Syllabus for B.Tech Manufacturing Technology

UPTU

TAS 301

MATHEMATICS-III

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3	1	0

Unit - I: Integral Transforms **8**

Fourier integral, Fourier complex transform, Fourier sine and cosine transforms and applications to simple heat transfer equations.

Z – transform and its application to solve difference equations.

Unit - II: Functions of a Complex Variable - I **9**

Analytic functions, C-R equations and harmonic functions, Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic functions, Liouvilles theorem, Fundamental theorem of algebra.

Unit - III: Functions of a Complex Variable - II **8**

Representation of a function by power series, Taylor's and Laurent's series, Singularities, zeroes and poles, Residue theorem, evaluation of real integrals of type $\int_0^{2\pi} f(\cos\theta, \sin\theta)\, d\theta$ and $\int_{-\infty}^{+\infty} f(x)\, dx$, Conformal mapping and bilinear transformations.

Unit - IV: Statistics and Probability **8**

Moments, Moment generating functions, Skewness, Kurtosis, Correlation and Regression, Binomial distribution, Poisson distribution, Normal distribution.

Unit - V: Curve Fitting and Solution of Equations **5**

Method of least squares and curve fitting of straight line and parabola, Solution of cubic and bi-quadratic equations.

REFERENCE:

1. “Higher Engineering Mathematics”, B.S Grewal, Khanna Publishers.
2. “Advanced Engineering Mathematics”,H.K Dass, S.Chand;New Delhi.
3. “Advanced Engineering Mathematics” Erwin Kreyzig;John Wiley, New York.

TME-301

MATERIALS SCIENCE

L T P
3 1 0

Objective: *The course will give insight about the importance of materials in the engineering application with physical and chemical description of the materials. The students would be taught about the crystallography and imperfections. An exposure to Iron-carbon phase diagram, ferrous materials, heat treatment process, various ferrous and non-ferrous alloys and their application. Familiarity on magnetic, electric properties. An overview of application and processes of ceramics, plastics and other material in the field of Engineering will also be provided. The student would also be able to understand the various destructive testing methods for materials, examination of the microstructure of the engineering materials.*

Unit-I

Introduction: Historical perspective, importance of materials. Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bonding. 4

Crystallography and Imperfections: Concept of unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices. X-ray crystallography techniques. Imperfections, Defects & Dislocations in solids. 3

Unit-II

Mechanical properties and Testing: Stress strain diagram, Ductile & brittle material, Stress VS strength. Toughness, Hardness, Fracture, Fatigue and Creep. Testing such as Strength testing, Hardness testing, Impact testing, Fatigue testing Creep testing, Non-destructive testing (NDT) 4

Micro structural Exam: Microscope principle and methods. Preparation of samples and Microstructure exam and grain size determination. Comparative study of microstructure of various metals & alloys such as Mild steel, CI, Brass. 2

Phase Diagram and Equilibrium Diagram: Unitary and Binary diagrams, Phase rules. Types of equilibrium diagrams: Solid solution type, eutectic type and combination type. Iron-carbon equilibrium diagram. 4

Unit-III

Ferrous materials: Iron and steel manufacture, furnaces. Various types of carbon steels, alloy steels and cast irons, its properties and uses. 3

Heat Treatment: Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams. 2

Non-Ferrous metals and alloys: Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications. Various type Brass, Bronze, bearing materials, its properties and uses. Aluminum alloys such as Duralumin. Other advanced materials/alloys. 3

Unit-IV

Magnetic properties: Concept of magnetism - Dia, Para, Ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages. 2

Electric properties: Energy band concept of conductor, insulator and semi-conductor. Intrinsic & extrinsic semi-conductors. p-n junction and transistors. Basic devices and its application. Diffusion of Solid. 3

Super conductivity and its applications. Messier effect. Type I & II superconductors. High Te superconductors. 2

Unit-V

Ceramics: Structure types and properties and applications of ceramics. Mechanical/Electrical behavior and processing of Ceramics. 2

Plastics: Various types of polymers/plastics and its applications. Mechanical behaviors and processing of plastics. Future of plastics. 2

Other materials: Brief description of other material such as optical and thermal materials concrete, Composite Materials and its uses. 2

Performance of materials in service: Brief theoretical consideration of Fracture, Fatigue, and Corrosion and its control. 3

Suggested Reading

1. W.D.Callister, Jr "Material Science & Engineering" Addition-Wesley Publishing Co.
2. V. Raghvan - Material Science, Pretice Hall of India

References:

1. Van Vlash " Elements of Material Science & Engineering", John Wiley & Sons.
2. Lakhtin, Y. (Moskow). "Engineering Physical Metallurgy" Foreign Languages Publishing House
3. Narula - Material Science, TMH
4. Srivastava, Srinivasan " Science of Materials Engineering" New age.
5. K.M. Gupta " Material Science".

TMT-302 **THERMAL ENGINEERING** **L T P**
3 1 0

Objective

1. *Introduce students to thermodynamic terminology and concepts.*
2. *Teach students to understand and apply the principles of conservation of mass and energy and entropy.*
3. *Teach students to understand and apply thermodynamic property relationships for pure substances.*
4. *Familiarize students with some common equipment used in energy systems.*
5. *Reinforce students' knowledge and use of problem solving methods by solving a variety of thermodynamic process and systems applications.*
6. *Apply the fundamentals of thermodynamics to selected machines, cycles, and processes. The selected applications emphasize the thermodynamic fundamentals of mass conservation, energy conservation, and the Second Law so that students will develop the skills to analyze other systems as needed.*
7. *Expose students to the basic modes of heat transfer – conduction, convection and radiation*

UNIT I **8**

Engineering Thermodynamics

Systems, Zeroth Law, First Law - Heat and work transfer in flow and non-flow processes, Second law, Kelvin- Planck statement - Clausius statement - concept of entropy - Clausius inequality - entropy change in non-flow processes.

UNIT II **9**

Gas Laws, Air Cycles and Compressors

Properties of gases and vapors - Otto, Diesel, Dual combustion and Brayton combustion cycles - Air standard efficiency - Cycle comparisons - Mean effective pressure - Engine performance parameters – reciprocating compressors - Multistage - Minimum work - Effect of clearance - Volumetric efficiency.

UNIT III **7**

Steam and One Dimensional Fluid Flow

Steady flow energy equation - Continuity and energy equation - Properties of steam - Rankine cycle – Isentropic flow of ideal gases through nozzles - Simple jet propulsion system - Thrust rocket motor - Specific impulse.

UNIT IV **8**

Refrigeration and Air Conditioning

Principles of refrigeration, Air conditioning - Heat pumps - Vapor compression - Vapor absorption types - Coefficient of performance, Properties of refrigerants.

UNIT V **8**

Heat Transfer

Conduction in parallel, radial and composite wall - Convective heat transfer with laminar and turbulent flows - Overall heat transfer coefficient, Flow through heat exchangers, Radiative heat transfer -. Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoff Law –Black Body Radiation –Grey body radiation

Suggested Reading

1 Van Wylen, G.J. and Sonntag, R.E., ”Fundamentals of Classical Thermodynamics” (S.I.Version) Second Edition, 1986 -, John Wiley & Sons

2 Nag. P.K, “Engineering Thermodynamics”, Seventh Edn, 1993, TMH

References

1 Mayhew, A. and Rogers, B., Longman, “Engineering Thermodynamics” Green & Co. Ltd., London, ELBS, Edition, 1990.

2 Frank Kreith, Mark S. Bohn, “Principles of Heat Transfer” Publisher: Thomson-Engineering, ISBN: 0534375960

3 Ozisik M.N “Heat Transfer”, 1994 McGraw-Hill Book Co.,

4 Bacon, D.H., “Engineering Thermodynamics”, Butterworth & Co., London, 1989.

5 Domkundwar & Arora, “A Reference in Heat and Mass transfer”

6 Saad, M.A., “Thermodynamics for Engineers”, Prentice-Hall of India Pvt. Ltd., 1989.

7 Reynolds, “Thermodynamics”, Int. Student Edn, McGraw Hill Book Co., Ltd., 1990

8 Kothandaraman C.P., “Fundamentals of Heat and Mass Transfer”, New Age International, New Delhi, 1998

TME-303

STRENGTH OF MATERIALS

L T P
3 1 0

Objective

1. *To develop the theoretical basis and to derive the theories of strength of materials Using sound mathematical principles and to enable students to systematically solve engineering problems.*
2. *This course is a foundation to many advanced techniques that allow engineers to design structures, predict failures and understand the physical properties of materials. Mechanics of Materials gives student basic tools for stress, strain and strength analysis. Methods for determining the stresses, strains and deflections produced by applied loads are learned.*
3. *At the end of the course students would be able to analyze and design structural members subjected to tension, compression, torsion and bending using fundamental concepts of stresses, strain, elastic behaviour and inelastic behaviour.*

UNIT-I

Review: Review of simple and compound stresses, Mohr's Circle. 1

3-D Stress, Theory of failure, Castingliona's Theorem, Impact load: Three-dimensional state of stress & strain, equilibrium equations. Generalized Hook's Law. Theories of Failure. Castigliano's Theorem. Impact load & stresses. 4

Airy's Stress Function: Airy's stress function and its applications 3

UNIT –II

Stresses in Beams: **Review of pure Bending**. **Direct and shear stresses in beams due to transverse and axial loads, composite beams. 2**

Deflection of Beams: **Equation of elastic curve, cantilever and simply supported beams, Macaulys method, area moment method, fixed and continuous beams. 4**

Torsion: **Review of Torsion, combined bending & torsion of solid & hollow shafts. 2**

UNIT-III

Helical and Leaf Springs: **deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs. 4**

Columns and Struts: Combined bending and direct stress, middle third and middle quarter rules. Struts with different end conditions. Euler's theory and experimental results, Ranking Gardon Formulae, Examples of columns in mechanical equipments and machines. 4

UNIT-IV

Thin cylinders & spheres: **Hoop and axial stresses and strain. Volumetric strain. 2**

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, Compound cylinders. Stress due to interference fits. 5

UNIT-V

Curved Beams: **Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression. 4**

Unsymmetrical Bending: **Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel-section. 5**

Suggested Reading

1.Ryder, "Strength of Materials", Cleaver-Hume Press; 3d;enl edition (1961)

2.Popov "E.P, Engineering Mechanics" of Solids", Prentice-Hall of India, New Delhi, 1997

References

1.Singer, Strength of Materials,"Harpercollins"College Div; 4th edition (February 1, 1987) ISBN:0060453133

2. Timoshenko S.P; "Elements of Strength of Materials", Tata Mc Graw hill, New Delhi 1997

3. Bear Johnson, "Mechanics of Materials,"by, Prentice hall India

4. R.K Rajput, "Strength of Materials", SK Kataria and Sons, Delhi

5. Ramamrutham, S "Strength of Materials", Dhanpat Rai and Sons, Delhi

6. Kazimi S.M.A, "Solid Mechanics", Tata Mc Graw Hill Publishing Co; New Delhi, 1981

TMT-303	MANUFACTURING TECHNOLOGY I	L	T	P
		3	1	0

Objective

1. *To gain theoretical and practical knowledge in material casting processes and develop an understanding of the dependent and independent variables which control materials casting in a production setting.*
2. *Introduce students to good foundry practices and product design considerations.*
3. *Provide an overview of joining processes; discuss in detail the weld the welding process and the physics of welding. Introduce students to different welding processes weld testing and advanced processes to be able to appreciate the practical applications of welding.*

UNIT I **10**

Patterns and Pattern making (5)

Introduction to Foundry - Steps involved in casting, advantages, limitations and applications of casting process. Pattern types, allowances for pattern, pattern materials, color coding and storing of patterns

Moulding (5)

Moulding methods and processes-materials, equipment, Moulding sand ingredients, essential requirements, sand preparation and control, testing, cores and core making. Design considerations in casting, gating and Riser - directional solidification in castings, Metallurgical aspects of Casting

UNIT II **10**

Casting Processes (7)

Sand castings, pressure die casting, permanent mould casting, centrifugal casting, precision investment casting, shell Moulding, Co2 Moulding, continuous casting-squeeze casting, electro slag casting, Fettling and finishing, defects in Castings, Casting of non-ferrous materials

Melting, Pouring and Testing (3)

Melting furnaces- -crucibles oil fired furnaces-electric furnaces-cupola, selection of furnace, calculation of cupola charges-Degasification, inoculation, pouring techniques casting defects and Inspection of castings.

UNIT III **7**

Basic Joining Processes

Types of welding-gas welding, -arc welding,-shielded metal arc welding, GTAW, GMAW, SAW, ESW-Resistance welding (spot, seam, projection, percussion, flash types)-atomic hydrogen arc welding-thermit welding, Flame cutting - Use of Oxyacetylene, modern cutting processes, arc cutting,

UNIT IV **6**

Special Welding Processes

Soldering, brazing and braze welding and their application., welding of special materials – Stainless steel, Aluminium etc. weldability of cast iron, steel, stainless steel, aluminium alloys. Introduction to Electron beam and Laser welding.

7

UNIT V

Design of Weldments (3)

Welding symbols-Positions of welding-joint and groove design-weld stress-calculations-design of weld size, estimation of weld dilution, heat input, effect of welding parameters preheating, and post heating temperature: Selection of electrodes, flux etc.

Weldments Testing and Metallurgy (4)

Inspection of welds – destructive and non-destructive testing methods, Defects in welding-causes and remedies, -effect of gases in welding-fatigue failure in Weldments.

Suggested Reading

1.Lindberg,"Processes and Materials of Manufacture", Prentice hall India (p) Ltd.
2.P.N.Rao, "Manufacturing Technology", TMH Ltd 1998(Revised edition)
3.Richard L.Little, "Welding& Welding Technology", Tata Mc Graw Hill, 1992.

References

1.Heine, Loper and Rosenthal, "Principles of Metal Casting", Tata Mc Graw Hill Publishing Co, Ltd; New Delhi, 1995.
2.Doehler.E.H, "Die Casting", McGraw Hill Book Co. New York.1991.
3.Banga T.R; and Agrawal R.L, "Foundry Engineering", Khanna Publishers, 1992.
4.Serope Kalpakjian, Steven R.Schmid, "Manufacturing Engineering and Technology". (4th Edition), Prentice Hall 2000-06-15 ISBN:0201361310
5.E.PaulDeGarmo, J.T.Black, Ronald A.Khoser, "Materials and Processes in Manufacturing" Wiley; 9 edition (December6, 2002) ISBN:0471033065
6.Taylor H.F Flemings M.C&Wulff J, "Foundry Engineering", Wiley Eastern Limited, 1993.
7.Gupta R.B, "Foundry Engineering"Satyaprakashan, 1989.
8.Lal, Mand Khanna O.P A, "Text Book of Foundry Technology", Dhanpat Rai and Sons, 1986.
9.Jain P.L, "Principles of Foundry Technology", Tata Mc Graw Hill Publishing Company, Ltd; 1995".
10. "ASM Metals Hand Book on Casting", 1992.
11.Parmer R.S; "Welding Processes& Technology", Khanna Publishers, 1994.
12.Lancaster J.F., George Allen and Unwin, 1991, "Metallurgy of Welding".
13.Metals Hand Book, Vol 6,8th edition, ASM, 1971.
14.AWS Welding Hand Book,Vol 1 to 4 AWS.

TME- 351

MATERIAL SCIENCE AND TESTING LAB

L	T	P
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A. Material Science Lab Experiments: (at least 5 of the following)

1. Making a plastic mould for small metallic specimen.
2. Specimen preparation for micro structural examination cutting, grinding, polishing, etching.
3. Grain Size determination of a given specimen.
4. Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, cooper etc.)
5. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
6. Material identification of says 50 common items kept in a box.
7. Faradays law of electrolysis experiment.
8. Study of corrosion and its effects.
9. Study of microstructure of welded component and HAZ. Macro & Micro examination.

B. Material Testing Lab Experiments: (at least 5 of the following)

1. Strength testing of a given mild steel specimen on UTM with full details and s-e plot on the machine.
2. Other tests such as shear bend tests on UTM.
3. Impact testing on impact testing machine like Charpy, Izod or both.
4. Hardness testing of given specimen using Rockwell and Vickers/Brinell testing machines.
5. Spring index testing on spring testing machine.
6. Fatigue testing on fatigue testing machine.
7. Creep testing on creep testing machine.
8. Deflection of beam experiment, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young's modulus of beam.

4.Torsion testing of a rod on torsion testing machine.

5.Study of non-destructive testing methods like magnetic flaw detector, ultrasonic flaw detector, and eddy current testing machine, dye penetrate tests.

TMT-352	THERMAL ENGINEERING LAB	L	T	P
		0	0	2

Thermodynamics Lab (At least 6 experiments)

1 **Study the working & conduct of performance test for the following:**
Two & four stroke Petrol Engine
Four stroke petrol & diesel engine
2 Determination of indicated HP of IC Engine by Morse test.
3 Determination of flash point and fire point of fuels
4 Determination of viscosity of lubricants
5 **Determination of calorific value of fuel**
6 Study of gas turbine model
7 Study the working of Air conditioner & conduct the experiment to determine COP
8 **Study of ignition system of IC engine**
9 **Study of breaking system of any vehicle**
10 **Prepare the energy balance for diesel / petrol engine**

Heat and Mass Transfer Lab (At least 4 experiments)

1 **Determination of thermal conductivity of fluids.**
2 **Determination of thermal conductivity between walls**
3 **Determination heat transfer from tube by natural convection**
4 **Determination of heat transfer through tube/fin by forced convection**
5 **An experiment on radiation such as Stephen's law, determination of emissivity Etc.**
6 **Determination of overall heat transfer coefficient of**
Parallel flow Heat exchanger
Counter flow Heat exchanger

TMT-353	MANUFACTURING TECHNOLOGY I LAB	L	T	P
		0	0	3

Foundry Lab (Any four experiments)

1 Design of pattern & pattern making
- At least one wooden pattern with proper calculations

2 Making a green sand mould
- One mould each on pit Moulding & split pattern
- At least two for different type of components with core and without core to be made

3 Sand testing experiments to determine:
- Grain Fineness Number
- Green Strength
- Permeability Test
- Moisture content test

4 **Study, understanding and working of simple destructive & non-destructive testing procedures used for castings**

5 **Melting of metal in furnace**

6 **Visit to foundry – study of automation processes, Layout, Material handling equipment & other processes with preparation of report**

Welding Lab (Any four experiments)

1 **Preparation of simple shapes of metal sheets by gas cutting**

2 **Preparation of specimen & welding of:**
Angle joint / T joint
Lap joint / Butt joint
(use of both Arc & Gas welding)

3 **Study, understanding and working of simple destructive & non-destructive testing procedures used for welding**

4 **Study on influence of welding parameters in Arc & Gas welding with demonstration**

5 **Visit to welding facility preferably for automated welding**

TMT-354	MACHINE DRAWING & COMPUTER AIDED DRAFTING LAB	L	T	P
		0	0	2

Review: **12**

Orthographic projection, missing lines, Interpolation of views and sectioning Part and assembly drawing

Introduction, assembly drawing of stuffing box, steam engine cross head, air valve, Lathe tailstock, gate valve, screw jack, connecting rods, spark plug, tool post, safety Valves etc. Drawing exercises.

Specification of materials: **2**

Engineering materials, code designation of steels, copper, and aluminum and its alloys.

Limits, tolerances and fits:

Introduction, limit systems, tolerance, fits drawing exercises.

Surface roughness **1**

Introduction, surface roughness, machining symbols, identification of surface roughness drawing exercises.

Production drawing: **9**

Introduction to developing and reading of production drawing of simple machine elements like helical gear, bevel gear, flange, pinion shaft, connecting rod, crank shaft, belt pulley, piston details etc, idea about tool drawing.

Computer aided drawing **9**

Introduction, input, output devices, introduction to drafting software like AUTOCAD, basic commands and development of simple 2D and 3D drawings.

References

1 Narayana “Machine drawing”, New Age International

2 K.L.Narayana and P.Kannaiah “Production drawing”, New Age International

3 Nageshwar Rao “AutoCAD 14 for Engineering drawing”, TMH

4 Bhatt N.D “Machine drawing”, Charotar

TMT-401 **FLUID MECHANICS & MACHINERY** **L T P**
3 1 0

Objective

This is an introductory course in the mechanics of fluid motion. It is designed to establish fundamental knowledge of basic fluid mechanics and address specific topics relevant to simple applications involving fluids. Also, to familiarize students with the relevance of fluid dynamics to many engineering systems Students successfully completing this course will:

- *have an understanding of basic fluid properties and their dimensions*
- *Be able to explain to others basic principles of incompressible fluid mechanics.*
  - *Flow continuity*
  - *Law of momentum*
  - *Law of mechanical energy*
- *Understand the importance of dimensional analysis.*
- *Be able to solve practical pipe flow problems.*
- *Understand the applications of turbo-machinery such as turbines and pumps to fluid flow.*
- *Be able to analyze static pressure effects of fluids.*

Fluid Mechanics **4**

UNIT I

Fluid Properties and Definitions: Definition of fluid, Scope of fluid mechanics, Basic equations, Methods of analysis, Fluid as a continuum, Velocity field, Stress field, Fluid viscosity, Newtonian and non-Newtonian fluid, Density, Surface tension, Compressibility, Vapour pressure, Cohesion and adhesion, Classification of fluid motions.

UNIT II **10**

Fluid Statics: Pressure at a point, Basic equation of fluid statics, pressure variation in a static fluid, the standard atmosphere, Hydrostatic force on submerged plane and curved surfaces, Buoyancy and Stability (5)

Kinematics of Fluid Flow: Timelines, Streamlines, Streak lines, path lines, stream function, velocity potential, acceleration of fluid particle in a velocity field, Irrotational flow, (5)

UNIT III **8**

Basic Equations of Fluid Flow: Basic laws for a system-Conservation of mass, Newton's Second Law, Principle of angular momentum, Euler's Equation, Bernoulli's Equation, Bernoulli equation applied to Irrotational flow, Static, Stagnation and Dynamic Pressures, Pitot tube, Pitot-Static tube. Flow measurement devices-venturi meter, orifice meter, and nozzle meter (6)

Dimensional Analysis and Similitude: Nature of dimensional analysis, Buckingham Pi theorem, Determining the Pi groups, Dimensionless groups, Flow similarity and model studies. (2)

Hydraulic Machines

UNIT IV **10**

Introduction: Kinematics. Relative, angular and absolute velocity. Dynamic action of a fluid. Linear momentum. Impulse and momentum equations. Dynamic force exerted by fluid jet. Stationary and moving plates. Radial flow over turbine blades, power produced by a radial machine. Fluid couplings, fluid flywheel, torque converter. Hydrostatic transmissions. (6)

Pumps: Centrifugal, reciprocating, rotary and radial type. Working principles. Pump characteristics and selection. Hydraulic ram. (4)

8

UNIT V

Water turbines: Pelton, Francis and Kaplan type. Working principles. Components and their functions. Characteristics. Water turbine governors, working principle – selection & application of turbines (4)

Design of pumps and turbines: Fundamental principles for design. Classification. Dimensional analysis. Euler's energy equation. Flow through impellers. Axial forces and moments. Velocity diagrams. Cavitations in hydraulic machines. (4)

Suggested Reading

1 Fox, R.W., & McDonald, A.T, "Introduction to Fluid Mechanics", Fifth Edition, John Wiley & Sons
2 R.K Rajput, "Text book on hydraulic machines", S.Chand
3 Jagadish Lal, "Fluid machines Including Fluid mechanics", Metropolitan Book Co., New Delhi, 1995.

References

1 Streeter & Wylie, "Fluid Mechanics", McGraw-Hill Inc
2 L.H. Shames, "Mechanics of Fluids", Mc Graw Hill, Int. Student, Education
3 Kumar, K.L, "Engineering Fluid Mechanics", Eurasia Publishing House, New Delhi, 1995.
4 P.N Modi and S.M Seth, "Hydraulics and Fluid Mechanics", Standard Book House
5 S.K Agrawal, "Fluid mechanics and machinery", Tata McGraw hill
6 Dr.R.K. Bansal, "Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications

TME -404

MEASUREMENT, METROLOGY AND CONTROL **L T P**

Unit-I **3 1 0**

I. Mechanical Measurements

Introduction: Introduction to measurement and measuring instruments, Generalized Measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors. 4

Sensors and Transducers:

Types of sensors, types of transducers and their characteristics. 2

Signal transmission and processing:

Devices and systems. 2

Signal Display & Recording Devices 1

Unit-II

Time related measurements:

Counters, stroboscope, frequency measurement by direct comparison. 1

Measurement of displacement 1

Measurement of pressure:

Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures. 1

Strain measurement:

Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration. 2

Measurements of force and torque:

Different types of load cells, elastic transducers, pneumatic & hydraulic systems. 1

Temperature measurement :

By thermometers, bimetallic, thermocouples, thermostats and pyrometers. 2

Vibration:

Seismic instruments, vibration pick-ups and decibel meters, vibrometers accelerometers. 2

Unit-III: METROLOGY

II. Metrology and Inspection:

Standards of linear measurement, line and end standards. Limit, fits and tolerances. Interchangeability and standarisation. 2

Linear and angular measurements devices and systems Comparators: Sigma, Johansson's Microreader. 2

Limit gauges classification, Taylor's Principle of Gauge Design. 2

Unit-IV

Measurement of geometric forms like straightness, flatness, roundness. 2

Tool makers microscope, profile project autocollimator. 1

Interferometry: principle and use of Interferometry, optical flat.	2
Measurement of screw threads and gears.	2
Surface texture: quantitative evaluation of surface roughness and its measurement.	1

Unit-V: Controls

Introduction: Concept of Automatic Controls – open loop & closed loop systems. Servomechanisms. Block diagrams, transfer functions. Applications of Laplace-Transform in control systems with simple examples / numericals. 5

Representation of control components & Systems: Translation & rotational mechanical components, series & parallel combinations, cascade system, analogous system. 2

Controllers: Brief introduction to Pneumatic, hydraulic and electric controllers 1

References

1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
2. Doeblein E.O., “Measurement Systems, Application Design”, McGraw Hill, 1990.
3. Kumar D.S., “Mechanical Measurements and Control”, Metropolitan, N. Delhi.
4. Hume K.J., “Engineering Metrology”, MacDonald and Co. 1963
5. Gupta, I.C., “Engineering Metrology”, Dhanpat Rai & Sons, New Delhi, 1994
6. Sirohi, “Mechanical Measurement” New Age Publishers
7. Jain, R.K., “Engineering Metrology” Khanna Publishers
8. Jain, R.K., “Mechanical Measurement” Khanna Publishers
9. Raven, “Automatic Control Theory”, McGraw Hill Publishers.
10 Nagrath and Gopal, “Control System Engineering”, New Age Publishers.

TMT-403 **MANUFACTURING TECHNOLOGY-II** **L T P**
3 1 0

Objective

The course will enable the students to acquire a fundamental knowledge on metal forming technology which is necessary for an understanding of industrial processes. To introduce students to the wide range of materials and processes, which are currently used in manufacturing industry. The course will also provide methods of analysis allowing a mathematical/physical description of forming processes. The course will enable the students to identify the processes characteristics, select the main operator parameters, the tool geometry and materials, and determine forces and power required to select the main and auxiliary equipment.

UNIT I **7**

Theory of Metal Forming

Introduction to cold/hot forming processes: Metallurgical aspects of metal forming –slip-twining-mechanics of plastic deformation- effects of temperature, strain rate, microstructure and friction in metal forming, yield criteria and their significance, classification of metal forming processes: slip line field theory.

UNIT II

Forging and rolling processes. **9**

Forging principle, classification, equipment, tooling-processes, parameters and calculation of forces and power requirements during forging post forging heat treatment - defects (cause and remedy) & application; Principles of rolling processes, classification, types of rolling mills, ring comparison tests calculation of forces and geometrical relationship in rolling, analysis of rolling load, torque and power, rolling mill control, , effects of friction. Form rolling, rolling defects, causes and remedies

UNIT III **9**

Extrusion and Drawing Processes.

Classification of extrusion processes-tool, equipment, and principle of these processes, influence on friction-Extrusion force calculation-defects and analysis-rod/wire drawing-tool, equipment and principle of processes defects-Tube drawing and sinking processes-Mannessmann processes of seamless pipe manufacturing.

UNIT IV **9**

Sheet metal forming processes

Classification - conventional and HERF processes-presses-types and selection of presses-formability of sheet metals- principle, process parameters, equipment and application of the following processes: deep drawing, spinning, stretch forming. Plate bending, spring back, press brake forming, Introduction to forming, electro hydraulic forming, magnetic pulse forming. Introduction to press work – coining, embossing etc., Design of sheet metal dies.

UNIT V **6**

Powder Metallurgy

Introduction to Powder Metallurgy process, preparation of powders, types & function of binders, green compaction, sintering process and its effect on the product, application of powder metallurgy products, advantages of powder metallurgy products. Sintering equipment.

Suggested Reading

1 Serope Kalpakjian, Steven R. Schmid “Manufacturing Engineering and Technology” (4th

Edition) Prentice Hall 2000-06-15 ISBN: 0201361310
2 P.N.Rao “Manufacturing Technology”, TMH Ltd 1998(Revised edition)
3 Dieter “Mechanical Metallurgy”, Revised edition 1992, Mcgraw

References

1 E. Paul DeGarmo, J. T. Black, Ronald A. Kohser, “Materials and Processes in Manufacturing”, Wiley; 9 edition (December 6, 2002) ISBN: 0471033065
2 Lindberg, “Processes and Materials of Manufacture ", Prentice Hall of India (p) Ltd
3 George.E. Dieter, “Engineering design (A materials and processing approach)”, McGraw Hill – EditionII 1991
4 William F.Hosford & Robert M.Caddel “Metal forming”
5 Amitabha Ghosh and Mallik, “Manufacturing Science”, East west press pvt ltd
6 Narayanaswamy. R, “Metal Working Technology”, PHI (1997)
7 Nagpal. G.R., ”Metal Forming Processes” Khanna publishers, Delhi 1998
8 Sinha and Prasad, “Theory of Metal Forming and Metal Cutting”, Dhanpat Rai Publication 1999

TEE – 405

ELECTRICAL MACHINES

L	T	P
3	1	0

Unit – I:

Transformers: Construction, polarity test, Sumpner's test, all day efficiency

Autotransformer: Volt-amp relation, efficiency, advantages & disadvantages and applications; Three-phase transformers: Connections, three-phase bank of single-phase transformers, Scott connections; Instrument Transformers. (8)

Unit – II:

D.C. Machines:

D.C.machine: Construction, emf and torque equations. Armature reaction, commutation, performance characteristics of motors and generators, starting of motors, speed control losses and efficiency. (8)

Unit – III:

Three-Phase Induction Motor:

Construction, rotating magnetic field and principle of operation, of equivalent circuit, torque production, Torque-slip characteristics, speed control, starting of squirrel cage and slip ring induction motors. (7)

Unit – IV:

Three-phase Synchronous Machines:

Alternator: Construction, emf equation & effects of pitch and distribution factors phase diagram, armature reaction, Voltage regulation and its determination by synchronous impedance method, methods of synchronization

Synchronous motor: Principle of operation and starting torque and mechanical power developed, effect of excitation on line current, (v – curves) (8)

Unit – V:

1. **Fractional H.P. Motors:**

Single phase induction motor: Construction, revolving field theory and principle of operation, equivalent circuit and starting methods. Two-phase servomotor, stepper motor, and their applications.

2. **Industrial Applications**:

Concept of braking in dc and ac motors, two quadrant and four quadrant operation of dc and three phase induction motors, industrial applications of dc and ac motors.(9)

REFERENCES:

1 Electric Machines by I J Nagrath & D P Kothari, Tata McGraw Hill, 1997
2 Electric Machines by Ashfaq Husain, Dhanpat Rai & Com., 2005
3 Generalized Theory of Electrical Machines by Dr. P S Bimbhra, 1996
4 Irvin L.Kosow,"Electric Machinery and Transformers" Prentice Hall of India.
5 P.S. Bimbhra,"Electric Machinery" Khanna Publishers.

TMT-405 **THEORY OF MACHINES** **L T P**
3 1 0

Objective

1. *Deepen understanding of kinematics analysis as an essential element of the design process*
2. *Develop skills in analytical, graphical, and numerical methods for calculating **kinematics** and dynamics of machine elements.*
3. *By the end of this course in Machine Engineering, each student will:*
   - *Be able to analyze the kinematics of a linkage to determine position, velocity and acceleration variation throughout its range of motion.*
   - *Be able to design a cam or gear train to produce a desired motion.*
   - *Be able to understand the principles and working of gyroscopes, governors and flywheels.*
   - *Be able to understand the nature of imbalance in systems and develop an understanding to use tools to methodically solve imbalance conditions.*

UNIT I **7**

Introduction: Type of links; kinematics pairs, classification; types of constraints; linkage mechanisms, inversions of four bar linkage, slider crank chain (4)

Velocity in Mechanisms: Velocity of point in mechanism, relative velocity method, instantaneous point in mechanism, Kennedy's theorem, instantaneous centre method (3)

UNIT II **7**

Acceleration in Mechanisms: Acceleration diagram, Coriolis component of acceleration, Klien's construction for slider crank and four bar mechanism, analytic method for slider crank mechanism (4)

Mechanisms with lower pairs: Pantograph, exact straight line motion mechanisms; Peaucellier's, Hart and Scott (3)

UNIT III **11**

Cams: Cams and followers, classification and terminology, cam profile by graphical method for uniform velocity, simple harmonic motion, cyclodial & uniform acceleration and retardation (5)

Gears: Classification & terminology, law of gearing, tooth forms, interference, under cutting, simple, compound and planetary gear trains (6)

UNIT IV **8**

Flywheel: Turning moment diagrams, fluctuation of energy, flywheel

Balancing: Static and dynamic balancing, balancing of rotating and reciprocating masses, primary and secondary forces and couples;

Friction: Friction in belts and pulleys, flat and v-belts, design and selection

UNIT IV

Governors & Gyroscope: Operating principles, Dead weight and spring loaded governors; Principles of gyroscopic motion, gyroscope applications **7**

Mechanical Vibrations – single degree free and forced vibration, damped and un damped vibration

Suggested Reading

1 Mable& Ocvirk, “Mechanism and Dynamics of Machinery”, John Wiley & Sons
2 BevanThomas, “Theory of Machine”, CBS Publications

References

1 Burton Paul, “Kinematics and Dynamic of Planer Machinery”, Prentice Hall 1979
2 Shigley J.E and Uicker J.J, “Theory of Machines & Mechanisms”, McGraw Hill 1980
3 Rao J.S and Dukkipati R.V, “Mechanism and Machine Theory”, Second edition, Wiley Eastern Ltd., 1992
4 Gosh and Mallick, “Theory of Machines & Mechanism”, East west press 1989
5 Dr. Jagadishlal, “Theory of Machines”, Metropolitan Book Co.
6 Ballaney P L, “Theory of Machines”, Khanna Publisher, New Delhi, 2002
7 Rattan S.S, “Theory of Machines”, Tata McGraw Hill publishing Co., New Delhi 2004

TMT-451 **FLUID MECHANICS AND MACHINERY LAB**

L	T	P
0	0	3

List of Experiments

Fluid Mechanics Lab (At least 5 experiments)

1 To determine experimentally the meta-centric height of a ship model
2 To determine the coefficient of discharge using venturimenter
3 To determine the coefficient of discharge of an orifice of a given shape. Also to determine the coefficient of velocity and coefficient of contraction of the orifice.
4 To measure surface tension of liquid
5 To calibrate an orifice meter and study the variation of the coefficient of discharge with the Reynolds number
6 To study the variation of friction factor for turbulent flow in smooth and rough commercial pipes
7 To determine the loss coefficient for the pipe fitting
8 To study the flow behaviour in a pipe bend and to calibrate the pipe bends for discharge measurement
9 Experiment to find the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile

Hydraulics Lab (At least 5 experiments)

1 To determine the coefficient of impact for different types of vanes
2 To conduct the experiment on Pelton wheel and draw the performance characteristics curves
3 To conduct the experiment on Francis Turbine and draw the performance characteristics curves
4 To conduct the experiment on Kaplan turbine and draw the performance characteristics curves.
5 To study the performance characteristics of reciprocating pump at variable speed and to find the percentage of slip
6 **To study the characteristics of centrifugal pump at variable speed & to draw the characteristic curves**

TME 454

MEASUREMENT, METROLOGY AND CONTROL LAB

L	T	P
0	0	2

Experiments:

Say minimum 8 out of following (or such experiments)

1. Study & working of simple measuring instruments. Like vernier calipers, micrometer, tachometer etc.
2. Measurement of effective diameter of a screw thread using 3-wire method.
3. Measurement of angle using sinebar & slip gauges.
4. Study of limit gauges.
5. Study & angular measurement using level protector
6. Adjustment of spark plug gap using feeler gauges.
7. Study of dial indicator & its constructional details.
8. Use of dial indicator to check a shape run use.
9. Study and understanding of limits, fits & tolerances
10. Pressure measuring experiment
11. Temperature measurement experiment
12. Strain gauge measurement
13. Speed measurement using stroboscope
14. Flow measurement experiment
15. Vibration/work measuring experiment.

16. & 17. Experiments on 'Controls'

TMT-453 MANUFACTURING TECHNOLOY II LAB

L	T	P
0	0	3

List of experiments (at least 8 experiments)

1 Use of rolling mill, measurement of friction, power consumption
2 Basic experiment on forging – preparation of at least two models in smithy shop
3 Experiment on sheet metal development:
Preparation of models – tray, funnel, truncated cone, pyramid, transition piece
Soldering and brazing exercises on above models
4 Formability test on sheet metals
5 Simple exercise on wire drawing
6 Study of power hammer
7 Study of the extrusion and drawing process – visit to industry with report presentation
8 Preparation of layouts of various metal forming units for specific products with material handling equipments
9 Grain size measurements, microstructure studies
10 Experiment on strain hardening
11 Experiment on Powder metallurgy
- Sintering
- Making green compact

TEE 455

ELECTRICAL MACHINES LABORATORY

L	T	P
0	0	2

Note: Minimum nine experiments are to be performed from the following list.

1 To obtain magnetization characteristics of a dc shunt generator
2 To obtain load characteristics of a dc shunt generator
3 To obtain load characteristics of a dc series generator
4 To obtain load characteristics of a dc compound generator (a) cumulatively compounded (b) differentially compounded
5 To obtain speed – torque characteristics of a dc shunt motor
6 To obtain efficiency & voltage regulation of a single phase transformer by Sumpner's (back to back) test
7 To perform no load test & block rotor test on a three phase induction motor and determine parameters of equivalent circuit and efficiency
8 To perform no load test and blocked rotor test on a single phase induction motor and determine efficiency
9 To obtain variation of stator current with excitation current (V/curve) of a three-phase synchronous motor at no load ½ load and full load.
10 To perform open circuit and short circuit tests on a three phase alternator and determine voltage regulation by synchronous impedance method at a power factor of unity 0.8 lagging & 0.8 leading
11 To study operation of a 2-phase ac servomotor and a stepper motor
12 To study parallel operation of three phase alternators

TMT 501 RELIABILITY & MAINTENANCE ENGINEERING

L T P
3 1 0

UNIT I
Introduction to maintenance: Need for maintenance. Types of maintenance, breakdown, corrective and preventive maintenance. Maintenance planning, Scheduled maintenance. Cost of maintenance versus Cost of equipment and production delays. Inspection: Inspection intervals, Inspection reports, card history system.

6

UNIT II
Predictive maintenance. Equipment wear records, standards. Equipment used in predictive maintenance. Computerized maintenance. The role of computers in a maintenance programme. Types if lubrication system and selection of lubricants. Non-destructive testing: Liquid Penetrate, Magnetic particles, Ultrasonic testing, and Vibration analysis. Oil analysis Radiographic testing.
8
UNIT III
Maintenance of mechanical drives: Bearings: Overheating, noise, vibration. Chain drives: Normal wear in chain drives. Tension in chain drives, Sprockets: Lubrication, Belt drives: Tension in belts, slip &creep. Gears: Normal wear in gears, Lubrication &alignment problems. Shock, overloading. Couplings: Rigid flexible couplings.

8

UNIT IV
Maintenance of fluid power systems: Pumps: Noise& heat, Compressors: Heating, noise, vibration problems. Maintenance of Control valves.

6
UNIT V
LIFE TESTING-RELIABILITY
Life testing-Objectives-failure data analysis, Mean failure rate, mean time to failure, mean time between failures, hazard rate, system reliability: series &parallel and mixed configuration-simple problems. Maintainability and availability. Reliability of acceptance sampling based on reliability test-O. C Curves.

QUALITY AND RELIABILITY

Reliability improvements-techniques, use of Pareto analysis-Design for reliability, redundancy unit and stand by redundancy, Optimization of reliability.

12

References:

1.Terry Wireman, “Preventive Maintenance”, Reston Publishing Company, Prentice Hall.
2.Miller&Blood, Modern Maintenance Management”
3.Stainer, Plant Engg Hand Book”
4.Morrow, Maintenance Engg Hand Book”

TMT 502 MATERIALS MANAGEMENT L T P

3 1 0

UNIT I

Introduction

Introduction to material, Productivity and role of materials. Introduction to material, Productivity and role of materials Standardization &variety reduction. Cost reduction and value improvement. Principles of material handling, plant layout, overview of material handling equipment, material transport system, industrial trucks. Automated guided vehicles, conveyer system, cranes and hoists, choice of material transport system.

UNIT II

Organization of purchasing function, Role of purchasing in cost reduction, Value analysis for right choice and rationalization of material, Vendor rating, vendor identification, Tendering, Negotiations and purchase, Price analysis.

UNIT III

Forecasting techniques, aggregate planning, Master production schedule, Material requirement planning, Make& Buy decision, Lot sizing and acceptance sampling.

UNIT IV

Inventory management, ABC-VED analysis. Various Inventory models. Inventory models with quantity discount, Exchange curve concept and coverage analysis. Information system for inventory management. Introduction to JIT.

UNIT V

Stores Management and warehousing. optional stocking and issuing policies, Inventory management of perishable commodities, surplus management. Design of inventory Distribution systems, storage systems, storage location strategies, conventional storage methods& equipments, automated storage systems, analysis of storage systems.

References

Production systems &Computer Integrated manufacturing. Micelle P Grover

TMT 503	DESIGN OF MACHINE ELEMENTS	L	T	P
		3	1	0

UNIT I **7**

FUNDAMENTALS OF DESIGN:

Design Process – Computer aided design – Optimum design – Mechanical properties of materials – BIS system of designations of steel, plastics &rubbers. Types of loads – Stresses –Static, varying, thermal, impact and residue – Factor of safety –

Design against static load, modes of failure theories, Stress concentration factors – Preferred numbers.

Design against fluctuating load, Stress concentration, Stress concentration factors, fluctuating stress, fatigue failure, Endurance limit, design for finite & infinite life, soberer & Goodman criteria.

UNIT II **10**

DESIGN OF GEARS

Design of gears – Spur, Helical, Bevel and Worm gears – Design of multistage speed reducers.

UNIT III **12**

DESIGN OF BASIC MACHINE ELEMENTS AND JOINTS

Design of shafts, keys, couplings, journal bearings – Selection of rolling element bearings – Design of pin, riveted and welded joints – Screw fasteners – Power screws

UNIT IV **8**

DESIGN OF ENGINE PARTS

Design of piston - Connecting rod - Crankshafts - Flywheels

UNIT V **8**

DESIGN OF SPRINGS

Design of Helical springs –Compression and tension – Leaf springs

References
1. V.B.Bhandari, “Design of Machine Elements”, Tata McGraw-Hill Publishing Company Ltd, 1998.
2. R.S.Khurmi & J.K.Gupta, “A Text book of Machine Design” – S.Chand & Company (Ltd), New Delhi, 2004.
3. Bernard J.Harmrock, B O Jacobson, “Fundamentals of Machine Elements”, McGraw-Hill, 1999
4. Sharma C.S., Kamlesh Purohit, “Design of Machine Elements”, PHI 2003
5. T.J.Prabhu, “Design of Transmission Elements”, Mani Offset Printers, Chennai 2004.
6. Design of machines Eliments-Dr.Sharma &agarwal-Kataria
7. Machine design-Dr.R.karwa
8. Machine design-Dr. Shadu Singh
9. Machine design-shigley, TMH
10. Design of machines Elements-M.F.Sports
11. Machine design-Malvee&hortman

TMT 504 **MANUFACTURING PROCESSES-III** **L T P**
3 1 0

8

UNIT I

Cutting tools and tool geometry

Types of cutting tools, tool materials-HSS(including heat treatment)ceramics, cements, CBN &PCD ,tool geometry and nomenclature ,selection of tool materials and tool life,, tool wear and mach inability

UNIT II **8**

MECHANICS OF METAL CUTTING

Mechanics of clip formation ,types of chips and conditions conducive for the formation of each type Built-up edge, its effects Orthogonal Vs oblique cutting- merchant’s force circle diagram. Force and velocity relationship, shear plane angle. Energy consideration in machining-Ernst Merchant theory of shear angle, relationship-original assumptions and modification made.

8

UNIT III

LATHE,MILLING AND DRILLING MACHINE

Lathe, types of lathes-special purpose lathes-kinematics arrangement of lathe, -work holding devices-types of milling machines-types of milling machine-schematic diagrams,-operations, milling cutters-mounting of cutters-Drilling machines-types-reaming and boring operations

UNIT IV

BORING,SHAPER,SLOTTER,PLANER,BROACHING

Schematic diagram of boring machine, shaper, planer, slotting and broaching machine-operations-tools. Grinding and allied finishing process **7**

UNIT V

Forces, power consumption in machinery

Forces and power consumption in turning,drilling,milling and grinding, forces in up and down milling, chip thickness calculation, specific cutting pressure and horsepower requirment.Tool dynamometer construction and operation , **7**

References

1 Shaw M.C., " Metal cutting principles ", Oxford, Clarendon Press, 1984.

2 Bhattacharya A. " Metal Cutting Theory and Practice ", New Central Book Agency (p) Ltd., Calcutta, 1984.

3 Venkataesh V.C and Chandrasekaran. H " Expermental Techniques in Metal Cutting ", Prentice Hall of India, 1982.

4 Xing Sheng Li & Low.I.M., Editors, " Advanced ceramic tools for machining Applications ", I TRANSTECH PUBLICATIONS, 1994.

5 Kuppuswamy. G. " Principles of Metal Cutting ", Universites Press, 1996.

6 . " Handbook of Metal forming ", Kurt Lunge McGraw Hill, Pub Co., 1985.

7 Paquin, " Die design fundamentals ", Industrial Press Inc, New York, 1979.

8 ASTME, " Fundamentals of tool Design ", Prentice-Hall, 1974

9 Kemster M.H.A, " Introduction to Jigs and tool design ", ELBS EDN, 1976.

10 Manufacturing processes for engineering material-KalpakJain.

11. Materials & processes in Manufacturing-DE Garmo Black Khoser.

12. Manufacturing process, P C Pandey

INDUSTRIAL MANAGEMENT

TMT—505 **L T P**

UNIT I **3 1 0**

BUSINESS ORGANIZATION

Various types of business organizations, Duties and responsibilities of management, Concept of good organization, authority and responsibility, Wages and incentives, method of wage payment, bonus systems, time or day rate systems, systems approach, mangement by objective (MBO), functions of management SWOT analysis, entrepreneurship

UNIT II

ECONOMICS

interest and interest rates, industrial costs, cost accounting, replacement study, theory of populations, economic study of public, depreciation and depreciation calculation, the concept of demand and supply, elasticity of demand and supply, price effect, income effect and substitutions effect, macro and micro economics.

UNIT III

MONEY AND BANKING

Money and banking, functions of money, inflation and measure to control it, brief idea of function of banking system, VIZ commercial and central banking, business fluctuations, Balance sheet preparations.

UNIT IV

COSTING AND ESTIMATION

Importance of estimation, Aim of estimations, Allowance of estimations, Sources of error in estimating, Estimation of Material cost, Estimation in Machine shop, Lathe operations, Estimation in welding shop, Estimation in forging shop.

UNIT V

PERSONNEL MANAGEMENT

Objectives and Functions of Personnel Management, Functional areas of Personnel Management, Personnel Administration – Introduction, Industrial relations, Industrial disputes, causes of industrial disputes, settlement of disputes, Trade unions, Training and promotion of personnel and their recruitment, Selection Procedure, Industrial Fatigue, accidents, Absenteeism- causes and measures to control absenteeism.

References:

1. Harold Kooritz & Heinz Weihrich “Essentials of management.
2. Joseph L Massie “Essentials of Management”
3. Tripathy PC & Reddy PN “Principal of managements”
4. Decenzo David ,Robbin Stephen A, “Personnel & Human Reasons Managements”
5. JAF Stomer, Freeman R.E. & Daniel R Gilbert, “Management”
6. Fraidoon Mazda, “Engineering Management”
7. Dr. A.K.Singh, Industrial Engg & Management
8. Dr. A.K.Singh, Enterpreneurship Development & Management

RELIABILITY & MAINTENANCE ENGINEERING

TMT 551

List of experiments

1. Prepare maintenance schedule for lathe machines.
2. Prepare maintenance schedule for milling machines
3. Study of computerized maintenance management system.
4. Examination of used lubrication oils by laboratory methods spectrometric\ ferrography technique.
5. Study of various inspection & performance monitoring techniques.
6. Study of various vibration analysis techniques-vibration analysis data presentation, survey charts, data interpretations.
7. Failure analysis of bearing & gears.
8. Prepare maintenance schedule for welding shop.

DESIGN OF MACHINE ELEMENTS LAB

TMT 553

List of experiments

1 Design of coupling –Rigid & flexible type
2 Design of riveted joint.
3 Design of eccentrically loaded riveted & bolted joint.
4 Design of cotter & knuckle joint.
5 Design of leaf spring.
6 Design of IC engine parts, Piston, Connected rod, crankshaft, flywheel,
7 Design of screw Jack.
8 Design of gears
9 Best practices in computer aided design of some of above mention design using 3D software.

Reference:

1. K. Mahadevan & Balaveera Reddy

MANUFACTURING PROCESS -III LAB

TMT 554

List of experiments

1 Measurement of forces for orthogonal turning operation by tool dynamometer.

2 Study of divided head and generation of gear profile on milling machine.

3 Perform thread cutting operation.

4 To perform taper turning by different method on lathe machine.

5 Study of various super finishing operations-Lapping, honing, burnishing.

6 Perform boring & facing operations.

7 To set up a capstan lathe for tools and stops for the manufacturing of a given component.

8 To select an appropriate grinding wheel to perform cylindrical & surface grinding operation.

TIME & MOTION STUDY

TMT-601 **L T P : 3 1 0**

UNITI

Introduction

Introduction to industrial Engineering, productivity, measurement of productivity
6

UNITII

Introduction to work-study. The basic procedure of work-study. Work study for establishing the standard time for a given activity. Method study, procedure for Method study, Principles of motion economy, Filming techniques and micro motion analysis, recording technique. Construction of process chart, Gantt chart, SIMO chart, string chart, Travel chart, Multiple activity chart, Sampling process, Critical examination analysis. Primary, secondary and tertiary stages. Search for alternatives. Steps involved in evaluation of alternatives
8

UNIT III

Introduction to work measurement, objectives of work measurement, Techniques of work measurement. Basic procedure in time study. Advantages and limitations of time study. Time recording techniques in time study. Performance rating standard allowances, personal allowance, fatigue allowance, production delay allowance. Factors affecting the rating. Synthetic rating method.
8

UNIT-IV

Work sampling, process of work sampling, predetermined motion time systems, standard data system, job evaluation and merit rating. work factor method. Method time measurement system, basic, motion time study system
8

UNIT-V

Wages and incentive plans. relationship between wages productivity and cost. Case studies
10

REFERENCE:

1. ILO International labor organization "Introduction to work study" TATA McGraw Hill
2. M.E.Mundel" Motion and Time study"
3. R.M.Barynes "Motion and Time study"
4. E.S.Buffa "Modern production management" TATA McGraw Hill
5 Dr.A.K.Singh "Time and motion study" Jaico publishing houses

TMT 602	**TOTAL QUALITY MANAGEMENT (TQM)**	**L**	**T**	**P**
		3	**1**	**0**

UNIT I

Quality Concepts:

Evaluation of Quality control, concept change, TQM modern concept, quality concept in design, review of design, Evaluation of proto type

Control of purchased product: Procurement of various products, Evaluation of suppliers, capacity verification, development of sources, procurement procedure.

Manufacturing quality: Methods and techniques for manufacturer, inspection and control of product, quality in sales and services, guarantee, Analysis of claims.

UNIT II

Quality Management:

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

Human Factor in Quality: Attitude of top management, co-operation of groups, operator's attitude responsibility, causes of operator's error and corrective methods.

UNIT III

CONTROL CHART:

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

Attributes of control charts:

Defects, Construction and analysis of p- charts, Improvement by control chart, variable sample size, Construction and analysis of C-charts.

UNIT IV

SAMPLING THEORY:

Fundamental concepts in sampling, O.C. Curve of an ideal Sampling plan, Average outgoing quality and the AOQL, Double sampling, Acceptable quality level (AQL) and Standards, single, double &Multiple

Sampling plans in AQL system, Classification of Defects.

UNIT V

ISO-9000 and ISO-14000 series japanees concept of quality management, Taguchi's concepts of quality, loss function. Kanban system its composition with MRP system, advantage & limitations.

References

1 Lt Gen H.Lol TOTAL QUALITY MANAGEMENT Wiley estern ltd.1990
2 Gerg Bonds "Beyond Total quality Management"- McGraw Hill, 1994
3 Menon H.G."TQM in new product manufacturing'- McGraw Hill, 1992
4 Industrial Engineering & Management. By Dr.A.K. Singh, Satya Prakashan

UNCONVENTIONAL MANUFACTURING PROCESS

TMT 603 **L T P 3 1 0**

Unit-I

Introduction: Limitations of conventional manufacturing processes, need of unconventional manufacturing processes and its classification. 6

Unit-II

Un-conventional Machining Processes: Principle and working and applications of un-conventional machining processes such as Electric Discharge machining (EDM), Electro-Chemical machining (ECM), Ultrasonic Machining (USM), Abrasive Jet machining (AJM) etc 10

Unit-III

Un-conventional Welding Processes: Principle and working and applications of un-conventional welding processes such as Laser Beam Welding, Electron Beam Welding, Ultrasonic Welding, Plasma Arc Welding processes. 8

Unit-IV

Explosive Welding: Cladding etc. Under water welding, Metalising Theory, Process and applications. 6

Unit-V

Un-conventional forming processes: Principle and working and applications of high energy forming processes such as Explosive forming, Electromagnetic forming. Electro discharge forming Water hammer forming. Explosive Compaction Etc 10

References

1. Modern Machining Process, P.C.Pandey

2. Un-conventional machining, V.K. Jain

TMT 604 PNEUMATIC & CONTROL L T P
3 1 2

UNIT 1 (Introduction to Fluid Power And Drives) 8

Fluid Power Systems – Application of fluid power – Properties of hydraulics fluids –

Hydraulics pumps – Characteristics – Pump Selection -, Hydraulics Actuators – Linear, Rotary – Selection – Characteristics – Cylinder Mountings, cushioning, pipe fittings.

UNIT 2 (Fluid Power Elements) 8

Pressure control valves, flow control valves, directional control valves – working principle and construction, special type valves, servo valves, Cartridge valves Actuation methods, Shock absorbers – Accumulator – Symbol for fluid power elements.

UNIT III (Hydraulics Circuits)

8

Hydraulics circuits – automatic reciprocating circuit – speed control circuit - Meter in - Meter out – Sequencing Circuits – Synchronizing circuits
Accumulator circuit – Safety circuits – Hydraulic Motor braking System. Design of Hydraulic circuits.

UNIT IV (Pneumatic Systems) 8

Pneumatic fundamentals Filter, regulator, lubricator, air motors, air cylinders, pneumatic valves, Basic Pneumatic circuits – Hydro Pneumatic Systems – air- oil cylinder, air – oil reservoir, air – oil intensifier and simple circuits.

UNIT V (Fluid Logic Control) 8

Principle of fluid Logic control, Basic fluidic devices - Fluid sensors

Fluidic circuits – sequencing control, continuous reciprocation,
Electrical controls – electrical components – simple electro hydraulic/ pneumatic circuits. PLC application in fluid power control.

References:

1. “Fluid Power with applications”, Antony Esposito, Prentice Hall
2. “Pneumatic Systems – Principles and Maintenance”, Mazumdar S. R, Tata Mc Graw-Hill
3. “Oil Hydraulics Systems – Principles and Maintenance”, Mazumdar S. R, Tata Mc Graw-Hill.
4. “Industrial Hydraulics”, John Pipenger & Tyler Hicks, Mc-Graw Hill.

TMT 605 PRODUCTION PLANNING & CONTROL L T P

3 1 0

Unit-I

Introduction: Types and characteristics of production systems Objective and functions of Production,
Planning & Control,
Preplanning: Forecasting & Market Analysis. Factory Location & Layout, Equipment policy and replacement. Preplanning production, capacity planning.

Unit-II

Production Planning: Material Resource Planning, Selection of material methods, machines & manpower. Routing, Scheduling and Dispatching. Types of charts and form used. Computer Aided Process Planning.

Unit-III

Production and Inventory Control: Progress control through records and charts. Types of inventories, ABC analysis
Inventory Classification. Economic lot (batch) size. Trends in purchasing and store keeping.

Unit-IV

PRODUCT STANDARDIZATION &VALUE ENGINEERING

Production standardization variety reduction. Use of Preferred numbers in standardization. Introduction &scope of value engineering. Evaluation of part function, cost and worth. Application of value engg methodology, simple value engineering case studies.

UNIT-V

PROJECT CONTROL

Review of CPM&PERT, Concurrent engineering, Re-engineering, MRP and ERP.Introduction to manufacturing resource planning (MRP-II), Enterprise resource planning (ERP), case studies.

REFERENCES:

1.Industrial Engineering&Management-Dr.A.K Singh, Satya Prakashan.
2. Industrial Engineering-Ravi Shankar
3. Production Planning & Control – Jain and Agrawal
4. Elements of Production Planning & Control –Eilon
5. Operations Management – Buffa.
6.Facilities Planning &Layout-Topmpkins & White

PNEUMATICS & CONTROL LAB

TMT 654

List of experiments

1. **S**tudy of hydraulic & pneumatic actuators and control valves.

2. Comparitive study of single and double acting pneumatic cylinders.

3rd &4th. Study of constructional detail and performance characteristics of linear /rotary pumps.

5. Study of constructional detail and performance characteristics of pleated paper filters for hydraulic /pneumatic systems.

6 .Determination of viscosity index of hydraulic fluids and similar experiments.

7 .Study and operation of solenoid valves and relay timers.

COMPUTER ASSISTED MANUFACTURING LAB

TMT 655

List of experiments

1 Study & use of software for

Inventory control .
Facility Design
Process planning
Production control.

2 Study of simulation software and applications in material flow.

3 Study of software for simple project management.

4 Study & use of PDM software for collaborative design & manufacturing

5 Creation & use a actual manufacturing database.

Suggested list of Softwares.

SIMPROCESS,GPSS,QUEST,SMARTEAM, DELIMIA, VMAP ,MS-PROJECT, PROCOL,WINMAN, SEER etc.

TIME & MOTION STUDY LAB

TMT-651

List Of Experiments

1. To study of the existing method of assembly of bulb holders with the layout as given and

    a . Prepare the operation process chart.
    b . Prepare the two-hand process chart.
    C. Draw the learning curve.
    D. Determine the cycle time from the sufficient number of observations

2. For the operation in experiment no 1

    a. Develop the new method.
    b. Prepare the improved new THPC (Two hand process chart)
    c. Calculates the cycle time for the new method.

3 The object of the experiment is to demonstrate

    a. Technique of the activity sampling in an office environment.
    b. Calculate the limits of accuracy.
    c. Number of observations to achieve degree of accuracy.

4. Compute the normal time for the following operation.

1- Production of a thread bolt (M 10 x2o mm long) on a lathe machine & compute the standard time.

b - Office string chart for memo /box movement in the departmental office /library and suggestions for the process improvements.

5. A test series five demonstrations of each of the following operations are given for the practice

1 winding electric fuse wire on a spool.
2 stacking new empty drums.

TMT 701	CAD/CAM	L	T	P
		3	1	0

UNIT I

INTRODUCTION

Introduction to CAD, CAM, Evolution, definition, integration within the scope of CIM **8**

Components of CAD systems, Fundamentals of CAD, Automation and CAD, Product Cycle &CAD, Introduction to Computer Hardware, Introduction to computer software and their applications. Introduction to Automation, need & future of NC systems and CAM, Advantages & disadvantages. Hardware components and configurations.

UNIT II

GEOMETRIC MODELING

Modeling techniques, geometric entities, solid modelers 7

Computer Graphics

2D graphics and transformations, 3D graphics and transformations, Hidden line & hidden surface removal, rendering

UNIT III

Representation and manipulation of curves

Types of curve equations, conic sections, Hermite curves, Bezier curves, B-Spline curves, NURBS 8

Representation and manipulations of surfaces

Types of surface equations, bicubic patch, Bezier surface, B-Spline surface

CAD of machine elements such as Shaft, Springs, Bearings

UNIT IV **8**

Classification, Historical development and future trends of NC Machines. CNC Machine outline, Selection of parts for NC machining. Difference between ordinary and NC machine tools. Methods for improving Accuracy and Productivity, Tooling for NC.

NC Part Programming: Manual (word address format) programming. Examples Drilling and Milling. (b) APT programming. Geometry, Motion and Additional statements, Macro statement

UNIT V

System Devices: Introduction to DC motors, stepping motors, Feedback devices such as encoder, counting devices, Digital to Analog converter and vice versa.

Interpolators: Principle, Digital Differential Analyses. Linear Interpolator, circulator Interpolator and its software interpolator. 9

Control of NC Systems: Open and closed loops. Automatic control of closed loops with encoder & tachometers. Speed variation of DC motor. Adaptive control.

References

CAD/CAM by Groover.
NC Machines by Koren
Computer Graphics by Hearn & Baker, Prentice Hall.
NC Machine Tools by S.J. Martin.
Computer aided analysis & design of machine elements by Rao & Dukhipati

TMT702	FINITE ELEMENT METHOD	L	T	P
		3	1	0

UNIT I

INTRODUCTION

Different approaches in Finite Element Method - Direct Stiffness approach, simple examples Variational approach, Elements of variational calculus - Euler Lagrange equation, Rayliegh Ritz method, Weighted Residual methods, Point Collocation method, Sub domain Collocation method, Galarkins method - Steps involved in FEM. 7

UNIT II

TYPES OF ELEMENTS USED

Interpolation Polynomials - Linear elements Shape function - Analysis of simply supported beam - Element and Global matrices - Two-dimensional elements, triangular and rectangular elements - Local and Natural Co-ordinate systems. 8

UNIT III

FINITE ELEMENT FORMULATION OF FIELD PROBLEMS

Classification of partial differential equations - Quasiharmonic equation - Steady state problems - Eigen value problems - Propogation problems - Examples, Torsional problem - Fluid flow and Heat transfer problems - Acoustic vibrations. **9**

UNIT IV

FINITE ELEMENT FORMULATION OF SOLID MECHANICS PROBLEMS

Axial force member - element matrices for axial force members - Truss element analysis of pinned truss - Two dimensional elasticity problems **8**

UNIT V

NUMERICAL METHODS IN FEM

Evaluation of shape functions - One dimensional & triangular elements, Quadrilateral elements, Isoperimetric elements - Numerical Integration, Gauss Legendre quadrature - Solution of finite element equations - Cholesky decomposition, Skyline storage - Computer implementation. **7**

TEXT BOOKS

1. Larry J Segerlind ,“ Applied Finite Element Analysis”, John Wiley, 1984.

REFERENCES

1. K.J.Bathe, “Finite Element Procedures”, Prentice Hall, 1994.
2. Huebner and E.A.Thornton, “The Finite Element Method for Engineers”, John

Wiley, 1982.
3. Reddy, “Introduction to Finite Element Method”, McGraw Hill, 1993

TMT703/ME 703 **AUTOMOBILE ENGINEERING** **L T P**

3 1 0

Unit I

Power unit and gearbox: Principles of design of main components. Valve mechanism. Power and torque characteristics. Rolling, air and gradient resistance. Tractate effort. Gearbox. Gear ratio determination. Design of gearbox. **7**

Unit II

Transmission System: Requirements, clutches, torque converters over drive and free wheel universal joints, differential gear mechanism of rear axle. Automatic steering and front axle, caster angle, wheel chamber toe-in toe-out etc, steering geometry, under steer and over steer. **8**

Unit III

Braking system: General requirements, road, tyre adhesion, weight transfer, braking ratio, mechanical brakes, hydraulic brakes, vacuum and air brakes, thermal aspects. Chassis and suspension system. Loads on the frame strength and stiffness, various suspension systems **8**

Unit IV

Electrical system Types of starting motors, generators and regulators, lighting system ignition system horn battery etc. Fuel supply system: Diesel and petrol vehicles system such as fuel injection pump, injector and fuel pumps carburetors and MPFI etc **9**

Unit V

Cooling and lubrication system: Different types of cooling system and lubrication system Maintenance system: Preventive system brake down maintenance system and overhauling system. **8**

References

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

6 Automobile Engg – Dr. A K Singh By Narosa Publication
7 IC Engine – H B Keshwani

TMT 751 **CAD/CAM LAB**

L	T	P
0	0	2

List of experiments – CAD Labs

1. Line drawing or circle drawing algorithm experiment: writing the Programme and running it on the computer
2. Transformation algorithm experiment for translation / rotation/scaling: writing the Programme and running it on the computer
3. Design problem experiment: Writing the program for design on machine element or other system and running it on computer
4. Optimization problem experiment: writing a program for optimizing and running it on computer
5. Auto CAD experiment: Understanding and use of auto CAD commands]
6. Use of graphic software standards packages e.g. GKs/PHICS/GL etc.
7. Use of Pro Engineer/IDEAS etc.

List of experiments – CAM Labs

1. Writing a part programming (In word address or in APT) for a job for drilling operation (point to point) and running the on NC machine
2. Writing a part programming (In word address or in APT) for a job for milling operation (contouring) and running the on NC machine
3. Experiment on different between ordinary machine and NC machine, Study or retrofitting.
4. Experiment on study of system device such has motors feed back devices.

5. Experiment on Mechtronics & Controls

TME 753 **AUTOMOBILE ENGINEERING - LAB**

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List of experiments

1. Study & experiment on braking system.

2. Study & experiment on fuel supply system.
3. Study & experiment on ignition system.
4. Study & experiment on steering system.
5. Study & experiment on transmission system.
6. Study & experiment on suspension system.
7. Study safety aspect of automobile design.
8. Study & experiment on Lighting or lubrication system.
9. Study & experiment on lubrication and cooling system.
10. Comparative study features of common small cars (such as fiat, Ambassador, Maruti, Matiz, Santro, Indica and its variations) available in India.
11. Comparative study & technical features of common scooters & motorcycles available in India. Case study/term paper.
12. Comparative & Technical features of common heavy vehicles available in India. Case study/term paper.
13. Engine tuning and carburetor servicing experiment.
14. Experiment & study of MPFI system.
15. Experiment on fuel consumption measurement.

16. Review experiment on IC Engines & modern trends.
17. Visit of an Automobile factory.
18. Study & experiment of main gearbox and differential gear box.

Elective-1	ADVANCED FOUNDRY TECHNOLOGY	L	T	P
TMT013		3	0	0

UNIT I

INTRODUCTION

Design advantages of casting, Advantages of casting process, Metallurgical advantage **4**

UNIT II

Technology of pattern making requirement, Pattern material, wood &wood product, plaster, Plastics and rubbers, Polyesters resins waxes, Machines and tools for pattern making machine for wood pattern making, Machines for metal pattern making, Allowance and other Technological considerations – contraction allowance, Machining allowance, Draft or taper allowance, Rapping and shake allowance, Distortion allowance, Core Prints, Core boxes, Use of loose pieces **6**

UNIT III

TECHNOLOGY OF MOULDING AND CORE MAKING

Moulding sands, Principal ingredients of molding sands, Specification and testing of moulding sands, Classification of Moulding sands, Additives to moulding and Core making sands, Mould Dressings. Sand Conditioning, Sand Preparation equipment. **8**

UNIT IV

MOULDING PROCESSES

Types of sand moulding, Tools for hand moulding, Characteristics of cores and core sands, Types of cores, Use of chaplets, Machine moulding, Core making machines, Processes based on organic binders **8**

UNIT V

TECHNOLOGY OF METAL MOULD CASTING PROCESSES

Permanent mould casting, Types of die casting machines, Centrifugal casting, Continues casting, Electro slag casting, Gating system, Risering of casting, Economic considerations, Melting equipments for foundries, Defects in castings. **7**

UNIT VI

MODERNISATION & MECHNISATION OF FOUNDRIES

Need, Area for mechanisation, Material handling, Pollution control in foundries, Pollutants in a foundry, Plant layout for foundries, steps in planning a foundry layout. **7**

References

1 Principal of Foundry Technology – P L Jain, Tata Mc Grew Hill

Elective 01	**OPERATIONS RESEARCH**	**L**	**T**	**P**
TMT011		**3**	**0**	**0**

Unit I

Linear Programming-Simplex methods, primal & dual problem sensitivity analysis. **8**

Unit II

Transportation & Assignment problems. Dynamic Programming-Multistage decision problems & solution, Principle of optimality. **8**

Unit III

Decision theory-Decision under various conditions. Game Theory-Minimum & maximum strategies. Application of linear programming. **8**

Unit IV

Stochastic inventory models-Single & multi period models with continuous & discrete demands. **8**

Unit V

Simulations-Monte Carlo simulation, generation of random numbers & simulation languages. Queuing models-M.M.1 & M/M/S system cost consideration **8**

References

1 H.A.Taha, “Operations Research ", Prentice Hall of India, 1999, Sixth Edition.
2 S.Bhaskar, “Operations Research ", Anuradha Publishers, Tamil Nadu, 1999
3 Shennoy, Srivastava, “Operation Research for Management ", Wiley Eastern, 1994.
4 M.J. Bazara, Jarvis, H. Sherali, " Linear Programming and Network Flows ", John Wiley, 1990
5 Philip and Ravindran, “Operational Research ", John Wiley, 1992
6 Hillier and Lieberman, “Operations Research ", Holden Day, 1986
7 Frank, S.Budnick, Dennis, McLeavy, " Principles of Operation Research for Management ", Richard D Irwin, 1990

Elective1 TMT012	DESIGN PLANNING AND CONTROL OF PRODUCTION SYSTEMS	L 3	T 1	P 0

UNIT I

Introduction to production systems:

Generalized model of production systems, types of production flows and impact on system design. Lifecycle concepts in production systems **6**

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UNIT II

Design of production system: Facilities location And layout planning, Design of mass production systems, Balanced assembly lines. Material handling activities, objective of material handling, Importance material handling, computation of material handling cost, Material Handling survey check sheet, Methods material handling, Types of materials stages of handling, Materials handling equipments Selection of material handling equipment. **7**

Unit III

Planning of production, Systems models of aggregate production planning, Batch production system planning. Multistage production inventory system. In process inventory, Sequencing and scheduling models. **7**

Unit IV

Materials requirement planning. Computerized production control, LOB, element of monitoring and follow up. Basics of Material Requirement Planning, Manufacturing Resource Planning (MRPI),Lot sizing in MRP. **8**

UNIT V

Case studies **12**

References

1 Production & operation Management, Buffa E S and Sarin R K (willy 1987) 8th Edn
2 Production & operation Management, Concept models & Behavior Adame E E & R J Ebort 5th Edn (PHI) 1993
3 Analysis & Control Of Production System, E A Elsayed & T O Bouchy
4 Production Planning & Inventory, wily 1974
5 Operation Management, S N Cherry,TMHND 1988
6 Elements of Production Planning & Control, Elions
7 Facilities planning & layout, -Topmpkin's & White

Elective-1	MECHANICAL VIBRATIONS	L	T	P
TME021		3	0	0

UNIT I

REVIEW OF SINGLE DEGREE OF FREEDOM SYSTEM

Review of Free and Forced Un damped and damped Vibrations of Single Degree of Freedom Systems. **5**

UNIT II **8**

TWO DEGREE OF FREEDOM SYSTEMS

Introduction, Principle modes, Double Pendulum, Torsional Two degree of freedom System with Damping, Un damping Dynamic Vibration Absorbers, Centrifugal Pendulum Absorber, Dry Friction Damper, Untuned Viscous Damping.

UNIT III **10**

MULTI DEGREE OF FREEDOM SYSTEMS

Un damped free and Forced Vibration of Multi- Degree system Influence Numbers. Reciprocal Theorem Torsional Vibration of Multi- Rotor System. Vibration of Geared Systems Principle Coordinates Longitudinal Vibration of Bars Lateral Vibration of Beams Solids or Structural Damping Slip Or Interfacial Damping Eddy Current Damping.

UNIT IV **09**

NUMERICAL METHODS

Rayleigh's Dunker ley's, Holzer's and Strodda methods Rayleigh Ritzs Method

CRITICAL SPEED OF SHAFTS

Shafts with one disc with or without damping. Multi- Disc Shafts Secondary Critical Speeds.

UNIT V **08**

TRANSIENT VIBRATION

Harmonic Excitation Laplace Transform Response To Step And Pulse Inputs. Impulsive Inputs. Hock Spectrum.

NON LINEAR VIBRATION Brief Introduction to Non – Linear system. Un-damped Free Vibration with Non-linear Spring force Hard and Soft Springs Self excited vibrations Due to dry friction.

Reference:

1. Mechanical Vibration – P.Srinivasan – TMH
2. Mechanical Vibration – GK. Grover – Jain Bros Roorkee
3. Mechanical Vibration – WT. Thomson
4. Mechanical Vibration - Theory and Application - Tse, Morse & Hinkle

5. Introduction Course on theory And Practice of Mech. Vibration – JS Rao & K Gupta, New Age Publishers.

TMT 801

AUTOMATION & ROBOTICS

L	T	P
3	1	0

Unit I

REASONS FOR AUTOMATION

Reasons for Automation: Strategies of Automation, Detroit type of Automation, Flow lines, Transform Mechanisms, work part transfer, Different Methods, Problems.

Automation for machining operations design & Fabrication consideration, machining center, center. **8**

Unit II

ANALYSIS OF AUTOMATED FLOW LINES

Analysis of transfer lines without storage-with storage buffers Single stage, Double stage, multistage with problems, Automated assembly systems-Design for Automated assembly parts feedings devices-analysis of Multi-station assembly machine, Analysis of Single stage Assembly Machine, Automated inspection-principles and methods, sensors, coordinate, measuring machine, machine vision system, optical inspection method. **8**

UNIT III

AUTOMATED MATERIAL HANDLING STORAGE

Material handling function, types of material handling Equipment, analysis of material handling systems, Design of systems, Conveyor systems, Automated guided vehicle systems, Automated storage/Revival systems. Caroused storage systems work in process storage, interfacing handling & storage with manufacturing. **8**

Unit IV

INTRODUCTION TO ROBOTICS

Robot configurations - Types of Robot drives - Basic robot motions - Point to point control - Continuous path control

COMPONENTS AND OPERATIONS Basic control system concepts - control system analysis - robot actuation and fed back, Manipulators – director and inverse kinematics, Coordinate transformation - Brief Robot dynamics. Types of Robot and effectors - Grippers - Tools as end effectors - Robot/End - effort interface. **8**

Unit V

ROBOT PROGRAMMING

Methods - languages - Capabilities and limitation - Artificial intelligence - Knowledge representation – Search techniques - A1 and Robotics

INDUSTRIAL APPLICATIONS **8**

Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading - CIM - Hostile and remote environments.

References

1. Micell P. Groover, “Automation, Production System and computer integrated manufacturing ", Prentice - Hall of India Pvt Ltd., 1995.
2. N.Viswanadham and Y. Narahari, “Performance Modelling of automated Manufacturing Systems ", Prentice-Hall of India Pvt Ltd., 1994.
3. . P.Radhakrishnan and S.Subramanian, “CAD/CAM/CIM ", Wiley Eastern Limited, 1994.
4. GIDEON HALEVI and ROLAND D.WEILL, “Principles of process planning ", Chapman Hall, 1995.
5. Koren Yoram, “Robotics for Engineers”, McGraw Hill

TMT 802 **Tool Engineering**

L	T	P
3	1	0

Unit I

General Considerations:

Tool classification, Tool materials, properties & applications, Tooling economics General design considerations, Safety aspects. 6

Unit II

Design Of Metal Cutting Tools:

Design of single point cutting tool for strength & rigidity. Design for optimum geometry. Design strategies for H. S. S, Carbide and Ceramics chip Breakers, Design of form tool.

Multipoint cutting tool: Design of drills, reamers, milling cutters, broach & gear cutting tools. 9

Unit III

Design Of Metal Working Tools:

Design of press working tools, shearing, piercing, blanking, dies, compound die design, progressive dies, bending, forming drawing dies. Tooling for Forging-Design principles for forging dies, Drop forging, upset forging. Design principles and practice for rolling, Roll pass Design. 10

Unit IV

Design Of Jigs And Fixtures: Principles of location and clamping, locating & clamping, materials for locating and clamping elements, Drilling bushes. Design of various **j**igs & fixtures. 7

Unit V

Design Of Gauges And Inspection Features: Design of gauges for tolerancing for dimensions and form inspection.

Dies And Mould Design For Plastics & Rubber Parts: Compression Moulding, transfer Moulding, blow Moulding. 8

Suggested Books:

1. Fundamentals of Tool Design Wilson ASTME
2. Tooling for production parron
3. Tool Design Donaldson T.M.H.
4. Die Design Handbook Paqwin J.R. The Industrial Press, NY
5. Die Design Hand Book by ASTME/ McGraw Hill
6. Metal cutting & Cutting Tool Design Archinov MIR Publishers Moscow

Introduction to Jig and Tool Design M. H. A. Kempster FLBS

TMT 803	ADVANCED WELDING TECHNOLOGY	L	T	P
		3	1	0

Unit I

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

Review of Conventional Welding Process: Gas Welding, Arc Welding, MIG, TIG Welding,SAW, Resistance Welding, Electro slag Welding, Friction Welding. **7**

Unit II

Advanced Welding Techniques – Principle and working and application of advanced welding techniques such as Plasma Arc Welding, Laser Beam Welding, Electron beam welding, Ultrasonic Welding etc. **8**

Unit III

QUEUEING THEORY

Advanced Welding Techniques – Principle and working and application of advanced welding techniques such as explosive welding/ cladding, Underwater welding, spray welding hard facing. **8**

Unit IV

Weld Design: Weld defects and distortion and its remedies, Inspection / testing of welds, Macrostructure & microstructure of welds, HAZ Weld Design, Welding of pipelines and pressure vessels, Life prediction. Techniques for welding of specific materials like steel, copper, Titanium. **8**

Unit V

Thermal and Metallurgical Consideration: Thermal consideration for welding, temperature distribution. Analytical analysis, Metallurgical consideration of Weld, HAZ and Parent metal, structure solidification of weld **9**

References

1 Welding Hand Book American Welding Society

2 Advanced Welding Techniques by R. S. Parmar.

TMT 851	COMPUTER INTEGRATED MANUFACTURING LAB	L	T	P
		0	0	2

List of Experiments:

1. Study of robot anatomy
2. Study of various robot programming techniques
3. Write a program to perform the desired task
4. Study of automated material handling system.
5. Design a work cell to perform loading and unloading.
6. Study of various sensors used in factory.
7. Study & use some comparative integrated inspection systems
    - CMM
    - Optical Instruments
    - Laser Interfero meter
    - Surface imaging & roughness
    - Digital linear measurement instruments
8. Use of 3D software for design
    - Press tools
    - Plastic component moulds
    - Fixtures
9. Use of MIG, TIG & other special welding techniques to prepare different types of joints
10. Study of different techniques used for inspection of welds
11. Study of micro & macro structure of welds

Elective -2 **PROJECT MANAGEMENT** **L T P**

TMT 021 **3 0 0**

UNIT I

Project Management concepts, Establishing the Project and Goals; Organizing Human Resource and contracting; organizing systems and Procedures for implementation, project direction, coordination & control. Project management performance. **7**

UNIT II

Project Management case studies; Project information systems; computer based Project Management; Future of Project Management. **8**

UNIT III

Development of Project Network; Time estimation, Determination of critical Path (CPM), Event slacks and floats, choice of a schedule in view of resource constraints. Program Evaluation Review Technique (PERT) Examples, illustrations & case studies. **10**

UNIT IV

Misc. Topics **5**

Introduction to MRP/ERP, TQM and e-commerce etc.

References

F Project Management, A Systems Approach – H. Kerzner, CBS Publishers
2 A Management Guide to PERT/CPM - Wiest , J. D. and F. K. Levy, Prentice Hall
3 Management by Network - S. Bhattacharya, Institution of Engrs
4 Network Based Management System - O'Brien, McGraw Hill
5 PERT and CPM, Principles and Applications - L. S. Srinath, East-West Press
6 Project Management, - Dr, A K Singh, Laxmi Publication
7 Entrepreneurship Development and Management.-By Dr A.K.Singh Laxmi Publication.

TMT 022 **SUPPLY CHAIN MANAGEMENT**

L	T	P
3	1	0

Unit I

Understanding The Supply Chain: Basic Concept & Philosophy of Supply Chain Management; conceptual model in SCM, essential features, infrastructure, flows (cash, value and information), key issues in SCM, benefits and case examples. 07

Unit II

Planning & Managing inventories in supply Chain: Concept, various costs associated with inventory, various EOQ models, ABC Analysis, SDE / VED Analysis buffer stock Managing uncertainty in a supply chain: Planning Demand and Supply in a Supply Chain: Demand Forecasting in a supply chain, Concept of aggregate planning, Use of mathematical model for vendor rating / evaluation, single vendor concept, management of stores, accounting for materials, Just-In-Time & Kanban System of Inventory management, case studies. 10

Unit III

Operations Management in SCM:

Basic Principles of Manufacturing Management, Manufacturing System, Lean manufacturing agile manufacturing, quick response manufacturing (QRM), ERP, implementation of ERP, ERP software applications.

Process management: TQM, JIT issues in supply chain management. Basic elements of TQM&JIT, casestudies. 08

Unit IV

Logistics management**:** History and evaluation of logistics, elements of logistics, Managing Cross- Functional Drivers in a Supply Chain: Logistics as part of SCM, Logistics costs, different models, logistics sub-system, inbound and outbound logistics, bullwhip effect in logistics, outbound logistics-distribution and warehousing management.

08

Unit V

Recent Issues in SCM: Role of Computer / IT in Supply Chain Management, CRM Vs SCM, Benchmarking- concept, features and implementation, Outsourcing-basic concept, value addition in SCM-concept of demand chain management. 07

SUGGESTED READINGS

1. G. Raghuram (I.I.M.A.)-Logics and Supply Chain Management Macmillan, 2000
2. Emiko Bonafield -Harnessing Value in the Supply Chain, John Wiley: Singapore, 1999
3. Dr. Gopal Krishnan-Material Management rearew, 2002 Pearson New Delhi.
4. R.G. Koragaonkar-JIT Manufacturing
5. B.S. Sahay, Macmillan- Supply Chain Management, 2000.
6. S.Chopra & PeterMeindl – Supply Chain Management
7. Dr.A.K.Singh – Entrepreneurship Development and Management by Laxmi Publication.

Elective-02

TMT-023 ADVANCED METROLOGY AND MEASUREMENT

L	T	P
3	1	0

METROLOGY

UNIT-I **(6)**

- Computer Aided Metrology – Principles and interfacing, software metrology.
- Laser metrology – Applications of Lasers in precision measurements – Laser interferometer, speckle measurements, Laser scanners. Introduction to Nano-metrology.

UNIT-II **(8)**

- Coordinate Measuring Machine – Types of CMM – Probes used – Applications – Non-contact CMM using Electro optical sensors for dimensional metrology – Non-contact sensors for surface finish measurements.

MEASUREMENT

UNIT-III

Basic functional elements and classification of instruments. Basic concepts like sensitivity, threshold, resolution, precision and accuracy, linearity, zero drift, sensitivity drift, etc. Relation between concepts.

UNIT-IV **(6)**

Definition for source of error and methods of minimizing for eliminating the effects of error sources like friction, play, temperature, loading error, etc. Error and least count through four-quadrant diagram.

Uncertainty of measurements, static calibration, Error in computed value and rounding -off procedure**.** **(10)**

UNIT-V

Dynamic characteristics of zero- order, first-order, and second-order instruments for step, ramp, sinusoidal and impulse inputs. Signal conditioners like bridge circuit, amplifiers, and low pass filter and radio telemetry, Analysis of random signals.

Measurement of quantities like displacement, velocity, acceleration, force, torque, temperature, pressure, vacuum, sound, flow, and level**.** **(10)**

Text Books / References:

1.Parsons. S. A. J, Metrology and Gauging, MacDonald and Evans, UK, 1970
2. Hume K. J., Engineering Metrology, Kalyani Publishers, India, 1970.
3. Rembold et al. U, Computer Integrated Manufacturing Technology and Systems, Marcel Dekker Inc., USA, 1985.
4. Robinson S. L. and R. K. Miller, Automated Inspection and Quality Assurance, Marcel Dekker, 1989.
5. Galyer J. and C. Shotbolt, Metrology for Engineers, Cassel, London, 1980
6. Doebelin E. O., "Measurement Systems-Application and Design", McGraw Hill, 1990
7. Raman R., "Principles of Mechanical Measurements" Oxford & IBH, 1992.
8. Holman J. P., "Experimental Methods for Engineers", McGraw Hill, 1966.
9. Beckwith, T. G., and Buck N. L., "Mechanical Measurements", Addison Wesley, 1965.

Elective -2 TMT024	REFRIGERATION AND AIR CONDITIONING	L 3	T 1	P 0

UNIT II

Introduction

Introduction to refrigeration system: Methods of refrigeration, Carnot cycle, Unit of refrigeration capacity, C. O.P., Application
Air refrigeration cycle, Bell Coleman air refrigeration cycle, Baryton refrigeration cycle, Optimum C.O.P. And Pressure ratio, air craft refrigeration system, classification of air craft refrigeration system, Actual power for refrigeration system, Dry air rated temperature [DART] 6
Classification, Nomenclature, Desirable properties of refrigerants, common refrigerants and CFM free refrigerants **10**

UNIT II

Vapor Compression System:

Single stage system, Analysis of vapor compression cycle, Effect of pressure charge on C.O.P. use of T- S and p-h chart, Effect of sub cooling of condensate on C.O.P. and capacity, effect of super heating of vapor compression constructional details of Refrigerator and Air conditioners. Multistage compression. **8**

UNIT III

Vapor – Absorption System:

Working principle of continuous Absorption system, comparison between Absorption and compression system. Theory of mixtures, Temp-concentration Diagram Enthalpy concentration diagrams. Adiabatic mixture of two systems. Lithium- Bromide water – vapor absorption system. Working principle, comparison with Ammonia – water system. **6**

UNIT IV

Air Conditioning: -

Introduction to air – conditioning, psychometrics terms, Definitions, Adiabatic saturation and thermodynamics, Wet-bulb temperature, psychometric use of psychometric chart, air conditioning requirement for comfort and industrial processes, comfort chart and comfort zone, cooling towers, cooling and load calculations. **8**

UNIT V

Refrigeration Equipment and Application: -

Expansion device, duck design. Food preservation cold storage, refrigerators, freezers, ice plant, water coolers, thermal analysis for human body. Automotive air conditioning brief overview. Introduction to solar radiation distributions. Empirical methods to evaluate heat transfer through walls and roofs infiltration, passive heating and cooling of buildings. **8**

References

1 Refrigeration and Air conditioning by Manohar prasad.
2 Principle of refrigeration by Roy J. Dossat
3 Refrigeration and Air conditioning by Arora and Domkundwar
4 Refrigeration and Air conditioning by C.P.Arora

Elective 03	PRODUCTION OF GEARS AND SCREWS	L	T	P
TMT031		3	1	0

Unit I

INTRODUCTION TO GEARS

Types of gears, classification, gear drawings, gearboxes, application of gears, gear production methods, an overview.

GEAR MATERIALS

Non-metallic, ferrous and non-ferrous gears. Properties of gear materials, selection of material for typical gears and applications – blank preparation methods for different gears, size, type and material. **7**

Unit II

PRODUCTION OF GEARS & SCREW THREADS

Gear milling different gears, cut quality obtainable. Gear hobbing, description and operation of machine, types of gears cut, hobbing cutters, work holding methods gear shaping, disc type and rack type gear shapers, Production of straight bevel gears and spiral gears, milling, generation by straight bevel gear generator. Duplex cutter, straight bevel gear generator, Spiral bevel gear generator.

PRODUCTION OF SCREW THREADS: Screw thread terminology, Types of screw thread, Methods of producing screw threads, Effect of pitch errors, measurement of various elements of screw threads. Thread rolling, Thread Grinding, Mass Production of Screws. **12**

Unit III

HEAT TREATMENT OF GEARS

Through hardening, case hardening, flames hardening, induction hardening of gears, Nitriding of gears. Tuft riding of gears. Inspection of gears for hardening defects

GEAR FINISHING

Gear finishing advantages, finishing of gears by grinding, shaving, lapping, honing methods and cold rolling of gears. Description of machines, process and process parameters **7**

Unit IV

GEAR INSPECTION

Types of gear errors, gear quality standards tooth thickness and base tangent length measurement, pitch errors, radial run out errors, profile errors, pitch error measurement. Composite error measurement. Computerized gear inspection centers. Reasons and remedies for gear errors **6**

UNIT V

MODERN GEAR PRODUCTION METHODS

Gear production by stamping, die casting, power metal process, injection and compression Moulding in plastics. Die casting, cold and hot rolling, mass production methods shear speed shaping. Gear broaching – Gleason. G-Trac Gear generation method **8**

References

1 HMT, “Production Technology “TMH, INDIA 1992

2 Week, M “Handbook Tools” Vol 1, Jhon Wiley and Sons 1984

3 Society of Manufacturing engineers, Gear Priocessing and Manufacturing”, 2nd Edition 1984

TME-024	FUNDMENTALS OF BIO MEDICAL ENGINEERING	L	T	P
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UNIT I

Biomechanics

Statics and dynamics of the musculoskeletal system, forces and moments. Acting in the skeletal system and the various techniques used to describe them. Forces and moments with in the body such as forces acting at hip and knee joint and in the extremities. Analysis of pathological situations of human joints. **8**

UNIT II

Biomaterials

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

UNIT III

Bio Fluid Flow

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

UNIT IV

Bioinstrumentation

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

UNIT V

Computing for Biomedical Engineers

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

References

1 Basic orthopedic biomechanics, Editors-VC Mow & Wc Hayes, Lippincott Raven Publishers.

2 Biomaterials Science- An Introduction to Materials in Medicine. Buddy D.Rattner, Allan S.Hoffman, Frederick J.Schoen, Jack E.Lemmons, Editors, Academic Press.

3 Biomaterials: An Introduction (second edition) Joon B.Park & Roderic S.Lakes, Plenum Press, 1992

4 Biofluid Mechanics, Jagan N.Mezumdar; World Scientific Pub.Co.,NJ 1992

5 Handbook of Biomedical Instrumentation, RS Khandpur.

6 Mthematical models in biology and medicine- J.N.Kapur, Affiliated East West Press Pvt. Ltd., New Delhi-India

7 Bone Mechanism – W.C.Heys, CRC Press

8 Computers in Medicine- Lele.

Elective III

TMT032 SIMULATION AND MODELING

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UNIT-1	**3**	**1**	**0**

PHYSICAL MODELING

Concept of system and environment, continuous and discrete system, linear and nonlinear system, stochastic activities, static and dynamic models, principles used in modeling, Basic simulation modeling, Role of simulation in model evaluation and studies, Advantages and Disadvantages of simulation. Modeling of Systems, iconic analog. Mathematical Modeling 08

UNIT-1I

COMPUTER SYSTEM SIMULATION

Technique of simulation, Monte Carlo method, experimental nature of simulation, numerical computation techniques, continuous system models, analog and hybrid simulation, feedback systems, Buildings simulation models of waiting line system, Job shop, material handling and flexible manufacturing systems 07

UNIT-1II

PROBABILITY CONCEPTS IN SIMULATION

Stochastic variables, discrete and continuous probability functions, random numbers, generation of random numbers, variance reduction techniques, Determination of the length of simulation runs, Output analysis. 09

UNIT-IV

SYSTEM DYNAMICS MODELING

Identification of problem situation, preparation of causal loop diagrams and flow diagrams, equation writing, level and rate relationship. Simulation of system dynamics model. 08

UNIT-V

VERIFICATION AND VALIDATION

Design of simulation experiments, validation of experimental models, testing and analysis. Simulation languages comparison and selection, study of SIMULA, DYNAMO, STELLA, POWERSIM. Simulation softwares 08

Suggested Reading

- Gordon G., System simulation, Prentice Hall.
- Payer T., Introduction to system simulation, McGraw Hill.
- Spriet, Computer Aided Modeling and Simulation, W.I.A.
- Sushil, System Dynamics, Wiley Eastern Ltd.
- Shannon R.E., System simulation, Prentice Hall.
- Allan Carrie, " Simulation and Manufacturing", Jhon Wiley & Sons

* Simulation & Modelling: Kelton &Law.Mc Graw Hill.