

NORTH MAHARASHTRA UNIVERSITY, JALGAON  
STRUCTURE OF TEACHING AND EVALUATION  
S.E. (MECHANICAL ENGINEERING)

***FIRST TERM***

**W.E.F. 2006-07**

Sr. No.	Subject	Teaching Scheme Hours/week			Examination Scheme				
		Lectures	Tutorial	Practical	Paper Duration Hours	Paper	TW	PR	OR
1	***Engineering Mathematics-III	4	--	--	3	100	--	--	--
2	***Strength of Materials	4	--	--	3	100	25	--	--
3	***Material Science	4	--	2	3	100	25	--	25
4	Manufacturing Engineering-I	4	--	--	3	100	--	--	--
5	Applied Thermodynamics	4	--	2	3	100	25	--	25
6	Machine Drawing	--	--	2	--	--	25	--	--
7	**Computer Graphics	--	--	2	--	--	25	25	--
8	***Workshop Practice -III	--	--	2	--	--	50	--	--
	<b>Total</b>	<b>20</b>	<b>--</b>	<b>10</b>		<b>500</b>	<b>175</b>	<b>25</b>	<b>50</b>
	<b>Grand Total</b>	<b>30</b>			<b>750</b>				

\*\* Common with Automobile Engineering

\*\*\* Common with Production Engineering and Automobile Engineering

***SECOND TERM***

Sr. No.	Subject	Teaching Scheme Hours/week			Examination Scheme				
		Lectures	Tutorial	Practical	Paper Duration Hours	Paper	TW	PR	OR
1	**Theory of Machines	4	--	2	3	100	25	--	25
2	***Industrial Engineering	4	--	--	3	100	25	--	--
3	***Fluid Mechanics	4	--	2	3	100	25	--	25
4	***Electrical Machines and Industrial Electronics	4	--	2	3	100	25	--	--
5	Manufacturing Engineering-II	4	--	--	3	100	25	--	--
6	***Workshop Practice-IV	--	--	4	--	--	25	--	50
	<b>Total</b>	<b>20</b>	<b>--</b>	<b>10</b>		<b>500</b>	<b>150</b>	<b>00</b>	<b>100</b>
	<b>Grand Total</b>	<b>30</b>			<b>750</b>				

\*\* Common with Automobile Engineering

\*\*\* Common with Production Engineering and Automobile Engineering

## Engineering Mathematics-III

(Common with Production Engineering And Automobile Engineering)

Teaching Scheme

Lecture: 4 Hours/Week

Examination Scheme

Theory Paper: 100 Marks

Paper Duration: 3 Hours.

### Unit: I Linear Differential Equations

Linear Differential Equations of order n, Solution of LDE with constant coefficient, method of variation of parameters, Equations reducible to linear form (with constant coefficient), Cauchy's linear equation, Legendre's linear equation. Whirling of Shafts.

(10 Hrs, 20 Marks)

### UNIT: II

a) Simultaneous differential equation. Introduction to Applications to mass spring system.

b) Solution of Partial Differential Equations.

(i) One dimensional heat flow equation :  $\partial u / \partial t = a^2 \partial^2 u / \partial x^2$

(ii) Laplace's equations (Two dimensional heat flow equation):

$\partial^2 u / \partial x^2 + \partial^2 u / \partial y^2 = 0$  by separating variables only.  
Applications of Partial Differential equations to problems of Mechanical and Allied Engineering.

(10 Hrs, 20 Marks)

### Unit: III Laplace transforms

Laplace Transform (LT): Definition, Existence, Laplace transforms of elementary/simplified functions, Theorems & Properties of LT (without proof), Inverse LT, Solution of differential equations using LT

(10 Hrs, 20 Marks)

### Unit: IV Statistics

Introduction to Mean, Mode, Median, Standard deviation.

Variance, Coefficient of variation, Moments, Skewness and Kurtosis.

Correlation and Regression, Chi-square tests.

(10 Hrs, 20 Marks)

### UNIT: V a) Probability

Revision of probability theorems. Probability distribution, Binomial, Poisson & Normal distributions.

### **b) Fourier Transform (FT)**

Fourier Integral theorem, Sine & Cosine Integrals. Fourier Transforms, Fourier Cosine Transforms, Fourier Sine Transform and their inverse.

(10 Hrs, 20 Marks)

\* No question is to be set on introductory part.

### **Text Books**

1. P.N. Wartikar & J.N. Wartikar A text of applied Mathematics (Volume –III), Pune Vidyarthi Griha Prakashan, Pune.
2. B.S. Grewal Higher Engineering Mathematics, Khanna Publication, New Delhi.
3. H.K. Das, Advance Engineering Mathematics S. Chand & Co. New Delhi.

### **Reference Books**

- 1 Erwin Kreyszig, Advanced Engineering Mathematics (7<sup>th</sup> edition) Wiley Eastern Ltd., Bombay.
2. C.R. Wylie, Advanced Engineering Mathematics McGraw Hill Publications, New Delhi.
- 3 Peter V.O'Neil, Advanced Engineering Mathematics (5<sup>th</sup> edition) Thomson Brook Cole, Singapore.
- 4 Kishore S, Trivedi, Probability & Statistics with reliability, queuing & Computer Science application Prentice Hall of India Pvt. Ltd., New Delhi.

## **STRENGTH OF MATERIALS**

(Common with Production Engineering And Automobile Engineering)

Teaching Scheme

Lecture: 4 Hours/Week

Examination Scheme

Theory Paper: 100 Marks

Term Work: 25 Marks

Paper Duration: 3 Hours.

### **UNIT: I SIMPLE STRESSES AND STRAIN**

Concept of stress and strain (linear, lateral, shear and volumetric), Hook's law, Poisson's ratio, modulus of elasticity, modulus of rigidity, stress-strain diagram for ductile and brittle materials, factor of safety and working stress, concept of 3-D stress state, bulk modulus, inter relation between elastic modulus.

Axial force diagram, stress-strain, deformations in determinate homogeneous and composite bars of following types.

- 1) Prismatic
- 2) Linearly varying
- 3) Stepped section under concentrated loads and self-weights.

Axial stresses and strain in determinate members –axial stress, strain and deformation in following indeterminate, homogeneous and composite bars.

- 1) Prismatic
- 2) Linearly varying
- 4) Stepped section under concentrated loads, self-weights and temperature changes.

(9 Hrs, 20 Marks)

### **UNIT: II PRINCIPLE STRESSES AND STRAINS**

Normal and shear stress on any oblique plane, concept of principle plane, derivation of expression for principle stresses and planes and plane of max. Shear stress, position of principle plane and plane of max. Shear, graphical solution using Mohr's circle of stresses, combined effect of shear and bending in beams.

Strain energy and impact-concept of stain energy, derivation and use of expression for deformation of axially loaded members under gradual, sudden and impact loads. Strain energy due to self-weight.

Theories of failure- Maximum stress, maximum strain, maximum shear stress, maximum total strain energy.

(9 Hrs, 20 Marks)

### **UNIT: III SHEAR FORCE AND BENDING MOMENT DIAGRAM**

Concept and definition of shear force and bending moment in determinant beams due to concentrated loads, UDL, UVL and couple.

Relation between SF, BM and intensity of loading, construction of shear force and bending moment diagram for cantilever, simple and compound beams, defining critical and maximum value and position of point of contra flexure.

Construction of BMD and load diagram from SFD, Construction of load diagram and SFD from BMD.

Slope and deflection for member in bending relation between moment and slope, slope and deflection of determinate beams, double integration method (Macaulay method) Derivation of formulae for slopes and deflections for standard cases, moment area method, conjugate beam method.

(9 Hrs, 20 Marks)

#### **UNIT: IV BENDING STRESSES**

Theory of simple bending, assumptions in bending theory, Derivation of flexural formula, Area center and moment of inertia of common cross section (regular section, T- section, channel section, I-section) with respect to centroidal and parallel axis, bending stress distribution diagram, moment of resistance and section modulus calculations.

Direct and bending stresses in short column and other structural component, Stress distribution diagram, axial load for single eccentric self weight combined with lateral loads, concept of core section, middle third rule.

Shear stresses: - Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common cross section, maximum and average shear stresses, shear connection between flange and web.

(9 Hrs, 20 Marks)

#### **UNIT: V TORSION IN CIRCULAR SHAFTS**

Stresses, strains and deformations in solid and hollow shafts, homogeneous and composite circular cross-sections subjected to torsion. Derivation of torsion equation. Stress due to combined torsion, bending and axial force on shafts.

Thin and thick walled pressure vessels: - Stress, strain and deformation in thin wall seamless cylindrical and spherical vessel due to internal fluid pressure, change in volume, constants, effects of additional compressible and incompressible fluid injected under pressure, use of I.S.code.

(9 Hrs, 20 Marks)

## REFERENCE BOOKS

- 1) Timoshenko, Mechanics of Materials, CBS Publisher & Distributor
- 2) Ramamrutham, Strengths of Materials, Dhanpat Rai Publication
- 3) Junnarkar & Advi, Mechanics of Structure, Charorar Publication House, ANAND
- 4) Bear & Johnson, Mechanics of Materials
- 5) Shigley J.E., Mechanical Engineering Design

# **MATERIAL SCIENCE**

**(Common with Production Engineering And Automobile Engineering)**

Teaching Scheme

Lecture: 4 hrs/week

Practical: 2-hrs/week

Examination Scheme

Theory Paper: 100 Marks

Term work: 25 Marks

Oral: 25 Marks

Paper Duration: 3 hrs.

## **UNIT-I Nature of Engineering Materials**

Nature of metals and alloys, structure-property relationship, atomic structure, atomic bonds, atomic arrangements in materials, crystal structure of metals, development of grain structure, elastic and plastic deformation of single crystals, dislocation theory of slippage, strain hardening or work hardening, plastic deformation in polycrystalline metals, ductile and brittle fractures, cold working, recrystallization and hot working.

Non-metallic materials: Plastic elastomers, ceramics and composites, property and structures. Application of these materials in various engineering fields.

(9 Hrs, 20 Marks)

## **UNIT-II Mechanical Properties and Testing**

Static property, tensile test, engineering and true stress, true strain curves, evaluation of properties and significance of test, typical engineering stress-strain diagrams, compression test, cupping test on sheet metals. Hardness test- Brinell, Poldi, Vickers, Rockwell superficial, Micro hardness test, Sceleroscope, Durometer, Mohr's test, relationship among the various hardness test, relationship of hardness to tensile strength, Dynamic properties, Impact tests, Charpy and Izod, Fatigue

test and the endurance limit, temperature effects, creep test, machinability, formability and weldability.

Non-destructive testing: Advantages and limitations of destructive and non-destructive testing, liquid penetrant, magnetic particle inspection, and ultrasonic test, radiography and eddy current test.

(9 Hrs, 20 Marks)

### **UNIT-III Equilibrium Diagrams**

Equilibrium Diagrams: Introduction, alloys, alloy types, phases, Hume Rothery's rule of solid solubility, Gibb's phase rule, Polymorphism, cooling curves, plotting of equilibrium diagrams, utilization of diagrams, solidification of alloy, types of equilibrium diagram, Isomorphs, eutectic and partial eutectic and layer type, Non-equilibrium cooling and its effects.

Strengthening mechanisms: Refinement of grain size, solid solution, hardening, desuperheating hardening, age hardening, martensitic transformation.

(9 Hrs, 20 Marks)

### **UNIT-IV Powder Metallurgy and Pyrometry**

Powder Metallurgy: Introduction Basic process, powder manufacturing, powder testing and evaluation, powder mixing and blending, compacting, sintering, hot isostatic pressing, secondary operations, applications, merits and demerits.

Pyrometry: principle, operation and uses of various pyrometers, thermocouples, thermocouple materials, resistance pyrometer, disappearing filament pyrometer, radiant pyrometer.

(9 Hrs, 20 Marks)

## **UNIT-V Corrosion and Prevention**

Corrosion and Prevention: Cost of corrosion, dry corrosion, wet corrosion, electrochemical mechanism, corrosion tendency and electrode potential polymerization, corrosion rates, passivity, forms of corrosion, galvanic pitting, crevice and intergranular corrosion, stress corrosion etc. Prevention of corrosion: selection of materials, modification of environment, design of components, cathodic protection, coating, anodizing, Inhibitors

Methods of surface improvement, surface treatment, coating, painting, paint application, methods- spray painting, electrostatic deposition, electro- coating, hot dip coating, chemical conversions coatings, electroplating, anodizing, electroless plating, vaporized metal coating, vacuum metallizing, spurting, chemical vapour deposition.

(9 Hrs, 20 Marks)

### **Term Work:**

1. Tensile test on mild steel and aluminum test pieces.
2. Rockwell and Rockwell superficial test on different samples with different scales.
3. Brinell hardness test on steel, cast iron, brass and aluminum alloys.
4. Vicker's hardness test on mild steel, hardened steel and cast iron.
5. Poldi hardness test on samples of three different metals.
6. Erichson cupping test.
7. Non-destructive tests: Dye penetrant test.
8. Magnetic particle testing or eddy current test.
9. Izod and charpy impact test.
10. Effect of cold working on hardness of minimum two materials.
11. Testing of bulk properties such as flow rate, apparent density and tap density of metal powder.

## **MANUFACTURING ENGINEERING-I**

Teaching Scheme  
Lecture: 4 Hours/Week

Examination Scheme  
Theory Paper: 100 Marks  
Paper Duration: 3 Hours.

### **UNIT: I CASTING**

Molding Sand: Types and Properties, Patterns: Types, Allowances, Cores: Types, Chaplets, Moulding Box, Principle of Operation, sketch, applications of Sand mould casting, Die Casting, Permanent mould Casting, Centrifugal Casting, Investment Casting, Continuous Casting. Defects in Casting, Cleaning and finishing of casting, Inspection and testing of casting.

(9 Hrs, 20 Marks)

### **UNIT: II MECHANICAL WORKING OF METALS**

Re-crystallization temperature, Hot Working and Cold Working of Metals, Principle of Operation, Sketch, Advantages, limitations and applications of: Rolling-rods, Wires, Tubes; Sheet Metal Working-Shearing, Piercing, Blanking, Drawing, Bending; Forging-Open Die, Closed Die, Drop Forging, Press Forging, Machine Forging, Cold Forging.

(9 Hrs, 20 Marks)

### **UNIT: III JOINING PROCESSES**

Welding, Classification of Welding Processes, Principle of Operation, Sketch, Advantages, limitations and applications of: Forge Welding, Friction Welding, Thermit Welding, Spot Welding, Seam Welding, Projection Welding, Arc Welding, Difference between AC and DC Welding, Shielded Metal Arc Welding, Gas Welding: Flames and Techniques, Tungsten Inert Gas Welding, Metal Inert Gas Welding, Submerged Arc Welding, Brazing, Soldering, Welding Defects.

(9 Hrs, 20 Marks)

### **UNIT: IV GEAR AND THREAD MANUFACTURING**

Gear Manufacturing Processes, Form Cutter Method, Gear Generating Method, Gear Cutting by Single Point Cutting Tool, Gear Shaping, Gear Manufacturing by –Casting, Roll Forming, Extrusion, Cold Drawing, Stamping, Hot Forging, Gear Finishing Operations-Gear Shaving, Gear Burnishing, Gear Grinding. Thread Manufacturing Methods-Casting, Chasing, Thread Rolling and Die Threading and Tapping, Thread Milling, Thread Grinding.

## **UNIT: V MACHINING PROCESSES & CAPSTAN AND TURRET LATHE**

Machining Processes – Turning, shaping, planning, boring, drilling, milling

Capstan & Turret Lathe --Introduction, Difference between Engineering Lathe, Capstan and Turret Lathe, Indexing mechanisms, Bar feeding mechanisms, Work holding devices, tool holding devices, Automates-single and multi spindle automates.

(9 Hrs, 20 Marks)

### **Reference Books**

- 1 Bawa, Manufacturing Technology- I (Ascent Series), Tata McGraw Hill, New Delhi
- 2 P.C. Sharma, A text Book of Production Technology - S. Chand Publication.
- 3 K. C. Jain Production Engineering – Tata McGraw Hill, New Delhi
- 4 E. Paul De Garmo, Materials & Processes in Manufacturing – Prentice Hall of India
- 5 Hajara Choudhari, Bose S.K. Elements of Workshop Technology Volume I&II Asia Publishing House

## **APPLIED THERMODYNAMICS**

Teaching Scheme  
Lecture: 4 Hours/Week  
Practical: 2 Hours/ Week

Examination Scheme  
Theory Paper: 100 Marks  
Term Work: 25 Marks  
Oral: 25 Marks  
Paper Duration: 3 Hours.

### **UNIT: I FUELS AND COMBUSTION**

Types of fuels, Ultimate and proximate analysis of fuel, Gravimetric and volumetric analysis and their conversions, Physical law of combustion, basic combustion equations, composition of dry air, Stoichiometric air-fuel ratio, Actual air fuel relation, excess air, determination of actual quantity of air from combustion analysis, Fuel gas analysis, Orsat apparatus, Enthalpy of formation, Enthalpy of combustion, calorific values and their determination.

(9 Hrs, 20 marks)

### **UNIT: II STEAM GENERATORS**

Classification of boilers, introduction to water tube and fire tube boiler, introduction to IBR laws, characteristics and features of high pressure boilers, Stirling, Lamont, Loeffler, Benson boilers, Boiler mountings and accessories, boiler draught, natural and artificial draught, draught losses, regulation and calculation for chimney height, Condition for maximum discharge, Equivalent evaporation, boiler efficiency, Heat balance.

(9 Hrs, 20 Marks)

### **UNIT: III STEAM CYCLES AND CONDENSERS**

Introduction to steam power plant, Carnot vapour power cycle, Rankine cycle, work ratio, back work ratio, specific steam consumption. Effect of operating variables (boiler pressure, condenser pressure and super heat) on Rankine cycle, Reheat and regenerative Rankine. Introduction to condensers, Jet and Surface condensers, types of condensers, condensers vacuum and vacuum efficiency, air pumps, capacity of air extraction pumps, sources of air leakage and effect of air leakage, cooling towers.

(9 Hrs, 20 Marks)

### **UNIT: IV COMPRESSIBLE FLUID FLOW AND STEAM NOZZLES**

Static and stagnation properties, sonic velocity, Mach number, types of nozzles, one dimensional steady isentropic flow through nozzles and diffusers, critical pressure ratio and maximum discharge, supersaturated

flow, effect of variation in back pressure on nozzle characteristics, shocks and losses, effect of friction and nozzle efficiency.

(9 Hrs, 20 Marks)

### **UNIT: V RECIPROCATING AIR COMPRESSORS**

Introduction, uses of compressed air, classification of compressors, air compressor terminology, Constructions and workings of single cylinder, single stage, single and double acting reciprocating air compressors, indicated work done (polytropic, isothermal and isentropic) without clearance, isothermal efficiency, effect of clearance, volumetric efficiency, F.A.D., theoretical and actual indicator diagrams, methods of improving volumetric efficiency, Multistage compression: requirement, work done in multistage compression, inter cooling and after cooling, condition for maximum efficiency.

(9 Hrs, 20 Marks)

### **LIST OF EXPERIMENTS**

Minimum eight experiments should be performed from following lists:

1. Determination of calorific value of solid/ liquid/gaseous fuel.
2. Analysis of flue gases by Orsat / PUC apparatus.
3. Study of high-pressure boilers.
4. Determination of Isothermal and Volumetric efficiency of reciprocating air compressor.
5. Study of steam nozzles.
6. Study of steam condensers and cooling towers.
7. Study of thermal power plant by actual visit.
8. Study of boiler draughts.
9. Study of Rankine cycle (five numericals based on the syllabus)
- 10 Study of on boiler efficiency and heat balance sheet. (Assignment on the same)

### **REFERENCE BOOKS**

1. R. K. Rajput, Thermal Engineering, Laxmi Publication, New Delhi.
2. Domkundwar, Refrigeration & Air Conditioning, Dhanpatrai and Sons, New Delhi.
3. P.L. Ballany, Thermal Engineering, Khanna Publication, New Delhi.
4. Kumar, Vasandani Heat Engineering, Metropolitan Book Company. Pvt.Ltd. New Delhi.
5. Rudramurthy, Thermal Engineering, Tata McGraw Hill, New Delhi.
6. S.C. Gupta, Thermal Engineering, Pearson Education Pvt. Ltd. New Delhi.
7. P. K. Nag, Thermodynamics, Tata McGraw Hill, New Delhi.

## **Machine Drawing**

Teaching Scheme  
Practical: 2 Hours/Week

Examination Scheme  
Term Work: 25 Marks

Term work shall consist of:

Two projects consisting of a full imperial size sheet each involving assembly drawing with a part list, overall dimensions and detailed drawing of couplings, bearings, lathe parts, screw jack, vices, valves etc.

Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified so as to make it a working drawing.

Third sheet should contain all the machining symbols, tolerances, welding symbols etc.

### **REFERENCE BOOKS**

1. N D Bhatt, Machine Drawing, Charotar Publishing Company.
2. J E Shigley & C R Mischke, Mechanical Engineering Design, 5th Edition, McGraw Hill Publications New Delhi.
3. N Sidheswar & Kannaiah, Machine Drawing, Tata McGraw Hill Publications New Delhi.

## **WORKSHOP PRACTICE – III**

**(Common with Production Engineering And Automobile Engineering)**

Teaching Scheme

Examination Scheme

Practical: 2 Hours/Week

Term Work: 50 Marks

### **1. Jobs: -**

#### **A. CARPENTARY SHOP**

[4 hrs]

Preparation & Manufacturing of solid pattern involving Wood Turning from component drawing. (1 job)

#### **B. MACHINE SHOP**

[8 hrs]

One composite job involving different machine operation on Lathe, Shaper, Slotter, Drilling, Milling & Grinding operations.

**NOTE:** Group of maximum 3 to 4 students depending upon the work involved.

#### **C. FOUNDRY SHOP**

[4 hrs]

Preparation of mould of above pattern, casting from this mould. Actual weight calculation, yield & casting of item should be performed.  
(1 job)

#### **D. WELDING SHOP**

[4 hrs]

One job on welding (fabrication) preparing a component comprising welding joints such as shoe rack, book rack, stands for flower pots, house hold applications etc.

### **2. Journals and Demonstration: -**

A journal containing records of following assignments based on the demonstration on machine tools (sketches and relevant description)

(i) Block Diagrams (any Two)

1. Lathe,
2. Universal Milling Machine,
3. Radial Drilling Machine,
4. Cylindrical Grinder.

(ii) Mechanisms (any Two)

1. All geared head stock of a Center Lathe,
2. Spindle arbor (assembly) drive of a Milling Machine,

3. Crank and slotted lever quick return drive of Shaping Machine,
  4. Spindle assembly in a Drilling Machine.
- (iii) Accessories (any Two)
1. Taper turning attachment for a Center Lathe,
  2. Universal Driving Head,
  3. Milling Cutter.
- (iv) 1. Process planning sheet of the components of the job to be under taken.
2. Tool profile sheet for job of turning.
  3. Introduction to industry.
- Special grinding machines – honing, lapping, super finishing, buffing, burnishing.

### **NOTE**

A) The candidates are required to finish the job to the following limits.

1. Lathe: - + /- 0.05 mm
2. Grinding: - + /- 0.05 mm
3. Shaper: - + /- 0.05 mm
4. Milling: - + /- 0.05 mm

B) Work Book shall include description with detailed drawing i.e. Working drawing of each job showing all dimensions, limits, finishing processes, material used, machining symbol etc.

C) Theory concerned is to be taught in workshop only to every batch going to work shop for practical, during only in practical hours only.

### **Reference Books**

1. Hajara Chaudhary Bose S. K., Element of Workshop Technology  
Volume II, Asia Publishing House.
2. P.N. Rao, Production Technology Volume I & II, Tata McGraw Hill  
Publication.
3. R.K. Jain, Production Technology, Khanna Publishers.
4. P.C. Sharma Production Technology, Khanna Publishers.
5. Chaprnan W.A. J., Workshop Technology, Volume II, ELBS  
Publishers.
6. HMT, Production Technology Tata McGraw Hill Publication.

**COMPUTER GRAPHICS**  
**(Common with Automobile Engineering)**

Teaching Scheme  
Practical: 2 Hours/Week

Examination Scheme  
Term Work: 25 Marks  
Practical: 25 Marks

Term work shall consists of:

- a) Two assignments on AutoCAD (preferably latest version).
- b) Two assignments on Auto LISP (such as Design and drafting of any mechanical component through Auto LISP)

**REFERENCE BOOKS**

1. AutoCAD reference manual
2. Auto LISP reference manual
3. George Omura, ABCs of Auto LISP, BPB. Publication.

**THEORY OF MACHINES-I**  
(Common with Automobile Engineering)

Teaching Scheme  
Lecture: 4 Hours/Week  
Practical: 2 Hours/ Week

Examination Scheme  
Theory Paper: 100 Marks  
Term Work: 25 Marks  
Oral: 25 Marks  
Paper Duration: 3 Hours.

**UNIT: I**

Fundamentals of kinematics, Types of motion, degree of freedom, Grubler's criterion, mechanisms with lower pairs, hooks joint, steering gear mechanism, straight line mechanism, Geneva mechanism, Inversion of mechanism.

1. Velocity analysis by ICR method, relative velocity method.
  2. Acceleration analysis by relative acceleration method, Coriolis acceleration.
- (9 Hrs, 20 Marks)

**UNIT: II**

1. Algebraic method of velocity & acceleration analysis.
2. Klein's construction.
3. Static force analysis.
4. Inertia force analysis of IC engine mechanism, geared system.
5. Dynamical equivalent system, compound pendulum, bifilar suspension & trifler suspension method for inertia analysis.

(9 Hrs, 20 Marks)

**UNIT: III**

1. Velocity & acceleration analysis by complex algebra method.
2. Velocity & acceleration by vector algebra method.

(Four bar & single slider mechanism only)

#### **UNIT: IV**

1. Friction, laws, efficiency of inclined plane, screws, clutches.
2. Friction circle and friction axis of mechanism.
3. Lubrication, system, types, proper

(9 Hrs, 20 Marks)

#### **UNIT: V**

1. Types of friction drives, open belt, cross belt, length of belt.
2. Slip. Creep, crowning of pulleys, steeped pulley.
3. Power transmitted, maximum power transmitted by belt drive.
4. Chain, types, length of chain, power transmitted.

(9 Hrs, 20 Marks)

#### **List of Practicals:**

1. To determine the mass moment of inertia of compound pendulum.
2. To determine the mass moment of inertia of bifilar/trifilar suspension method.
3. To determine the slip of belt drive.
4. Velocity analysis by ICR method ( 2 problems)
5. Relative velocity & acceleration method ( 4 problems)
6. Klein's construction ( 4 problems)
7. Inertia force analysis of IC engine mechanism by graphical method.

**Assignments:** Five assignments on above topics in addition to above practicals

#### **References:**

- 1) P.L. Ballany Theory of Machines & Mechanism, Khanna Publication  
New Delhi
- 2) Jagdish Lal, Theory of Machines & Mechanism

- 3) S.S Ratan, Theory of Machines & Mechanism, Tata McGraw Hill
- 4) R.S.Khurmi, Theory of Machine
- 5) Sadhu singh , Theory of Machine, Pearson Education
- 6) Thomas Bevan ,The Theory of Machine ,CBS Publication and Distributors
- 7) Shighley J.E, Theory of Machines, Tata McGraw Hill
- 8) Hannah & Stephen, Mechanics of Machines

**INDUSTRIAL ENGINEERING**  
(Common with Production Engineering And Automobile Engineering)

Teaching Scheme  
Lecture : 4Hrs/week

Examination Scheme  
Paper : 100 Marks  
Paper Duration : 3Hrs  
Term Work : 25 Marks

**UNIT I: -**

- 1) Introduction to Industrial Engineering, origin and growth, contribution of Taylor, Gilberths relevance and importance in the economics & industrial development through productivity.
- 2) Work study
  - a) Work study and productivity improvement; scope and application.
  - b) Method study:-
    - i) Introduction, scope and application
    - ii) Select criteria for selecting assignments; record charting symbols. Flow process chart, multiple activity chart. Examine- questioning technique,. Develop motion economy, work place layout, improvement and working condition, implement and maintain
  - c) Work Measurement
    - i) Aims objectives scope and application
    - ii) Stop watch study- equipment and procedure, rating allowance and standard time; activity sampling- principle, procedure and applications.

(9 Hrs, 20 Marks)

## **UNIT II: -**

### **1) PLANT LAYOUT AND MATERIAL HANDLING**

- a) Criteria for plant location, site selection, types of plant layout, planning for utilities
- b) Material Handling- necessity of material handling, procedure for analyzing material handling system, methods and equipment of material handling. Effect of layout and material handling system on productivity and profitability
- c) Safety in material handling and factory operation

### **2) a) Factories act**

- c) Indian Boiler Act

(9 Hrs, 20 Marks)

## **UNIT III: -**

### **PRODUCTION AND MATERIAL PLANNING CONTROL**

#### **a) Production Planning**

1. Production and material planning as in integral and interdependent system
2. Production Planning- for casting, capacity estimation, planning scheduling and control

b) Material Planning- need and basis for material planning, planning and control of raw material. In- and brought out components

c) Progress Control - introduction, step involved, bar chart, Gantt chart, transmission of report and corrective action.

(9 Hrs, 20 Marks)

## **UNIT IV: -**

Wage administration- job analysis, job description, job rating, wage survey, wage scale.

- i) Job evaluation and payment of result:-  
Job evaluation- necessity and principles of job evaluation, systems of job evaluation, application.
- ii) PBR as a motivating factor, incentive scheme- basis of schemes, Taylor, Rowan, Halsey and Bedoux plan, incentive to indirect workers, preplanning for introduction incentive scheme.
- iii) Value analysis/ engineering- concepts, procedure and steps in value analysis/engg. Scope and application

(9 Hrs, 20 Marks)

#### **UNIT V: -**

##### **Ergonomics:**

Definition and importance: historical background. Human machine systems- interfaces. Anthropometry: need, important body dimensions, data collections, statically analysis, percentile. Applied Anthropometry and work space design and seating, ergonomics and safety.

(9 Hrs, 20 Marks)

##### **References:-**

- 1) Maynard, Industrial Engineering. Hand book, McGraw Hill book company
- 2) ILO, Introduction to Work Study
- 3) Khanna O.P. , Industrial Engineering. and Management, Dhanpat Rai Publication, New Delhi.
- 4) Factory Act -1948
- 5) Indian Boiler Act- 1923 (Revised 1983)
- 6) L.C. Jhamb “A text book of Industrial Engineering”, Everest Publishing House, India.

# **FLUID MECHANICS**

**(Common with Production Engineering And Automobile Engineering)**

Teaching Scheme

Lecture : 4 Hrs/week

Practical : 2 Hrs/week

Examination Scheme

Theory : 100 Marks

T/W : 25 Marks

Oral : 25 Marks

Paper Duration: 3 Hours

## **UNIT – 1**

### **FLUID STATICS**

Fluid properties & definition, definition of fluid, Viscosity, Bulk modulus of elasticity, Vapour pressure, Surface tension, Capillary, Speed of sound, Pressure at a point, Liquid pressure on plane area, Curved surface, Center of pressure, Manometer, Buoyancy, Stability of floating and submerged body, Metacentric height, Uniform rotation of open vessels, Pascal's law.

(9 Hrs, 20 Marks)

## **UNIT – 2**

### **KINEMATICS OF FLUID FLOW**

Types of flow, Definition of steady, Unsteady, Uniform, Non uniform, Laminar, Turbulent, 1D-2D flows, Stream line, Streak line, Path line, Irrotational flow, concept of Velocity, potential & stream function flow net (no mathematical treatments) , Continuity equation, 2D Euler's equation, Bernoulli's equation along a stream line for compressible and incompressible flow and its application , pitot tube, Ventury meter, Differential monocircular sharp edge mouth pieces and orifice rotometer, Orifices, Orifices meter.

(9 Hrs, 20 Marks)

## **UNIT – 3**

### LAMINAR FLOW

Definition, Relation between shear stress & pressure gradient, Flow between parallel plates, Circular tube, Lubrication mechanism, Hagen poiseuille's theory.

### TURBULENT FLOW:

Definition, Prandtl's mixing length theory, Velocity distribution, Variation of flow through pipe, Minor losses in pipes & fittings, Darcy-Weisbach equation for frictional head loss, Moody diagram.

**(9 Hrs, 20 Marks)**

## UNIT-4

### FLOW THROUGH PIPES

Reynolds's experiment, pipe discharging from a reservoir, pipe connecting two reservoir, pipes in series and parallel, siphon, transmission of power and flow through nozzle.

Introduction to compressible flow, sound wave and Mach no. introduction to unsteady flow in closed conduit oscillation of liquid , phenomenon of surges and water hammer and other there control .

Dimension: - Dimensional homogeneity, dimensional analysis method. Raleigh's method and Buckingham's pi theorem, model analysis, dynamic forces, dimensional less no. , -similitude – based on Reynolds and mach numbers .

**(9 Hrs, 20 Marks)**

## **UNIT – 5**

### RECIPROCATING PUMP

Introduction, main parts, working, single & double acting, slip of reciprocating pump, classification, variation of velocity & acceleration, indicator diagram, air vessel's

## HYDRAULIC CIRCUITS

Flow control valve, direction control valves, pressure regulating valves, symbols, different types of hydraulic circuits

(9 Hrs, 20 Marks)

### List of practical :-(any eight)

1. Determination of viscosity of given liquid
2. Study Of Manometer
3. Study of stability of floating body.
4. Study of forced vertex motion
5. Flow net by Electrical Analogy Method
6. Calibration of venturi meter/ orifice meter
7. Verification of Bernoullis theorem.
8. Study of Sharp edged circular orifice / mouth piece.
9. Study of momentum equation
10. Study of Laminar and Turbulent flow by use of Reynolds apparatus
11. Study of flow through pipe

### Reference Books :

1. R.K. Bansal , Text book of Fluid Mechanics & Hydraulic Machines , Laxmi Publications, Delhi.
2. Dr. P.N Modi , S.M Seth, Hydralic and Fluid Mechanics .
3. S. Ramamurtham ,Fluid Mechanics, Hydraulics and Hydraulic machine ,Danpat Rai & Sons
4. K.L.Kumar , Engineering Fluid mechanics, Eurosa publications House Delhi.
5. S.K Agarwal., Fluid Mechanics & Machinery

## **Electrical Machines & Industrial Electronics**

**(Common with Production Engineering And Automobile Engineering)**

Teaching Scheme

Lecture: 4 Hours/Week

Practical: 2Hours/Week

Examination Scheme

Theory Paper: 100 Marks

Term Work: 25 Marks

Paper Duration: 3 Hours.

### **UNIT-I D.C. MACHINES**

Construction, types of generators, Action of motors, significance of back emf, Types of Dc motors, Voltage & current relationship of different motors, Different method of starting (Need of starters), Different methods of speed control, Different types of motor reversing & jogging, Motor stopping, applications.

(9Hrs,marks20)

### **UNIT-II Induction Motors**

Single phase AC Motors, Single phase Induction Motors, Stepper Motor, Servo Motor, their construction, operation & application.

**Three-phase induction motors:** construction, principle of operation, slip, power flow diagram, torque equation, Maximum & Full load torque, torque slip characteristics, various methods of speed control, different types of starter & application.

(9 Hrs, 20 Marks)

### **UNIT-III Synchronous Machine**

**Alternators:** construction, synchronous speed, frequency of induced emf, and regulation by synchronous impedance methods.

**Synchronous Motors:** principle of working, effect of variation of load & excitation, Hunting, method of starting, applications.

**Relays:** Electromechanical control relays, solid-state relay, timing & latching relays,

(9 Hrs, 20 Marks)

## **UNIT-IV INDUSTRIAL CONTROL DEVICES**

Primary & pilot control devices, manually operated switches, mechanically operated switches. Transducers, Strain gauge, LVDT.

**Sensors:** Proximity sensors, light sensors, Hall effect sensors, Ultrasonic sensors, pressure & temperature sensors, thermistors, IC sensors.

(9 Hrs, 20 Marks)

## **UNIT-V**

**Actuators:** Classification of actuators, selection criteria of control valves, single acting & double acting cylinders, Electro hydraulic: 3/2 valves, 4/2 valves, and 5/3 valves.

**Different types of control systems:** motion, pressure, temperature, time, count & sequence controls.

**Process & Machines control systems:** Types of processes, structure of control systems, controller responses, data acquisition system, computer numerical control & robotics, Basics of PLC programming. Computers in process & machine control

(9 Hrs, 20 Marks)

## **LIST OF EXPERIMENTS: - (Any Eight)**

1. Study of DC Motors.
2. Single phase & 3 phase Alternators.
3. Study of DC generator.
4. Study of AC & DC starters.
5. Study of Single phase & 3 phase Induction motors.

6. Study of LVDT
7. Study of photoconductive & solar cell.
8. Study of Speed control of DC Motor by solid-state devices.
9. Study of Data Acquisition Systems.
10. Study of Transducers

#### REFERENCE BOOKS

1. Stephen J Chapman, Fundamentals of Electrical Machinery International Student Edition.
2. Nagrath & Kothari, Electrical Machines Tata Mc Graw Hill Publication.
3. Dr. P.S. Bhimra, Generalise Theory of Electrical Machines, Khanna Publication.
4. Frank D. Petruzulla, Industrial Electronics, Mc Graw Hill International Editions.
5. Singh & Khanchandani , Power Electronics, Mc Graw Hill

## **MANUFACTURING ENGINEERING- I I**

Teaching Scheme

Lecture: 4 Hours/Week

Examination Scheme

Theory Paper: 100 Marks

Term Work: 25 Marks

Paper Duration: 3 Hours.

### **UNIT: I THEORY OF METAL CUTTING**

Introduction, Mechanics of chip formation, single point cutting tool, method of machining, type of chips, determination of shear angle, undeformed chip thickness, force relation, Energy considerations in metal cutting, Tool wear and tool life, Tool material, economic of metal cutting, Machinability, design of single point cutting tool.

(9 Hrs, 20 Marks)

### **UNIT: II JIG AND FIXTURES**

Definition, purpose and advantages, elements of jig and fixtures, principle of jig and fixture design, locating devices, design principle for location purpose, clamping devices, material for location and clamping elements, drill jigs, drill bushes, drill bush material, types of drill jigs, Milling fixture lathe fixture, Economic of jig and fixture selection.

(9 Hrs, 20 Marks)

### **UNIT: III PRESS TOOL DESIGN**

Introduction, Press operation, classification of power presses, Press selection, press working terminology, working of cutting die, principle of metal cutting, clearance, cutting forces, die design fundamentals, blanking and piercing die construction, pilots, strippers and presser pads, press work materials, strip layout, bending die, drawing

operations, variable that affect metal flow during drawing, determining blank size, drawing force.

(9 Hrs, 20 Marks)

#### **UNIT: IV ADVANCE MACHINES**

Introduction to CNC Machines, Advantage of CNC, classification of CNC machine, CNC Machine block diagram, part of CNC, steps in CNC manufacturing, CNC part programming, Computer assisted part programming, APT programming.

(9 Hrs, 20 Marks)

#### **UNIT: V FINISHING AND UNCONVENTIONAL MACHINING PROCESSES**

Principle of operation, Sketch, advantages, limitations and applications of: Grinding, Honing, Lapping, Buffing, Burnishing, Polishing, Abrasive Jet Machining, Electric Discharge Machining, Electro Chemical Machining, Ultrasonic Machining, Electron beam machining, Laser Beam Machining, Plasma Arc Machining, Ion Beam Machining.

(9 Hrs, 20 Marks)

#### **TERM WORK:**

1. Any Assignment on Unit. I
2. Design of jig/ fixture for drilling / milling operation of a given component.
3. Any Assignment on Unit. III
4. Write a program for manufacturing a component on CNC Milling or CNC Lathe.
5. Any Assignment on Unit. V

## REFERENCE BOOKS

- 1 Bawa, Manufacturing Process I & II - Tata McGraw Hill Publication Company. Ltd.
- 2 E. Paul DeGarmo, J.T. Black, Ronald A. Kohser, Materials and Process Manufacturing - John Willey Publication Ninth edition.
- 3 Erik K. Henriksen ,Jig and Fixture Design Manual - Industrial Press Inc.
- 4 Donaldson, Lecain, Goold Tool Design - Tata McGraw Hill Publishing Company. Ltd.
- 5 P. C. Sharma ,A Textbook of Production Engineering by - S. Chand & Company. Ltd.
- 6 Grover M. P. CAD/CAM by Grover- Tata McGraw hill Publication Company. Ltd.

## **WORKSHOP PRACTICE – IV**

**(Common with Production Engineering And Automobile Engineering)**

Teaching Scheme

Examination Scheme

Practical: 4Hours/Week

Term Work: 25 Marks

Oral: 50 Marks

### **A] Machine shop**

A mini project on die making for Sheet Metal Working, Rubber or Plastic die/ vice assembly/ hammer assembly/ pulley assembly/ coupling assembly/ drilling jig.

### **B] Plumbing Shop**

One pipe assembly including Union, T-joint, Elbow, Cock fitting.

### **C] Disassembly and assembly of following mechanisms for preventive maintenance**

- a) All geared head stock
- b) Apron mechanism
- c) Quick return mechanism
- d) Spindle assembly in a Drilling Machine

### **D] CNC Lathe**

One job of programming and manufacturing on CNC, Lathe or Trainer.

### **E] CNC Milling**

One job of programming and manufacturing on CNC, Milling Machine or Trainer.

**NOTE:** - All jobs specified A to E should be allocated to batch of 5 students and different batches should have different designs of jobs.

**DEMONSTRATIONS OF FOLLOWING MACHINES AND PROCESSES TO BE CARRIED OUT IN THE WORKSHOP ONLY.( One hour for each demonstration). (Any Four).**

1. Gear Hobbing or Gear Shaping Operation.
2. Operations on Capstan & Turret Lathe and Single Spindle Atocrats.
3. Sheet metalworking on Mechanical or Hydraulic Process.
4. Super finishing operations like Lapping, Honing, etc.
5. Plastic moulding operation Ton-injections moulding machines.
6. Die forging on power hammer.
7. Spot Welding Machine.
8. Different types of grinding wheels, selection criteria, standard marking system of grinding wheel, wheel balancing, truing & dressing operation.
9. Planner.

**SCOPE OF THE THEORY:** - Theory concerned with different machines, their capabilities, applications & limitations, tool holding, work holding devices etc. for above jobs & demonstrations is to be taught in the workshop only for every batch going to the workshop. Concept of alignment & geometric tolerance required for job No. 1 is to be taught in the classroom.

1. Marketable utility items should be selected & it should be manufactured as per IS codes, e.g. Nuts, bolts, bushes, pins, gas nozzles etc.
2. Setting of turret / caption for assigned jobs should be done by individual student.
3. Preparations of CNC programs for job on CNC machine should be done by groups of students for their jobs.
4. CNC maintenance should be done practically i.e. demonstrations regarding various components of both categories; electronics and mechanical.
5. Determination of cutting speeds, feeds, machining times and other parameters required for above job such as cost estimation etc. and should be compared with market rates.

#### Reference Books

- 1.Hajara Choudhary, Bose S. K., Element of Workshop Technology Volume II, Asia Publishing House.
- 2.P.N. Rao, Production Technology Volume I & II, Tata McGraw Hill Publication.
- 3.R.K. Jain, Production Technology, Khanna Publishers.
- 4.P.C. Sharma, Production Technology, Khanna Publishers.
- 5.Chapman W.A. J., Workshop Technology, Volume II, ELBS Publishers.
- 6.HMT, Production Technology, Tata McGraw Hill Publication.