition and factors influencing system effectiveness, various parameters of system effectiveness.

6**UNIT-II**

Reliability Mathematics, Definition of probability, laws of probability, conditional probability, Bay's theorem, Various probability distributions, Data collection, Recovery of data, Data analysis Procedures, Empirical reliability calculations.

8**UNIT-III**

Reliability types, System of series, parallel, series parallel, Stand by and complex systems; Development of logic diagram, Methods of reliability evaluation; Cut set and tie set methods, Matrix methods, Event trees and fault trees methods, Reliability evaluation using probability distributions, The Weibull distribution and its application in reliability, Markov method, Frequency and duration method.

10**UNIT-IV**

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

4

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

4**Books & references:**

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 Wiley and Sons.
3. S.K. Sinha& B.K. Kale,"Life Testing and Reliability Estimation", Wiley Eastern Ltd.
4. A Birolini. Reliability Engineering-Theory & Practice, Springer.
5. G.H.Sandler,"System Reliability Engineering", Prentice Hall.
6. D J Smith, Reliability, Maintainability & Risk, Butterworth-Heinemann.

NME-024 : UNCONVENTIONAL MANUFACTURING PROCESSES**L T P
2 1 0****UNIT-I**

Introduction, Limitations of conventional manufacturing processes, Need for unconventional manufacturing processes, its classification and future possibilities, Hybrid processes

4

Unconventional Machining Process based on material removal by abrasion, Principle and working and applications Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet machining and Ultrasonic Machining.

4**UNIT-II**

Thermoelectric unconventional methods, Principle, working and applications of Plasma Arc Machining, Laser Beam Machining, Electron Beam Machining etc

Working principle and applications of Electric Discharge Machining, EDM machines, EDM process characteristics, Wire electric discharge machining 4

UNIT-III 4

Electro-chemical machining processes, ECM, its working principle, advantages and applications, Electro-chemical grinding, Electro-chemical deburring, Chemical machining.
Unconventional welding processes: Explosive welding, Cladding etc., Under water welding, Metalizing, Plasma are welding/cutting etc. 8

UNIT-IV 5

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. 5

Electronic-device Manufacturing, Diffusion and Photo- Lithography process for electronic-device manufacturing. 3

Books and references:

1. Modern Machining Processes – P.C. Pandey
2. Advanced Machining Processes, V.K. Jain, Allied Publishers.
3. Handbook of Manufacturing Processes, James G Bralla, Industrial Press.

NME-651 : FLUID MACHINERY Lab

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0 0 3

Minimum ten experiments out of the following along with study of the machines and processes

1. Impact of Jet experiment.
2. Experiment on Pelton wheel.
3. Experiment on Francis turbine.
4. Experiment on Kaplan turbine.
5. Experiment on Reciprocating pump.
6. Experiment on centrifugal pump.
7. Experiment on Hydraulic Jack/Press
8. Experiment on Hydraulic Brake
9. Experiment on Hydraulic Ram
10. Study through visit of any water pumping station/plant
11. Any other suitable experiment/test rig such as comparison & performance of different types of pumps and turbines.
12. Experiment on Compressor
13. Experiment for measurement of drag and lift on aerofoil in wind tunnel

NME-652 : MACHINE DESIGN-II Lab**L T P
0 0 2**

A. Computer and Language :students are required to learn the basics of computer language such as C and C++ so that they should be able to write the computer programme (3practical turns)

B. Writing Computer programme for conventional design: Students are required to write computer program and validate it for the design of machine components done in theory subject (5practical turns)

C. Mini Project: Each student will be given a real life problem for the complete design of a subsystem/system using either manual calculation with the help of design handbook or through computer programme, if needed. This will be done as home assignment to be submitted at the end of the semester.

NME-653 : THEORY OF MACHINES LAB**L T P
0 0 2****Minimum eight experiments out of the following:**

1. Study of simple linkage models/mechanisms
2. Study of inversions of four bar linkage
3. Study of inversions of single/double slider crank mechanisms
4. Experiment on Gears tooth profile, interference etc.
5. Experiment on Gear trains
6. Experiment on longitudinal vibration
7. Experiment on transverse vibration
8. Experiments on dead weight type governor
9. Experiment on spring controlled governor
10. Experiment on critical speed of shaft
11. Experiment on gyroscope
12. Experiment on static/dynamic balancing
13. Experiment on Brake
14. Experiment on clutch

NME-654 : REFRIGERATION & AIR CONDITIONING Lab**L T P
0 0 3****Minimum eight experiments out of the following:**

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. Study of different types of expansion devices used in refrigeration system.
3. Study of different types of evaporators used in refrigeration systems.
4. To study basic components of air-conditioning system.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.

6. Experiment on air washers
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
9. Visit of a central air conditioning plant and its detailed study.
10. Visit of cold-storage and its detailed study.
11. Experiment on Ice-plant.
12. Experiment on two stage Reciprocating compressor for determination of volumetric efficiency , PV diagram and effect of intercooling.
13. Study of Hermetically sealed compressor.
14. Experiment on Desert coolers.

NPI-651 : MACHINE TOOL DESIGN LAB

**L T P
0 0 2**

Minimum eight experiments out of the following:

1. Measurement and analysis of cutting forces in orthogonal turning.
2. Flank wear – time characteristics for single point cutting tools.
3. (i) Checking the level of installation of a lathe in horizontal & vertical planes
(ii) Checking the bed ways for straightness and parallelism.
4. Testing the main spindle of a lathe for axial movement and true running.
5. Process capability determination of a center lathe.
6. Flatness checking of a surface plate.
7. A study of devices for intermittent motion used in machine tools e.g. ratchet gear & Geneva Mechanism.
8. A study of Kinematics structure of lathe/milling machine.
9. A study of the drives for reciprocation used in machine tools.
10. Development the speed chart and gearing diagram for a gassed head lathe.
11. A study of the cone pulley drive in center lathe and development of its raydiagram for the speed structure.
12. Efficiency testing of lathe at various parameters-values.
13. Accuracy analysis of finished cylindrical work-pieces produced on a lathe.
14. Cutting (turning) with inclined placed tool (in tool fixture).
15. Turning with two simultaneously cutting tool (one from front on usual tool postand the other tool from back on tool-fixture on carriage)