

FOURTH SEMESTER

THEORY

Numerical Methods *	4	0	100
Thermal Engineering	4	0	100
Strength of Materials *	4	0	100
Kinematics of Machinery *	4	0	100
Manufacturing Technology – II	4	0	100
Engineering Materials and Metallurgy	4	0	100

PRACTICAL

a. Materials Testing. b. Metallurgy Lab	0	3	100
Fuels and Internal Combustion Engines Lab	0	3	100

THERMAL ENGINEERING

1. GAS POWER CYCLES

9

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure and air standard efficiency, Actual and theoretical PV diagram of Four stroke engines, Actual and theoretical PV diagram of two stroke engines.

2. INTERNAL COMBUSTION ENGINES

9

Classification of IC engine, IC engine components and functions. Valve timing diagram and port timing diagram. Comparison of two stroke and four stroke engines. Fuel supply systems, Ignition Systems, Performance calculation. Comparison of petrol & diesel engine. Fuels, Air-fuel ratio calculation, Knocking and Detonation. Lubrication system and cooling system. Exhaust gas analysis, pollution control norms.

3. STEAM NOZZLES AND TURBINES

9

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and reaction principles, compounding, velocity diagrams for simple and multistage turbines, speed regulations-governors and nozzle governors.

4. AIR COMPRESSOR

9

Classification and working principle, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating air compressors. Multistage air compressor and inter cooling – work of multistage air compressor, various types of compressors (Descriptive treatment only).

5. REFRIGERATION AND AIR-CONDITIONING

9

Vapour compression Refrigeration cycle – super heat, sub cooling, performance calculations. Working principle of vapour absorption system. Ammonia – water, Lithium bromide – water systems (Description only), Comparison between vapour compression and absorption systems. Psychrometry, Psychrometric chart, Cooling load calculations. Concept of RSHP, GSHF, ESHF, Air conditioning systems.

TUTORIALS

15

TOTAL : 60

(Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables are permitted in the examination)

TEXT BOOKS

1. Rajput, "Thermal Engineering", S. Chand publishers, 2000.
2. Rudramoorthy R, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2003.

REFERENCES

1. Kothandaraman.C.P., Domkundwar.S. and A.V.Domkundwar., "A course in Thermal Engineering", Dhanpat Rai & Sons, Fifth edition, 2002
2. Holman. J.P., "Thermodynamics", McGraw-Hill, 1985.
3. Rogers, Meyhew, "Engineering Thermodynamics", ELBS, 1992.
4. Arora.C.P., "Refrigeration and Air conditioning", TMH, 1994.
5. Sarkar B.K, " Thermal Engineering", Tata McGraw-Hill, 1998.

STRENGTH OF MATERIALS
(Common to Mechanical and Mechatronics)

1. STRESS, STRAIN AND DEFORMATION OF SOLIDS

9

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

2. BEAMS - LOADS AND STRESSES

9

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

3. TORSION

9

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads

4. BEAM DEFLECTION

9

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope : Double integration method, Macaulay Method, and Moment-area Method – Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns

5. ANALYSIS OF STRESSES IN TWO DIMENSIONS

9

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress - Strain energy in bending and torsion.

TUTORIALS

15

TOTAL : 60

TEXT BOOKS

1. Ramamutham.S, Strength of Materials, S.Chand &B Co., New Delhi,2005.
2. Beer F. P. and Johnston R, “Mechanics of Materials”, McGraw-Hill Book Co, Third Edition, 2002.

REFERENCES

1. Nash W.A, “Theory and problems in Strength of Materials”, Schaum Outline Series, McGraw-Hill Book Co, New York, 1995
2. Ryder G.H, “Strength of Materials”, Macmillan India Ltd., Third Edition, 2002
3. Ray Hulse, Keith Sherwin & Jack Cain, “Solid Mechanics”, Palgrave ANE Books, 2004.
4. Singh D.K “Mechanics of Solids” Pearson Education 2002.

KINEMATICS OF MACHINERY
(Common to Mechanical and Mechatronics)

1. BASICS OF MECHANISMS	7
Terminology and Definitions-Degree of Freedom Mobility-Kutzbach criterion-Grashoff's law-Kinematic Inversions of 4-bar chain and slider crank chains-Mechanical Advantage-Transmission angle-Description of common Mechanisms-Single, double and offset slider mechanisms - Quick return mechanisms - Ratchets and escapements - Indexing Mechanisms - Rocking Mechanisms - Straight line generators-Design of Crank-rocker Mechanisms.	
2. KINEMATICS	12
Displacement, velocity and acceleration - analysis in simple mechanisms - Graphical Method velocity and acceleration polygons - Kinematic analysis by Complex Algebra methods-Vector Approach, Computer applications in the kinematic analysis of simple mechanisms-Coincident points- Coriolis Acceleration.	
3. KINEMATICS OF CAM	8
Classifications - Displacement diagrams-parabolic, Simple harmonic and Cycloidal motions - Layout of plate cam profiles - Derivatives of Follower motion - High speed cams - circular arc and tangent cams - Standard cam motion - Pressure angle and undercutting.	
4. GEARS	10
Spur gear Terminology and definitions-Fundamental Law of toothed gearing and involute gearing-Inter changeable gears-gear tooth action – Terminology - Interference and undercutting-Non standard gear teeth- Helical, Bevel, Worm, Rack and Pinion gears (Basics only)-Gear trains-Parallel axis gear trains-Epicyclic gear trains-Differentials	
5. FRICTION	8
Surface contacts-Sliding and Rolling friction - Friction drives – Friction in screw threads - Friction clutches - Belt and rope drives, Friction aspects in Brakes – Friction in vehicle propulsion and braking	
TUTORIALS	15
TOTAL : 60	

TEXT BOOKS

1. Rattan S.S, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2003.
2. Khurnmi.R.S., Gupta, Theory of Machines, S.Chand, 2005.

REFERENCES

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.

2. Ghosh A and A.K.Mallick, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.

STANDARDS

1. IS 2458 : 2001, Vocabulary of Gear Terms – Definitions Related to Geometry
2. IS 3756 : 2002, Method of Gear correction – Addendum modification for External Cylindrical Gears with Parallel Axes.
3. IS 5267 : 2002 Vocabulary of Gear Terms – Definitions Related to Worm Gear Geometry.
4. IS 12328 : Part 1: 1988 Bevel Gear Systems Part – 1 Straight Bevel Gears.
5. IS 12328 : Part 2: 1988 Bevel Gear Systems Part – 2 Spiral Bevel Gears.

ENGINEERING MATERIALS AND METALLURGY

1. CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS

10

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

2. HEAT TREATMENT

11

Definition – Full annealing, stress relief, recrystallisation and spheroidizing –normalising, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR - Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening.

3. FERROUS AND NON FERROUS METALS

9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) - stainless and tool steels – HSLA - maraging steels – Gray, White malleable, spheroidal - Graphite - alloy cast irons.

Copper and Copper alloys – Brass, Bronze and Cupronickel – Aluminum and Al-Cu – precipitation strengthening treatment – Bearing alloys.

4. NON-METALLIC MATERIALS

9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers – Urea and Phenol Formaldehydes – Engineering Ceramics – Properties and applications of Al_2O_3 , SiC, SiC, Si_3N_4 , PSZ and Sialon – Fibre and particulate reinforced composites.

5. MECHANICAL PROPERTIES AND TESTING

6

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and charpy, fatigue and creep test.

TOTAL : 45

TEXT BOOKS

1. Kenneth G.Budinski and Michael K.Budinski “Engineering Materials” Prentice-Hall of India Private Limited, 4th Indian Reprint 2002.

REFERENCE BOOKS

1. William D Callsber “Material Science and Engineering”, John Wiley and Sons 1997.
2. Raghavan.V “Materials Science and Engineering”, Prentice Hall of India Pvt., Ltd., 1999.
3. Sydney H.Avner “Introduction to Physical Metallurgy” McGraw Hill Book Company, 1994.

MANUFACTURING TECHNOLOGY - II

1. THEORY OF METAL CUTTING

8

Introduction: material removal processes, types of machine tools – theory of metal cutting: chip formation, orthogonal metal cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids.

2. CENTRE LATHE AND SPECIAL PURPOSE LATHES

10

Centre lathe, constructional features, cutting tools, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation.

Capstan and turret lathes – automatic lathes: semi automatic, automats – single spindle: cutting off, Swiss type, automatic screw type – multi spindle; cutting off, bar type

3. RECIPROCATING , MILLING AND DRILLING MACHINES

10

Reciprocating machine tools: shaper, planer, slotting Machines

Milling Machines : types, milling cutters, operations ;

Hole making : drilling, reaming, boring, tapping

4. ABRASIVE PROCESS, SAWING, BROACHING AND GEAR CUTTING

10

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centre less grinding – honing, lapping, super finishing, polishing and buffing, abrasive jet grinding

Sawing machine: hack saw, band saw, circular saw;

Broaching machines - broach construction – push, pull, surface and continuous broaching machines.

Gear cutting: forming, generation, shaping, hobbing.

5. CNC MACHINE TOOLS AND PART PROGRAMMING

7

Numerical control(NC) machine tools – CNC: types, constructional details, special features.

Part programming fundamentals – manual programming – computer assisted part programming – apt language.

TOTAL : 45

TEXT BOOKS

1. Rao, P.N. "Manufacturing Technology", Metal Cutting and Machine Tools, Tata McGraw-Hill, New Delhi, 2003.
2. Richard R. Kibbe, John E. Neely, Roland O. Merges and Warren J. White, "Machine Tool Practices", Prentice Hall of India, 2003.

REFERENCES

1. HMT – "Production Technology", Tata McGraw-Hill, 1998.
2. P.C. Sharma, "A Text Book of Production Engineering", S. Chand and Co. Ltd, IV edition, 2002.
3. Hajra Choudry, "Elements of Work Shop Technology – Vol. II", Media Promoters. 2002

(a). MATERIALS TESTING. (b). METALLURGY LAB

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison
 - (i) Unhardened specimen
 - (ii) Quenched Specimen and
 - (iii) Quenched and tempered specimen.
11. Microscopic Examination of
 - Hardened samples and Hardened and tempered samples.

LIST OF EQUIPMENT

Universal Tensile Testing machine with double shear attachment – 40 Ton Capacity
1

Torsion Testing Machine (60 NM Capacity)
1

Impact Testing Machine (300 J Capacity)
1

Brinell Hardness Testing Machine
1

Rockwell Hardness Testing Machine
1

Spring Testing Machine for tensile and compressive loads (2500 N)
1

Metallurgical Microscopes
3

Muffle Furnace (800 °C)
1

FUELS AND INTERNAL COMBUSTION ENGINES LAB

LIST OF EXPERIMENTS

Determination of Viscosity – Red Wood Viscometer.
Determination of Flash Point and Fire Point.
Valve Timing and Port Timing Diagrams.
Performance Test on 4-stroke Diesel Engine.
Heat Balance Test on 4-stroke Diesel Engine.
Morse Test on Multicylinder Petrol Engine.
Retardation Test to find Frictional Power of a Diesel Engine.

LIST OF EQUIPMENT

(for a batch of 30 students)

I.C Engine – 2 stroke and 4 stroke model	1 set
Red Wood Viscometer	1 No.
Apparatus for Flash and Fire Point	1 No.
4-stroke Diesel Engine with mechanical loading.	1 No.
4-stroke Diesel Engine with hydraulic loading.	1 No.
4-stroke Diesel Engine with electrical loading.	1 No.
Multi-cylinder Petrol Engine	1 No.
Single cylinder Petrol Engine	1 No.