Bharati Vidyapeeth Deemed University

College of Engineering, Pune- 411043

The Structure of the Curriculum: 2014 Course

Choice Based Credit System (CBCS)

B. TECH. MECHANICAL: SEMESTER- V & VI

Bharati Vidyapeeth University

College of Engineering, Pune

Department of Mechanical Engineering

Vision: To provide mechanical engineers capable of dealing with global challenges

Mission: Social transformation through dynamic education

Programme Educational Objectives (PEOs):

Graduates will be able,

- To fulfill need of industry with theoretical and practical knowledge
- To engage in lifelong learning and continued professional development
- To fulfill social responsibilities

Programme Outcomes (POs):

a. To apply knowledge of mathematics, science and engineering fundamentals for solving engineering problems

b. To identify the need, plan and conduct experiments, analyze data for improving the mechanical processes

c. To design and develop mechanical systems considering social and environmental constraints.

d. To design and develop a complex mechanical system using advanced mathematical and statistical tools and techniques

e. Use of information technology (IT) tools for prediction and modeling of routine activities to enhance the work performance

f. To know social responsibilities while doing professional engineering practice.

g. To become familiar with eco-friendly, sustainable and safe work environment.

h. To take into account professional ethics while designing engineering systems.

i. Able to work efficiently as a group leader as well as an individual.

j. To communicate in written and verbal form with subordinates and supervisors

k. To apply project and finance management techniques in multidisciplinary environments.

l. To create interest for higher education and updating the knowledge.

B. TECH. MECHANICAL: SEMESTER- V (2014 Course)

S. N.	Course	Teaching Scheme (Contact Hrs. /week)			Examination Scheme (Marks)							Total Credits		
		L	P/ D	T	End Sem. Exam.	Continuous Assessment					Total	TH	TW	Total
						Unit Test	Attendance	Assignments	TW/ OR	TW/ PR				
1.	Machine Design –I*	3	2	-	60*	20	10	10	50	--	150	3	1	4
2	Theory of Machines	4	2	-	60	20	10	10	50	--	150	4	1	5
3.	Advanced Computer Graphics & Solid Modelling	3	2	-	60	20	10	10	--	50	150	3	1	4
4.	Heat and Mass Transfer	4	2	-	60	20	10	10	50	--	150	4	1	5
5.	Advanced Manufacturing Processes	3	--	-	60	20	10	10	--	--	100	3	--	3
6.	Professional skill Development-V	4	--	-	100	-		-	--	--	100	4	--	4
	Total	21	08	0	400	100	50	50	150	50	800	21	4	25

* End Semester examination of duration 4 Hours.

B. TECH. MECHANICAL: SEMESTER- VI (2014 Course)

S. N.	Course	Teaching Scheme (Contact Hrs. /week)			Examination Scheme (Marks)							Total Credits		
		L	P/ D	T	End Sem. Exam	Continuous Assessment					Total	TH	TW	Total
						Unit Test	Attendance	Assignments	TW/ OR	TW/ PR				
1.	Machine Design –II*	4	2	--	60*	20	10	10	50	--	150	4	1	5
2	Refrigeration Air Conditioning	3	2	--	60	20	10	10	50	--	150	3	1	4
3.	Internal Combustion Engines	3	2	-	60	20	10	10	-	50	150	3	1	4
4.	Mechanical Measurement & Metrology	4	2	--	60	20	10	10	--	50	150	4	1	5
5.	Elective -I	3	--	--	60	20	10	10	--	--	100	3	--	3
6.	Professional skill Development-VI	4	--	--	100	-		-	--	--	100	4	--	4
	Total	21	8	--	400	100	50	50	100	100	800	21	4	25

* End Semester examination of duration 4 Hours.

Total Credits Sem. V – 25

Total Credits Sem. VI – 25

Grand Total - 50

Elective-I

1) Machine Tool Design
2) Energy Audit and Management
3) Reliability Engineering
4) Design of Pumps, Blowers and Compressors
5) Management Information System

MACHINE DESIGN-I

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 03 Hours / Week	End Semester Examination	60 Marks	03
Practical:- 02 Hours / Week	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Term Work / Oral	50 Marks	01
	Total	150 Marks	04

Course Prerequisite:- Student should have knowledge of

1. Fundamentals of engineering Drawing
2. Analysis of forces
3. Utilizing the principles of drafting and strength of materials.

Course Objective:-

1. Ability to analyze the stress and strain of mechanical components and understand, identify and quantify failure modes for mechanical part.
2. Ability to decide optimum design parameters for mechanical systems.
3. Enhancement in proficiency of CAD software for designing Mechanical systems and to generate production drawing.
4. Ability to understand basics of fluctuating load.

Course Outcomes:- Learner will able to-

1. understand the basics of machine design
2. design of shafts, keys and couplings
3. design of power screws
4. design of springs
5. design of welded and riveted joints
6. understand basics of fluctuating load for static and dynamic loading

Unit 1 Basic Concept of Machine Design (06 Hrs.)

Traditional types of design methods, basic procedure of machine design, introduction to use of standards in design, selection of preferred series, introduction to aesthetic and ergonomic consideration in design. Engineering materials- properties, designation, and selection of material. Weighted point method. Castiglione's theorem.

Unit 2 Design of Shafts, Keys & Couplings (06 Hrs.)

Shaft design on strength basis, shaft design on torsional rigidity basis, ASME code of shaft design, keys – saddle, sunk, feather, woodruff, square, flat, Kennedy key, key design, design of splines, types of couplings, muff coupling, flange coupling, flexible bush pin type coupling.

Unit 3 Design of Power Screws (06 Hrs.)

Forms of threads, differential & compound screw, design of square & trapezoidal threads, self-locking screw, design of power screws, screw jack, recirculating ball screw, design of bolted joint.

Unit 4 Design of Springs (06 Hrs.)

Types, materials, stress & deflection equations for helical, tension & compression spring, torsional and multi leaf springs, styles of ends, nipping of leaf spring, shot peening, spring in series & parallel, concentric springs,

Unit 5 Design of Welded & Riveted Joints (06 Hrs.)

Design of welded joint: advantages, limitations, butt & fillet welds, parallel & transverse fillet welds, axially loaded unsymmetrical welded joint, eccentric loading in plane of weld, welded joint subjected to bending & torsional moment, basic types of riveted joints, different parameters of a riveted joints, uses of riveted joints, failure of riveting joint, strength of riveting joint and efficiency of riveting joints.

Unit 6 Design for Fluctuating Load (06 Hrs.)

Stress concentration - causes & remedies, fluctuating stresses, fatigue failures, S-N curve, endurance limit, notch sensitivity, endurance strength modifying factors, design for finite and infinite life, cumulative damage in fatigue failure, Soderberg, Gerber, Goodman, modified Goodman diagrams, fatigue design of components under combined stresses.

Term Work

Term work shall consist of two design projects by using AutoCAD/manually. Design projects should be in the form of system design comprising of machine elements studied in syllabus. Design data book should be used extensively. Four assignments on remaining topics.

Text Books

1) Shigley J. E. and Mischke C. R., "Mechanical Engineering Design", McGraw Hill Publication Co. Ltd.

2) Spotts M. F. and Shoup T.E., "Design of Machine Elements", Prentice Hall International

3) Bhandari V. B, "Design of Machine Elements", Tata McGraw Hill Publication Co. Ltd.

4) Juvinal R. C, "Fundamentals of Machine Components Design", John Wiley and Sons.

Reference Books

1) Black P.H. and O. Eugene Adams, "Machine Design", McGraw Hill Book Co. Inc.

2) Willium C. Orthwein, "Machine Components Design", West Publishing Co. and Jaico Publications House.

3) Hall A. S., Holowenko A. R. and Laughlin H. G, "Theory and Problems of Machine Design", Schaum's Outline Series.

4) Sharma C. S. and Purohit Kamlesh, "Design of Machine Elements", PHI Learing Pvt. Ltd.

5) D. K. Aggarwal & Sharma P. C., "Machine Design", S.K Kataria and Sons

6) Gope P. C., "Machine Design: Fundamentals and Applications", PHI Learing Pvt. Ltd.

7) "Design Data- P. S. G." College of Technology, Coimbatore.

8) Bhandari, V. B. “Machine Design data book”, Tata McGraw Hill Publication Co. Ltd.

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV, V and VI

THEORY OF MACHINES

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 04 Hours / Week	End Semester Examination	60 Marks	04
Practical:- 02 Hours / Week	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Term Work / Oral	50 Marks	01
	Total	150 Marks	05

Course Prerequisite:- Student should have knowledge of

1. Fundamentals of engineering mechanics
2. Analysis of forces and moments
3. Kinematics
4. Algebra and trigonometry

Course Objective:-

1. To acquaint with working principles of clutches and its constructional details.
2. To study working and types of brakes and dynamometers.
3. To acquaint with working principles and applications of gyroscope and governors.
4. To demonstrate different types of gear trains and its applications.

Course Outcomes:- Learner will able to-

1. analyze gears.
2. select gears
3. analyze and select gear trains.
4. apply the working principles of clutches and its constructional details and analyze working of brakes and dynamometers.
5. can decide the shape of cam profile
6. demonstrate working mechanism of different types of governors and analyze gyroscopic effect on various applications

Unit 1 Kinematics of Spur Gears (08 Hrs.)

Classification and applications of gears, terminology of gearing, law of gearing, velocity of sliding, conjugate action, forms of teeth, path of contact, arc of contact, interference, undercutting, methods to avoid interference and undercutting, effect of centre distance variation, friction between gear teeth, involutometry.

Unit 2 Kinematics of Helical, Bevel and Worm Gears (08Hrs.)

Helical gears: Terminology, virtual number of teeth, torque transmitted,

Spiral gears: terminology and efficiency.

Worm gears & bevel gears: Terminology, geometrical relationships, tooth forces, torque transmitted.

Unit 3 Inertia of Geared Systems and Gear Trains (08 Hrs.)

Inertia of gear systems, types of gear trains - simple, compound, reverted and epicyclic gear trains, analysis of epicyclic gear trains, torque on sun and planet gears, compound epicyclic gear trains, bevel epicyclic gear trains.

Unit 4 Friction, Clutches, Brakes & Dynamometers (08 Hrs.)

Friction:

Friction and types of friction, laws of friction, Friction in turning pairs, Friction circle, Friction axis, Friction in 4 bars and single slider crank mechanism.

Friction clutches:

Pivot and collar friction, plate clutches, cone clutch, centrifugal clutch, torque transmitting capacity.

Brakes & dynamometers:

Different types of brakes, Shoe brakes, External and internal shoe brakes, Block brakes, Band brakes, Band and block brakes, Braking torques, Different types of absorption and transmission type dynamometers.

Unit 5 Cams & Followers (08 Hrs.)

Types of cams and followers, analysis of standard motions to the follower, determination of cam profiles for a given follower motions, analysis of cams with specified contours- circular arc cam, tangent cam,

Eccentric cam, methods of control: pressure angle, radius of curvature and undercutting, kinematically equivalent system, jump phenomenon. Introduction to advanced cam curves.

Unit 6 Gyroscopes and Introduction to Governors (08 Hrs.)

Gyroscopes, concept of gyroscopic action, gyroscopic couple, effect of gyroscopic couple on ship, airplanes, and vehicles. Introduction to Governors, Types centrifugal governor (Watt, Porter, and Hartnell governor only), controlling force, governor effort and governor power with numerical treatment, sensitivity, stability, isochronism and hunting, friction, insensitiveness. (No Numerical Treatment)

Term Work:

The term work shall consist of the following experiments:

1. To draw conjugate profile for any general type of gear tooth.
2. To generate involute gear tooth profile and to study the effect of undercutting and rack shift using model.
3. To study various types of gearboxes such as: Industrial gear box, Synchromesh gearbox, Differential gearbox, or PIV gearbox.
4. To measure transmitted torque and holding torque of an epicyclic gear train.
5. To study the slip in belt drives.
6. To draw cam profiles for various types of follower motions.
7. To verify gyroscopic couple.
8. To determine the characteristic curves for centrifugal governor and to find its coefficient of insensitiveness and stability.

Text Books

1. Ratan S. S., "Theory of Machines", Tata McGraw Hill
2. Beven T ," Theory of Machines", Longman Publication
3. Ballaney P. L. "Theory of Machines", Khanna Publications

Reference Books

1. Hannah and Stephans, "Mechanics of Machines", Edward Arnolde Publication.
2. Shigley J. E. and Uicker, J. J., "Theory of Machines and Mechanisms", International Edition, MacGraw Hill Inc.
3. Jagdish Lal, "Theory of Machines ", Metrapolitan Book Co. Pvt. Ltd. N. Delhi.
4. Khurmi, R. S. and Gupta, J. K." Theory of Machines", Eurasia Publishing House (Pvt.) Ltd., New Delhi.
5. Ghosh Malik, "Theory of Mechanism and Machines", East-West Pvt. Ltd.
6. Dr.V. P. Singh, "Theory of machine", Dhanpatrai and Son.
7. C. S. Sharma & Kamesh Purohit," Theory of Machine and Mechanism", PHI.
8. David H. Myszka, "Machines and Mechanism", PHI.

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV,V and VI

ADVANCED COMPUTER GRAPHICS & SOLID MODELLING

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 03 Hours / Week	End Semester Examination	60 Marks	03
Practical:- 02 Hours / Week	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Term Work / Pract..	50 Marks	01
	Total	150 Marks	04

Course Prerequisite:-

1. Knowledge of basic concept of Engineering Graphics.
2. Basic knowledge of Mechanical Engineering drawing.
3. Basic knowledge of Computer Hardware and AutoCAD Software.

Course Objective:-

1. To introduce new and exciting field of Intelligent CAD with particular focus on engineering product design.
2. To develop a holistic view of initial competency in engineering design by modern computational methods.
3. To expose the student to contemporary computer design tools for mechanical engineers.
4. To prepare the student to be an effective user of a CAD system.
5. Model the 3-D geometric information of machine components including assemblies, and automatically generate 2-D production drawings.
6. Understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program.

Course Outcomes:-

Able to understand-

1. Algorithms to generate, points, lines, circles ellipse and different polygons
2. Basic transformations in 2D modelling
3. Different transformations in 3D modelling
4. Geometric modelling of curves
5. Parametric representation of analytic and synthetic surfaces
6. Basics of solid modelling and data exchange in CAD/CAM

Unit 1 Output primitives (06 Hrs.)

Points and Lines, Line Drawing Algorithms-DDA Algorithm, Bresenham's Line Drawing Algorithms, Thick Line Segments. Circle and Ellipse Generation Algorithm.
Polygon-Polygon Filling, Flood Fill, Boundary Fill, Scan Line Fill.

Unit 2 Two Dimensional Transformations (06 Hrs.)

Basic Transformation – Translation, Rotation, Scaling, Reflection, Shear, Matrix Representation and Homogeneous Co-Ordinates.
Composite Transformations.

Unit 3 Three-Dimensional Transformations (06 Hrs.)

Introduction to 3D, Translation, Rotation, Scaling, Reflection, Shear, Affine and Perspective Geometry. Orthographic, Axonometric, Oblique Projection.

Unit 4 Geometrical Modeling (06 Hrs.)

Mathematical Representation of Curves, Wire Frame Model, Wire Frame Entities. Parametric Representation of Analytic Curves- Lines, Circles, Ellipses. Parametric Representation of Synthetic Curves- Hermit, Cubic-Splines, Bezier Curve, B-Spline Curve.
Curve Manipulation: Displaying, Evaluating Points on Curve, Blending Segmentation.
Surface Manipulation: Displaying, Evaluating Points & Curve on Surfaces, Segmentation, Trimming, Intersection, Projection and Transformations.

Unit 5 Surface Modeling (06 Hrs.)

Surface Models, Surface Entities, Surface Representation.
Parametric Representation of Analytic Surfaces- Plan Surfaces, Ruled Surfaces, Surface of Revolution, Tabulated Cylinder.
Parametric Representation of Synthetic Surfaces- Hermit, Bi-cubic Surfaces, Bezier Surfaces, B-spline Surfaces.

Unit 6 Solid Modeling (06 Hrs.)

Solid Models, Solid Entities, Solid Representation, Fundamentals of Solid Modeling, Boundary Representation, Constructive Solid Geometry, Sweep Representation.
CAD/CAM Data Exchange: Evaluation of data exchange formation, IGES data representation & Structure, PDES Data representation, STEP Architecture.

Term Work:

The term work shall consist of record of eight experiments from the following:

1. DDA Line Drawing Algorithm.
2. 2 D Transformation.
3. 3D Transformation.
4. Assignment on 2-D sketching with geometrical and dimensional constraints using any commercially used solid modeling software.
5. Assignment on parametric solid modeling of a machine component using various commands and features of the software.
6. Assignment on solid modeling of the parts of a machine (min. 5 components).
7. Assignment on assembly modeling of the parts modeled in assignment 6 using proper mating conditions and generation of exploded view.
8. Generation of production drawings of the parts and assembly with appropriate tolerancing.

Reference Books

1. Ibrahim Zeid and R. Siva-Subramaniam – "CAD/CAM- Theory and Practice", Tata McGraw Hill, Publishing Co. 2009.
2. Rao P. N., "CAD/CAM", Tata McGraw Hill.
3. Foley, Van Dam, Feiner and Hughes, "Computer Graphics Principles and Practice", Second edition, Addison–Wesley, 2000.
4. Martenson, E. Micheal, "Geometric Modelling", John Wiley & Sons, 1995.
5. Hill Jr, F.S., "Computer Graphics Using OpenGL", Pearson Education, 2003.

6. Rao Singeresu S., “Engineering Optimization-Theory and Practice”, New Age International Limited Publishers, 2000.
7. Ray C. Johnson. “Optimum Design of Mechanical Elements”, Wiley, John & Sons, 1981.
8. Radhakrishnan P., Subramanyam S., “CAD/CAM/CIM”, New Age International.
9. Ramamurti V., “Computer Aided Mechanical Design and Analysis”, Tata McGraw Hill-1992.

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV, V and VI

HEAT AND MASS TRANSFER

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 04 Hours / Week	End Semester Examination	60 Marks	04
Practical:- 02 Hours / Week	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Term Work / Oral	50 Marks	01
	Total	150 Marks	05

Course Prerequisite:-

1. Knowledge of basic concepts in Physics.
2. Basic information of Thermodynamics.
3. Basic knowledge of Fluid Mechanics

Course Objective:-

1. The student should understand the scope, objective and application of heat and mass transfer and its applications.
2. They will also learn the three major modes of heat transfer *viz.*, conduction, convection, and radiation. In addition to these three main modes of heat transfer, students will also learn the phenomena of heat transfer during phase change

Course Outcomes:-

Able to understand-

1. Formulate basic equations for heat transfer problems.
2. Concept of thermal insulation in one dimensional steady state heat conduction
3. Analysis of extended surfaces and concept of unsteady heat conduction
4. Concept of heat transfer by forced and natural convection
5. Various laws related to thermal radiation and concepts of condensation and boiling
6. Preliminary analysis of heat exchangers and concept of mass transfer

Unit 1 Introduction and Basic Concepts (08 Hrs.)

Overview of subject, Modes of heat transfer, Applications of heat transfer in different fields of engineering, Fourier's law of conduction, Newton's law of cooling, Stefan-Boltzmann's law of radiation, Isotropic and anisotropic

materials, Three dimensional heat conduction equation in Cartesian coordinate for anisotropic material for steady state condition, and reduction to Fourier equation, Laplace equation and Poisson's equation, Three dimensional heat conduction equation in cylindrical and spherical coordinates (no derivation), Thermal diffusivity.

One dimensional steady state heat conduction:

One dimensional steady state heat conduction through a plane wall, cylindrical wall and sphere, Analogy between heat flow and electricity, heat conduction through a composite slab, cylinder and sphere, Overall heat transfer coefficient, Concept of thermal resistance and conductance.

Unit 2 Thermal Insulation (08 Hrs.)

Purpose of insulation, critical radius of Insulation, Economic thickness of Insulation, Thermal contact resistance, thermal conductivity and it's variation with temperature for metals, non-metallic solids, gases and liquids, one dimensional problems of variable thermal conductivity.

One Dimensional Steady State Heat Conduction with Internal Heat Generation:

Symmetrical boundary condition in plane wall, conduction in solid, hollow cylinder and sphere, practical problems of heat generation.

Unit 3 Extended Surfaces (08 Hrs.)

Heat transfer through extended surfaces, Classification of fins, Derivation of differential equation for fins with constant cross sectional area with insulated tip boundary conditions, Effectiveness and efficiency of a fin, design of thermo well.

Unsteady state heat conduction :

System with negligible internal resistance, Biot & Fourier numbers, Criteria for neglecting internal temperature gradient, Concept of time constant

Unit 4 Convection (08 Hrs.)

Introduction to hydrodynamic and thermal boundary layer, Laminar & turbulent flow over & closed conducts, convection heat transfer coefficients & order of magnitude, Dimensional analysis of free & forced convection, physical significance of the dimensionless ,parameters, Nusselt's number, Reynold's number, Prandtl's number, Grashoff's number, Stanton number, Rayleigh number.

Forced Convection

Empirical correlations for heat transfer in laminar and turbulent flow over a flat plate and in a circular pipe, Concept of hydraulic diameter, reference temperature.

Natural Convection

Flow patterns, Empirical correlations for free convection, heat transfer over horizontal, vertical plate.

Unit 5 Thermal Radiation (08 Hrs.)

Fundamental concepts, Black body radiation, Kirchoff's law, Planck's distribution law, Wein's displacement law, Stefan Boltzmann law, Surface emission, relative properties of a surface, Grey, black and real surface, solid angle and intensity of radiation, Lambert's Cosine law, Heat exchange by radiation between two finite black surfaces, Radiation shape factor, use of shape factor charts, Irradiation, radiosity, Electrical network, Heat exchange between two infinitely parallel planes and cylinders, Radiation shields.

Condensation and Boiling

Film and drop-wise condensation, heat transfer coefficient for laminar film condensation on verticaland inclined plate(descriptive treatment), Correlations for condensation on and inside tubes, modes of pool boiling, critical heat flux, pool boiling.

Unit 6 Heat Exchangers (08 Hrs.)

Classification, Applications of heat exchangers, Heat exchanger analysis, Logarithmic Mean Temperature Difference for parallel and counter flow heat exchangers, LMTD correction factors, fouling factor. The effectiveness: NTD method for parallel and counter flow heat exchangers, design considerations for heat exchangers

Mass Transfer:

Introduction, modes of mass transfer, analogy between heat and mass transfer, mass diffusion (mass and mole basis), Fick's law of diffusion

Term Work:

Term work shall consist of any eight experiments

1. Determination of thermal conductivity of insulating powder.
2. Determination of thermal conductivity of metal rod.
3. Determination of thermal conductivity of different materials in composite wall.
4. Temperature distribution along a length of a fin and determination of fin effectiveness and fin efficiencies.
5. Determination of film heat transfer coefficient on a hollow vertical tube heated from inside.
6. Determination of film heat transfer coefficient for turbulent flow inside a pipe.
7. Determination of emissivity of a non-black surface.
8. Determination of Stefan-Boltzmann constant.
9. Performance of a parallel flow and counter flow heat exchanger.
10. Calibration of thermocouple.
11. Demonstration of a heat pipe.
12. CFD simulation of conduction or convection problem.

Text Books

1. Incropera F. P., Dewitt D. P., "Fundamentals of Heat and Mass Transfer", John Wiley.
2. Cengel Y. A. and Ghajar A. J., "Heat and Mass Transfer – Fundamentals and Applications", Tata McGraw Hill Education Private Limited.
3. Sukhatme S. P., "A Textbook on Heat Transfer", Universities Press.
4. Mills A. F., "Basic Heat and Mass Transfer", Pearson.

Reference Books

1. Venkatesan S. P., "Heat Transfer", Ane Books Pvt. Ltd.
2. Holman J. P., "Fundamentals of Heat and Mass Transfer", McGraw – Hill publication.
3. Nag P. K., "Heat & Mass Transfer", McGraw Hill Education Private Limited.
4. Thirumaleshwar M., "Fundamentals of Heat and Mass Transfer", Pearson Education India.
5. Sachdeva R.C., "Fundamentals of Engineering Heat and Mass Transfer", New Age Science

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV, V and VI

ADVANCED MANUFACTURING PROCESSES

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 03 Hours / Week	End Semester Examination	60 Marks	03
	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Total	100 Marks	03

Course Prerequisite:- Student should have knowledge of

1. Conventional manufacturing Processes
2. Engineering Drawings and design
3. Engineering materials and its properties

Course Objective:- Provide knowledge of sheet metal working, non-conventional processes, NC/CNC machine, robotics and processing of materials.

Course Outcomes:- Learner will be able to understand

1. Various concepts related to sheet metal working
2. Design of jigs and fixtures
3. Various non-conventional machining processes
4. Concepts of CNC programming and robotic applications in manufacturing industries
5. Concept of various heat treatment processes for altering the mechanical properties of steels and alloys
6. Different methods of manufacturing of components by power metallurgy and composite materials

Unit 1 Sheet Metal Working (06 Hrs.)

Study of various press tools and presses, Study of various processes like Piercing, Notching forming, drawing, coining *etc*. Elements of dies and punches. Types of dies – simple, compound, combination and progressive dies and punches for various press working operations such as punching, blanking, drawing, bending, forming, coining etc. Calculations of clearances, centre of pressure, forces, press tonnage, blank size, number of draws, strip layout, sheet utilization, ratio. Methods of reducing forces. Design of simple blanking die, Progressive die, & Deep Drawing die.

Unit 2 Jigs and Fixtures (06 Hrs.)

Definitions, elements, Basic principles and guide lines for design. Location, types of locators and their selection. Clamping, basic principles, types and their selection, indexing methods. Design of drilling jigs. Design of milling& Turning fixtures.

Unit 3 Non-Conventional Machining (06 Hrs.)

Concept of non-conventional machining. Study of processes like, Electrochemical Machining, Electro Discharge Machining, Abrasive Jet Machining, Plasma Machining, LASER Machining, and Ion beam Machining, Ultrasonic Machining, Electron Beam Machining with reference to process capabilities, working principle, Material removal rate, Advantages and limitations.

Unit 4 C. N. C. Machine Tools & Robotics (06 Hrs.)

Principle of operation of CNC, Types, Features, Direct numerical control (DNC) and its applications. NC part programming, axes nomenclature of CNC machines. Manual part programming using. Computer aided part programming using APT. Types of Robots, construction and operation of robots, robot axes and configuration, robot applications, robot selection and economic justification. FMS, FMC and Adaptive Control.

Unit 5 Heat Treatment of Steels and Alloys (06 Hrs.)

Iron and Iron Carbide Equilibrium Diagram, Transformation product of Austenite, Martensitic transformation, Time- Temperature. Transformation curve, Heat treatment of steels, Annealing, Normalizing, Hardening and tempering, Hard ability, Jominy End quench test, Surface hardening heat treatments, Carburizing, Nitriding, Carbo-nitriding, Induction and flame hardening, Tool steels, Classification, Properties and application of tool steels, Heat treatment of tool steels.

Unit 6 Powder Metallurgy , Ceramics and Composite Manufacturing (06 Hrs.)

Important characteristics and methods of powder production, different techniques - pressing, extruding, isostatic moulding, fiber metal process, sintering and hot pressing.

Introduction to composite materials, basic concepts, constituent materials for composites, advantages, limitations of composites and application of composites. Manufacturing of Composites: Introduction, molding process for polymer matrix composites, metal matrix composites, ceramic matrix composites.

Text Books

1. Kodgere V. D., “Material Science and Physical Metallurgy”, Everest Publication, Pune
2. Donaldson, Lacain and Goold, “Tool Design”, Tata McGraw Hill
3. Kempster M. H. A., “Introduction to Jigs and Fixtures Design”, Viva Books Ltd.
4. ASTME, “Tools Engineering Handbook”
5. Sharma P. C., “Production Engineering”, Khanna Publication
6. Hoffman, “Introduction to Jigs and Fixture”, Galgotia Publishers
7. Radhakrishnan P. and Subramanyan CAD/ CAM/CIM Wiley Eastern Ltd.
8. Rao P. N., Tiwari N. K. and Kundra T. K., “Computer Aided Manufacturing”, Tata McGraw Hill
9. Groover M. P., “Automation, Production System and Computer Integrated Manufacturing”,

Reference Books

1. Amstead B. H., Philip F, Ostwald and Myron L, Begeman, “Manufacturing Processes" John Wiley and sons, eighth edition.
2. Benidict G. F., “Advanced Manufacturing Processes": Marcel Deker Publisher
3. Cook N. “Manufacturing Analysis", Addison- Wesley Publishing Co., 1966.
4. Weller, “Non-traditional Machining Process": SME Publications.
5. Mishra P. K., “Non-Conventional Machining Process”, Narosa Publication.
6. “Production Technology: HMT Ltd", McGraw-Hill Pub. 1986.
7. “Machining Data Handbook: 3rd (Third) edition” Machinability Data Center Technical Staff, 1980

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV, V and VI

PROFESSIONAL SKILLS DEVELOPMENT-V

Designation of Course	**Workshop Technology**		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- 4 Hours/ Week	End Semester Examination	100 Marks	Theory: 04 Practical: 00
Practical:- -- Hours/ Week	Unit Test Assignments Internal Evaluation	-- Marks -- Marks -- Marks	
	Term Work	-- Marks	
	Total	100 Marks	04

Course Pre-requisites	
The Students should have knowledge of	
1.	Basic concepts of Maths, Logical reasoning and English Grammar taught in the last semester.
2.	An overall idea about vocabulary, Public speaking skills taught in the last semester
3.	Knowledge of writing skills, importance of professionalism in emails and letters.
4.	Knowledge on handling criticism and the concept of conflicts.
5.	Awareness of the interpersonal skills like team work and its importance in the corporate sector.
Course Objectives	
	The Professional Skills Development 5 is an extension of PSD- 4 with focus on the remaining topics of Aptitude, Reasoning and Grammar. The further complex concepts of Aptitude and Grammar aims to acquaint them with the topics and also provide them techniques to solve the question with tricks/methods in a very short period. The English communication and soft skills section of PSD-5 focuses on the higher aspects of soft skills training students on how to handle Group Discussions during placement process and other topics such as grooming them on how to handle conflicts effectively in the corporate scenario and also the correct attitude/approach to solve problems collectively from a team's perspective and also individually.
Course Outcomes	
The student should be able to	
1.	Learn further concepts of Maths, Logical reasoning and English grammar and apply short cuts/ tricks to solve questions in less time. Learn remaining 25-30 rules of grammar topics of tenses and Sub- verb agreement relevant from the recruitment point of view.
2.	Use Mnemonics, and learn appropriate strategies to handle complex topics in GDs and ways to handle them. Students would learn the appropriate ways of stating opinions, disagreeing or communicating during the Group Discussion Process.
3.	Apply various strategies of conflict resolution through amicable way to settle team conflicts/disputes. They would learn to handle criticism and feedback in a positive way as an individual as well as a team.
4.	Students would learn effective time management strategies- Pareto principle (the 80-20 rule of time management) and apply them in the corporate life. It would be a continuation of the topic covered during the previous semester PSD-4
5.	Learn to handle Case studies effectively and incorporate the right approach towards Case Studies asked during the recruitment process.
6.	Apply 5-6 positive strategies to resolve conflicts arising during team work

Course Contents

Unit I	**Aptitude (Maths, Logical Reasoning, English)**	**(24 Hrs.)**
	• Maths ▪ Time, Speed & Distance ▪ Time & Work ▪ Simple Interest & Compound Interest in continuation ▪ Maths Revision • Logical Reasoning ▪ Data Interpretation ▪ Data Sufficiency ▪ Set Theory & Syllogisms ▪ Reasoning Revision	

	• English ▪ Grammar – II – (Adjective, Verb, Sub- Verb Agreement) ▪ Grammar- (Tenses) ▪ Vocabulary ▪ Verbal Ability- Revision	
Unit II	**Soft Skills & English Communication**	**(24 Hrs.)**
	• Situational Conversation • Situational Writing • GD Orientation • Mock GD-1 • Mock GD-2 • Mock GD-3 • Conflict Resolution • Problem Solving Skills • Time- Management Skills • Handling Case Studies • Management Games • Business Meeting Etiquettes	
Text Books		
1. APAART: Verbal Ability		
2. APAART: Logical Reasoning		
3. APAART: Quantitative Aptitude		
4. APAART: Speak Well 1 (English Language and Communication)		
5. APAART: Speak Well 2 (Soft Skills)		

Department of Mechanical Engineering

Syllabus: Semester VI

MACHINE DESIGN-II

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 04 Hours / Week	End Semester Examination	60 Marks	04
Practical:- 02 Hours / Week	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Term Work / Oral	50 Marks	01
	Total	150 Marks	05

Course Prerequisite:- Student should have knowledge of

1. Fundamentals of engineering Drawing
2. Analysis of forces
3. Utilizing the principles of drafting and strength of materials.
4. Basics of kinematics of gears in transmission system

Course Objective:-

1. Reinforce the philosophy that real engineering design problems are open-ended
2. Give practice in longer open-ended problems using design methodology
3. Enable students to apply engineering tools/techniques to product design
4. Broaden skills in team work, critical thinking, communication, planning and scheduling through design projects
5. Enable students to consider safety, ethical, legal, and other societal constraints in execution of their design projects
6. Enable students to attain the basic knowledge required to understand, analyze, design and select machine elements

Course Outcomes:- Learner will able to-

1. understand the concept of design for various manufacturing processes in Mechanical Engineering
2. understand the various concepts related to design of spur gears
3. understand the various concepts related to design of helical gears
4. the procedure for selection of different types of rolling contact bearings for different applications
5. understand the various concepts related to sliding contact bearings
6. technical details about belts, ropes and chain drives

Unit 1 Design For Manufacture (08 Hrs.)

General principles of design for manufacture & assembly (DFM & DFME), Principles of design of casting & forging, Design for machining, Design for powder metallurgy, Design for welding.

Unit 2 Design of Spur Gears (08 Hrs.)

Gear drives, Classification of gears, Selection of types of gears, Standard system of gear tooth.

Spur Gears: Number of teeth & face width, Types of gear tooth failure, Desirable properties & selection of gear materials, Force analysis, Beam strength, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength, Estimation of module based on beam
& wear strength, Gear design for maximum power capacity, Estimation of dynamic tooth load by velocity factor, Spott's equation, Buckingham's equation, Methods of gear lubrication. Introduction to Gear design standards like AGMA, IS.

Unit 3 Design of Helical Gears (08 Hrs.)

Transverse & normal module, virtual number of teeth, Force analysis, Beam & wear strength, Effective load on gear tooth, Estimation of dynamic load by velocity factor, Spott's equation, Buckingham's equation.

Unit 4 Rolling Contact Bearing (08 Hrs.)

Equivalent bearing load, Load life relationship, Selection of bearing life, Selection from manufacturer's catalog, Taper roller bearing, Design for cyclic load & speed, Bearing with probability of survival other than 90%, Lubrication & mounting construction materials, Selection of oil seals & gaskets, Pre loading, Types of failure of bearings and its remedies.

Unit 5 Sliding Contact Bearing (08 Hrs.)

Basic modes for lubrication, Viscosity. Effect of temperature on viscosity, Viscosity index, Additives, Greases, Selection of lubricants. Viscous flow through rectangular slot, Load carrying capacity & flow requirement of hydrostatic step bearing, Energy losses, Hydrodynamic lubrication, Reynolds equation, Summerfield number, Raimondi & Boyd's method, Temperature rise in hydrodynamic bearings, Parameters of bearing design, Length to diameter ratio, Unit bearing pressure, Radial clearance,

Minimum oil film thickness, Constructional details of bearings, Bearing materials & their selection, Sintered metal bearings, Comparison of rolling & sliding contact bearing.

Unit 6 Belts, Ropes and Chain Drives (08 Hrs.)

Materials and construction of flat and V belts, geometric relationships for length of belt, power rating of belts, concept of slip & creep, initial tension, effect of centrifugal tension, maximum power condition, selection of flat and V belts from manufacturer's catalogue, belt tensioning methods, relative advantages and limitations of flat and V belts, construction and applications of timing belts .Wire Ropes (Theoretical Treatment Only): Construction of wire ropes, lay of wire ropes, stresses in wire rope, selection of wire ropes, rope drum construction and design. Chain Drives (Theoretical Treatment Only**)**: Types of power transmission chains, Geometry of chain Polygonal effect of chain, Modes of failure for chain, Lubrication of chains

Term Work:

1. Term work shall consist of two design projects by using Autocad/manually. Design projects should be in the form of system design comprising of machine elements studied in syllabus. Design data book should be used extensively.
2. Four assignments- based on remaining topics.
3. Report- Industrial visit to gear manufacturing unit.

Text Books

1. Shigley J. E. and Mischke C.R., "Mechanical Engineering Design", McGraw Hill

Publication Co. Ltd.
2. Spotts M. F. and Shoup T. E., " Design of Machine Elements ", Prentice Hall International.
3. Bhandari V. B, "Design of Machine Elements", Tata McGraw Hill Publication Co. Ltd.
4. Juvinal R. C, "Fundamentals of Machine Components Design", John Wiley and Sons.

Reference Books

1. Black P. H. and O. Eugene Adams, "Machine Design", McGraw Hill Book Co. Inc.
2. Willium C. Orthwein, "Machine Components Design", West Publishing Co. and Jaico Publications House.
3. Hall A.S., Holowenko A. R. and Laughlin H.G, "Theory and Problems of Machine Design", Schaum's Outline Series.
4. Sharma C. S. and Kamlesh Purohit, Design of Machine Elements, PH I Learing Pvt. Ltd.
5. Aggarwal D. K. & Sharma P.C., "Machine Design", S. K. Kataria and Sons
6. P. C. Gope, "Machine Design: Fundamentals and Applications", PHI Learing Pvt. Ltd.
7. "Design Data - P.S.G." College of Technology, Coimbatore.
8. Bhandari, V. B., "Machine Design data book", Tata McGraw Hill Publication Co. Ltd.
9. Mahadevan K., Balveera Reddy K., "Design Data Handbook for Mechanical Engineers", CBS Publishers

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV, V and VI

REFRIGERATION AND AIR CONDITIONING

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 03 Hours / Week	End Semester Examination	60 Marks	03
Practical:- 02 Hours / Week	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Term Work / Oral	50 Marks	01
	Total	150 Marks	04

Course Prerequisite:-

1. Knowledge of basic concepts in heat transfer.
2. Basic information of thermodynamics.
3. Basic knowledge of fluid mechanics.

Course Objective:-

1. To study fundamental principles and different methods of refrigeration and air conditioning.
2. Study of various refrigeration cycles and evaluate performance using Mollier charts and/ or Refrigerant property tables.
3. Comparative study of different refrigerants with respect to properties, applications and Environmental issues.
4. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
5. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems.

Course Outcomes:-

Able to understand-

1. Different methods of refrigeration systems.
2. Simple vapour compression system and different multi-pressure systems
3. Vapour absorption system and different types of refrigerants
4. Various psychrometric processes used in air conditioning
5. Different components of refrigeration and air conditioning systems
6. Details of ducts for air conditioning system

Unit 1 Methods of Refrigeration (06 Hrs.)

Ice refrigeration, evaporative refrigeration, refrigeration by expansion of air, refrigeration by throttling of gas, vapour refrigeration system, steam jet refrigeration system, refrigeration by using liquid gases, Thermoelectric and ultrasound refrigeration.

Air refrigeration system: Definition, refrigeration load, unit of refrigeration, Reverse Carnot cycle, Bell Coleman cycle, Methods of air refrigeration systems, simple air cooling system, boot strap system, reduced ambient system, regenerative system.

Unit 2 Simple Vapour Compression System (06 Hrs.)

Limitations of air refrigeration system, development of vapour compressor cycle, effect of operating parameters on VCC, use of P-H charts, actual vapour compression cycle.

Multi Pressure Systems Introduction to multistage compression, two stage compression with flash gas removal, with liquid intercooler, Cascade systems.

Unit 3 Vapour Absorption System **(06 Hrs.)**

Introduction, Simple Vapour absorption system, practical vapour absorption system, COP of an ideal vapour absorption system, Water ammonia system, Electrolux refrigerator, Lithium-Bromide absorption System, Comparison between VCC and VAC (no mathematical treatment).

Refrigerants: Desirable properties of refrigerants, classification of refrigerants, secondary refrigerants, alternative refrigerants for CFC's, HCFC'S, ozone depletion potential (ODP), Global warming Potential (GWP).

Unit 4 Psychrometry **(06 Hrs.)**

Introduction, Psychrometric terms, Use of Psychrometric charts, Psychrometric processes, adiabatic saturation temperature, evaporative cooling, by pass factor of coil, efficiency of coil, adiabatic mixing of two air streams, Air washers, Thermodynamics of human body with environment effective temperature, comfort chart, factors influencing human comfort.

Unit 5 Air Conditioning Systems **(06 Hrs.)**

Definition, factors, equipment used, classification, all air system, all water system, air water system, unitary and central air conditioning, in filtration and ventilation loads, concepts of SHF, RSHF, ERSHF, ADP.

Components of Refrigeration and Air Conditioning System:
Compressors, condensers, evaporators, expansion devices such as capillary tubes, automatic expansion valves, thermostatic expansion valves and controls such as thermostats, humidistat, Solenoid, Installation, charging, testing and maintenance, study of modern trends in RAC

Unit 6 Ducts **(06 Hrs.)**

Introduction, classification of ducts, duct material, pressure in ducts, flow through duct, pressure losses in duct, friction losses, dynamic losses, air flow through simple duct system, equivalent diameter, for determination of duct size.

Food Preservation: Cold storage, control and modified atmosphere (CAMA) storages, mobile refrigeration and air conditioning, refrigerant piping selection, pressure drop, valves, fitting, insulating materials.

Term Work:

The term work shall consist of record of any eight experiments from the following:

1. Test on vapour compression test rig.
2. Test on air conditioning test rig.
3. Test on ice plant test rig.
4. Study of non-conventional refrigeration system.
5. Determination of cooling load of air conditioning system (case study).
6. Determination of refrigeration load in cold storage (case study / visit).
7. Study of installation /operation/maintenance practices for refrigeration system.
8. Visit to any refrigeration or air conditioning plant.
9. Trial on heat pump test rig
10. Test on vapour absorption test rig.

11. Market survey of various refrigerating & air conditioning systems which include the equipments with related specifications, manufacturer, cost. (minimum 3 to 4 equipments)
12. Determination of energy efficiency of refrigeration or air conditioning system.

Text Books/ Reference Books

1. Arora C. P., "Refrigeration and Air Conditioning", Tata McGraw Hill
2. Arora S. C., Domkundwar S., "Refrigeration and Air Conditioning", Dhanpat Rai and Company
3. Dossat Ray I, "Principal of Refrigeration", Wiley Eastern Limited
4. Manohar Prasad, "Refrigeration and Air Conditioning", Wiley Eastern Limited
5. Khurmi R. S. and Gupta J. K., "Refrigeration and Air Conditioning", Eurasia Publication House (P) Ltd. New Delhi
6. Stocker W. F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill International Editions

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV, V and VI

INTERNAL COMBUSTION ENGINES

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 03 Hours / Week	End Semester Examination	60 Marks	03
Practical:- 02 Hours / Week	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Term Work / Pract.	50 Marks	01
	Total	150 Marks	04

Course Prerequisite:-

1. Knowledge of basic concept heat transfer.
2. Basic information of thermodynamics.

Course Objective:- The student should understand the scope, objective and application of internal combustion engines.

Course Outcomes:- Able to -

1. Know constructional Features of I. C. Engine.
2. Understand fuel supply systems of C. I. and S. I. engines.
3. Acquire knowledge of different systems required for running of I.C. engines
4. Test the thermal and emission performance of I. C. Engines
5. Understand the phenomena of combustion in S. I. and C. I. engines
6. Understand norms for measurement of emissions from I. C. engines

Unit 1 Constructional Features of Reciprocating I. C. Engine (06 Hrs.)

Engine components, Engine classification

Cycle Analysis of I. C. Engines:

Fuel air cycle analysis, Comparison of P-V diagram of air standard cycles, Fuel air cycle & actual cycle

Unit 2 Fuel Supply Systems (06 Hrs.)

S. I. Engines:

Carburetion, Mixture requirements, Essential parts of modern carburetor, Carburetors used on automobiles, Calculation of A/F ratio, M.P.F.I. system for modern automobile engines.

C. I. Engines:

Functional requirements of an injection system, Typical arrangement of solid injection system, Types of fuel injection system, Fuel pump & fuel injectors, Quantity of fuel & size of nozzle orifice.

Unit 3	**I. C. Engine Systems**	**(06 Hrs.)**

Ignition System:

Battery & coil ignition system, Magneto ignition system, Electronic ignition system, Advantage over mechanical contact breaker point system.

Engine Cooling System:

Air cooling, Water cooling, Thermostatic radiators

Lubrication System:

Dry sump lubrication, Wet sump lubrication – Fully pressurized, Oil filters

Governing System:

Quality governing, Quantity governing, Hit & miss governing

Unit 4	**Testing & Performance of I. C. Engine**	**(06 Hrs.)**

Determination of brake power, Indicated power, Friction power, Determination of brake thermal efficiency, Mechanicalefficiency, Volumetric efficiency, Energy balance, Performance characteristics.

Supercharging:

Objects of supercharging, Effects on performance, Limits, Methods of supercharging& turbocharging, Limitation of turbocharging.

Unit 5	**Combustion in S. I. Engines**	**(06 Hrs.)**

Stages of combustion, Effect of engine variables on ignition lag & flame propagation, Abnormal combustion: Theories, Effects & Controlling measures, Combustion chambers for S. I. engines.

Combustion in C. I. Engines:

Stages of combustion, Ignition delay & factors influencing delay period, Diesel knock & its control, Combustion chambers for C. I. engines.

Unit 6	**Emissions & Pollution Control**	**(06 Hrs.)**

Emissions from S. I. and C. I. engines & their harmful effects, Catalytic convertors, Contemporary & proposed emission norms, BHARAT STAGE- I to IV emission norms, EGR system.

Fuels:

Types of fuels for I. C. engines, Rating of S. I. & C. I. engine fuels, Alternative fuels for I. C. engines & future trends, Hybrid vehicles.

Term Work:

1. Study of carburetor / MPFI system
2. Study of fuel pump & injector.
3. Trial on multi cylinder petrol engine – Morse Test.
4. Trial on diesel engine to determine energy balance & variable load performance.
5. Variable speed trial on petrol / diesel engine.
6. Trial on computerized I. C. engine to plot P – è diagram.
7. Trial / demonstration of smoke meter & exhaust gas analyzer.
8. Study of battery, magneto & electronic ignition system.
9. Study of superchargers & turbochargers.
10. Study of combustion chambers in S. I. & C. I. engines.
11. Study of recent hybrid cars in market

Reference Books

1. Ganesan V., Internal Combustion Engines, Tata McGraw Hill Publishing House
2. M. L. Mathur & R. P. Sharma, A Course in I. C. Engines, Dhanpat Rai & Sons
3. V. M. Domkundwar, A Course in I. C. Engines, Dhanpat Rai & Co.
4. Shrinivasan, Automobile Engines, Tata McGraw Hill Publishing House – CBS Publication

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV, V and VI

MECHANICAL MEASUREMENT & METROLOGY

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 04 Hours / Week	End Semester Examination	60 Marks	04
Practical:- 02 Hours / Week	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Term Work / Pract.	50 Marks	01
	Total	150 Marks	05

Course Prerequisite:-	Student should have knowledge of 1. Students should have Basic knowledge of Mechanical terms Force, Pressure, Temperature, and Electronics terms like as Voltage, Resistance and Current. 2. Students should have Basic knowledge of Measuring Units, Mathematics, and Various Measurement terms.
Course Objective:-	Student should be able to 1. Use various precision measuring instruments *viz.* Vernier caliper, micrometer *etc.* 2. Acquire knowledge of different sensors and transducers 3. Acquire knowledge of tolerances, gauges and measurement of surface finish
Course Outcomes:-	Learner will be able to… 1. Understand static and dynamic characteristics of measurement systems 2. Know different devices used for linear and angular measurement 3. Measure temperature, pressure, strain and fluid flow using different sensors for various applications 4. Using of concepts like limits, fits and tolerances for designing the limit gauges. 5. Use displacement, velocity, position, force, torque, level sensors for specific applications 6. Measure various screw thread or gear tooth parameters using specific equipment.

Unit 1 Introduction to Measurement systems (08 Hrs.)

Significance of Measurements, Mechanical Measurements, Classification of Measuring Instruments, Generalized Measurements Systems.

Static Characteristics of Measurement Systems: Sensitivity, Calibration, Accuracy, Linearity, Static Error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span, Range.

Dynamic Characteristics of Measurement Systems: Speed of response and measuring lag, fidelity and dynamic error, overshoot, dead time and dead zone. Standard test inputs: Step. Ramp, Impulse and Sinusoidal Inputs.

Errors in Measurements: Types & Sources of Errors and Uncertainty Analysis in Measurements. Probable Errors.

Unit 2 Introduction to Metrology (08 Hrs.)

Meaning of metrology & its Importance.

Linear Measurement :

Standards - line standard, end standard, wave length standard, classification of standards, precision, and non-precision measuring instrument, slip gauges, Different types of Vernier, Micrometer, Dial Gauges. Concept of Magnification.

Angular Measurement:

Sine bar, Sine center, Uses of sine bar, angle gauge, Auto Collimator, Angle Dekkor, angle slip gauges, Constant Deviation Prism.

Unit 3 Sensors and Transducers (08 Hrs.)

Concept of sensors and transducers. Significance of Transducers in Measurement and Instrumentation System. Classification and Selection Parameters of Transducers. Basic components of DAQ, Concept of signal conditioning.

Strain Measurement: Theory & Classification of Strain gauges, Gauge Factor, Temperature compensation, Wheatstone Bridge Circuit.

Temperature measurement: Resistance Temperature Detector(RTD), Thermocouples & Laws of thermocouples, Resistance Thermometers & Thermistors, Optical Pyrometers

Pressure measurement: Diaphragm Pressure Gauge, Bourdon Tube, Bellows, McLeod Gauge, Piezoelectric Sensor, Tactile Sensor

Flow measurement: Hot Wire anemometer, Thermal flow meters, Electromagnetic flow meter, Ultrasonic Flow meter, Turbine Meter

Unit 4 Tolerances and Gauging (08 Hrs.)

Limits, Fits, Tolerances:

Meaning of limit, Fits and Tolerance, Cost-Tolerance relationship, concept of Interchangeability, Indian Standard System (ISS).

Design of Limits Gauges:

Types, Uses, Taylor's principle, Design of limit gauges. Inspection of geometric parameters: Straightness, Parallelism, Concentricity, Squareness and circularity.

Comparators

Uses, types, advantages and disadvantages of various types of comparators.

Advances in Metrology: Introduction of CMM, Types of CMM

Unit 5: Measurement ofVelocity, Displacement, Force, Torque, Level and Acceleration (8 Hrs.)

Displacement, Velocity and Position Sensors: Potentiometer, LVDT, Hall Effect Sensor, optical encoders, Proximity Sensors, Tacho-generator.

Force and Torque Measurement: Load Cell and its different types, Torque measurement using strain gauges, Torsion Meter.

Acceleration Sensors: Displacement Seismic Accelerometer, Strain gauge

Accelerometer, Piezoelectric Accelerometer, Potentiometric Accelerometer

Level measurement & Thickness Measurement: Electrical Methods (Resistive & Capacitive), Laser Level Sensor, Ultrasonic Liquid Level Detector. Thickness measurement using contact and non-contact type

devices.

Unit 6 Measurement of Surface finish, Screw Thread, Gear Metrology (08 Hrs.)

Surface Finish Measurement:
Surface texture, Meaning of RMS and CLA values, Tomlinson's Surface meter, Taylor-Hobson surface meter, grades of roughness, specifications

Screw Thread Metrology:
External screw threads terminologies, floating carriage instruments, pitch and flank measurement of external screw thread, application of Tool Makers Microscope, use of profile projector.

Gear Metrology:
Spur gear parameters, gear tooth thickness measurement, gear tooth Vernier caliper, constant chord method, span micrometer, base tangent comparator.

Interferometry:
Introduction, flatness testing by interferometry, NPL flatness interferometer. Study of measuring machines, recent trends in engineering metrology.

Term Work:

1. Study & Calibration of Thermocouples (J & K-Type)/RTD(PT-100)
2. Study & Calibration of Pressure Measurement, & Vacuum Measurement
3. Measurement of Load/Force using Load Cells
4. Displacement & Angle measurement using LVDT & Encoder Sensor
5. Study of Different Switches & Relays
6. Vibration Measurement using Accelerometer.
7. Level Measurement using Capacitive Transducer.
8. Study of Data Acquisition System and Interfacing of sensors with computer using DAQ Cards (NI DAQ Card)
9. Study of Linear and Non Linear Measuring Instruments.
   i) Measurement of the surface roughness.
   ii) Measurement of angle by sine bar/sine center.
   iii) Measurement of optical surface using Interferometer.
   iv) Measurements of screw tread parameters using Floating Carriage Micrometer.
   v) Measurement of gear tooth thickness using gear tooth vernier caliper and span micrometer
   vi) Study and experiment on profile projector/Tool makers microscope
   vii) Industrial visit to Automation Company and Inspection & Quality control division of any Industry with detail report.

Text Books

1. Ramchandran K. P., Vijyaraghavan G. K., Balasundaram M. S., "Mechatronics: Integrated Mechanical Electronic Systems", John Wiley & Sons, 2008.
2. Bolton W., "Mechatronics - A Multidisciplinary approach", 4th Edition, Prentice Hall, 2009.
3. Kumar D. S., "Mechanical Measurement & Control", Metropolitan Book Co. Pvt. Ltd. New Delhi, 2007
4. Singh M. D. and Joshi J. G., "Mechatronics", 3rd Edition, Prentice Hall, New Delhi, 2009.
5. Beckwith T. G., Marangoni R. D., Lienhard J. H., "Mechanical Engineering Measurements", Pearson Prentice Hall, 2007
6. Jain R. K., "Engineering Metrology", Khanna Publishers

7. Hume K. J., "Engineering Metrology", Macdonald, 1950
8. Sharp K. W. B., "Practical Engineering Metrology", Pitman Publication, 1970
9. Kuber S. S., "Metrology and Quality Control", Nirali Prakashan

Reference Books

1. Doebelin Ernesto, "Measurement Systems", McGraw Hill International Publication Co. New York, 4th Edition,1990.
2. Sawhney A. K. and Sawhney P., "Mechanical Measurement and Control", Dhanpat Rai and Company Pvt. Ltd., New Delhi, 12th Edition, 2010.
3. Figliola R. S., Beasley D. E., "Theory and design for mechanical measurements", Wiley India Edition.
4. Alciatore & Histand, "Introduction to Mechatronics and Measurement System", 4th Edition, Mc-Graw Hill publication, 2011.
5. Bishop (Editor), "Mechatronics – An Introduction", CRC Press, 2006.

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV,V and VI

MACHINE TOOL DESIGN

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 03 Hours / Week	End Semester Examination	60 Marks	03
	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Term Work / Oral	-- Marks	
	Total	100 Marks	03

Course Prerequisite:-

1. Basic knowledge of Mechanisms and Mechanical elements.
2. Well conversant with different types of Machine Tools.
3. Basic knowledge of Materials.

Course Objective:- To be able to design the various elements of machine tools.

Course Outcomes:-

1. Understand the fundamentals of machine tool design.
2. Select the type of gear box for applications in machine tool and design the sliding cluster gear box.
3. Understand the design considerations for machine tool structures
4. Select the guide ways and design the power screws.
5. Design the spindle, select the spindle bearings and use acceptance test.
6. Design of cams for single spindle automate and maintenance and repair of machine tool.

Unit 1 Introduction to Machine Tool Drives and Mechanisms (06 Hrs.)

General Principles of Machine Tool Design: Working and Auxiliary Motions in Machine Tools. Parameters Defining. Working Motions of a Machine Tool. Machine Tool Drives. Hydraulic Transmission and its Elements. Mechanical Transmission and its Elements. Techno-Economical Prerequisites for Undertaking the Design of New Machine Tool. General Requirements of Machine Tool Design. Engineering Design Process Applied to Machine Tools. Layout of Machine Tools, Modular Concept of Machine tool design.

Unit 2 Regulation of Speed and Feed Rates (06 Hrs.)

Aim of speed and feed rate regulation. Stepped regulation of Speed: Design of speed box – Design of Feed Box – Machine Tool Drives using Multiple

Speed Motions–Special Cases of Gear Box Design–General Recommendations for Developing the Gearing Diagram–Step less Regulation of Speed and Feed Rates, VFD and VVFD drives-Design Considerations. Motors: three phase induction motors-stepper motor, servo motor and universal motor.

Unit 3 Design of Machine Tool Structures (06 Hrs.)

Functions of Machine Tool Structures and their requirements – Design criteria for machine tool structures – Materials of machines Tools structures
– Static and Dynamic stiffness – Profiles of machine tool structures – Basic Design procedure of machine tool structures – Design of Beds – Design of Columns – Design of Housings – Design of Bases and Tables – Design of Cross Rails, Arms, Saddles and carriages – Design of Rams.

Unit 4 Design of Guide-ways and Power Screws (06 Hrs.)

Functions and types of Guide-ways – Design of Slide-ways – Design criteria and calculations for slide-ways – Guide-ways operative under liquid friction conditions. Design of Anti-Friction Guide-ways – Combination Guide ways –Protecting devices for slide-ways

Design of power screws (Sliding & Rolling friction), Preloading of power screws.
Design with reference to advanced machine tools.

Unit 5 Design of Spindles and Spindle Supports (06 Hrs.)

Functions of Spindle Unit and requirements – Materials of Spindles – Effect of machine tool compliance on machining accuracy- Design calculations of spindles
Anti- friction bearing – Sliding bearings. Preloading of bearings. Bearings selection for machine tools.

Acceptance tests for Machine Tools:
Acceptance tests: Object and Procedure for acceptance test, Instruments required, sequence of acceptance test, standard acceptance test chart.ISO 230-1: 1996, ISO-2:2014.

Unit 6 Automatic Drives for Machine Tools (06 Hrs.)

Principles of automation. Automatic lathes with mechanical control. Design of cams for automatic screw cutting machines. Automatic loading and feeding of work pieces. Transfer devices in automatic machine tool systems. Modular design and unit heads for machine tools. Automatic in- process gauging.

Maintenance and repair of Machine Tools:
Types of Maintenance, Break down and preventive Maintenance, Organization of Maintenance department, Economic aspects of Preventive Maintenance, Restoration techniques.

Text Books / Reference Books

1. Basu S. K., "Design of Machine Tools", Allied Publisher, 1989.
2. Sen G. S. & Bhattacharya, "Principles of Machine Tools", New Central Book Agency, Calcutta – 1986.
3. Acherkan N., "Machine Tool Design", Vol. 2 & 3 Mir publishers, Moscow, 1968.
4. Mehta N. K., "Machine Tool Design", TMII.
5. Russe W. Henke, "Introduction to Fluid Power Circuits and Systems", Addison Wesley, 1970
6. Koenigs Berger & Tlusty, "Design of Machine Tools", Pergaman Press 1970.

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV, V and VI

ENERGY AUDIT AND MANAGEMENT

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 03 Hours / Week	End Semester Examination	60 Marks	03
	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Total	150 Marks	03

Course Prerequisite:- Student should have knowledge of

1. Basic Physics
2. Basic Electrical Engineering
3. Basic Thermal Engineering
4. Mathematics

Course Objective:-

1. Understand basic energy conversion, conservation and management principles
2. Identify sources of energy loss and target savings
3. Understand design of waste heat recovery systems, efficient power cycles and power generation systems
4. To enable students in carrying out life cycle cost analysis and budgeting

Course Outcomes:-

1. To understand the need for energy conservation and its management
2. To know procedure for balance of energy and material in different processes
3. To conduct economic analysis of energy conservation measures
4. To understand a system of electrical energy management
5. To understand a system of thermal energy management
6. Conduct energy audits and formulate & implement energy conservation strategies

Unit 1 Energy Conservation: (06 Hrs.)

Energy Conservation and its Importance; Energy Strategy for the Future; The Energy Conservation Act, 2001 and its Features

Energy Management:

Definition & Objectives of Energy Management; Importance; Indian need of Energy Management; Duties and responsibilities of energy managers.

Unit 2 Material and Energy Balance (06 Hrs.)

Basic Principles, Sankey diagrams, Material balances for different processes, Energy balances, heat balances, Methods for preparing process flow chart, Procedure to carry out the material and energy balance in different processes.

Unit 3 Economic Analysis of Energy Conservation Measures (06 Hrs.)

Retrofit: Power plant retrofit, Home energy retrofit.
Economics: Fundamentals: Cash flows, Inflation Rates, Time Points and Periods, Discount Rates, Cost of Capital, Present value, Taxes, Uncertainty and Risk Economic Measures: Net Present Value, Total Life-Cycle Cost, Revenue Requirements, Internal Rate of Return, Modified Internal Rate of Return, Simple Payback Period, Discounted Payback Period, Benefit-to-Cost Ratios, Savings-to-Investment Ratios, Profitability index estimation

Unit 4 Electrical Energy Management (06 Hrs.)

Supply side: Methods to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, HVDC, and FACTS. Demand side: conservation in motors, pumps and fan systems; energy efficient motors.
Case Studies on Electrical Energy Management

Unit 5 Thermal energy Management (06 Hrs.)

Energy conservation in boilers, steam turbines and industrial heating systems; Application of FBC; Cogeneration and waste heat recovery; Thermal insulation; Heat exchangers and heat pumps; Building Energy Management. Case Studies on Thermal Energy Management

Unit 6 Energy Audit (06 Hrs.)

Energy Audit: Types and Methodology; Scope of Energy Audit , Energy Audit Reporting Format; Understanding Energy Costs; Benchmarking and Energy Performance; Matching Energy Usage to Requirement; Maximizing SystemEfficiency;FuelandEnergySubstitution; EnergyAudit Instruments; Duties and responsibilities of energy auditors. Energy Management of Buildings and Energy Audit of Buildings. - Energy management matrix monitoring and targeting Case Studies

Reference Books

1. Amlan Chakrabarti, "Energy Engineering and Management", PHI Learning, New Delhi 2012
2. Mirjana Golusin, Sinisa Dodic, Stevan Popov, "Sustainable Energy Management", Academic Press
3. Shaligram Pokharel, "Energy Analysis for Planning and Policy", CRC Press, 2014
4. Trivedi P R, Jolka K R, "Energy Management", Commonwelth Publications, New Delhi
5. Y P Abbi, Shashank Jain, "Handbook on Energy Audit and Environment Management", TERI
6. General Aspects of Energy Management and Energy Audit, Buro of Energy Efficiency
7. Frank Krieth, D Yogi Goswami, "Energy Management and Conservation Handbook", CRC Press
8. Alburt Thumann, William J Younger, Terry Niehus, "Handbook of Energy Audits", 9th Ed, Better World Books

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV, V and VI

RELIABILITY ENGINEERING

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 03 Hours / Week	End Semester Examination	60 Marks	03
	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Term Work / Oral	-- Marks	
	Total	100 Marks	03

Course Prerequisite:- Student should have knowledge of-
Engineering Mathematics, Probability, Statistics

Course Objective:-

1. Understanding of basic principles of Reliability for ensuring sustainable product design.
2. Application to system requirements, design, manufacturing and testing, with real world examples
3. Understand in detail Asset Management, Maintenance, Quality and Productiveness,

Course Outcomes:- Student should be able to

1. Understand different measures of reliability
2. Know different probability methods used in reliability engineering
3. Calculate MTTF, MTBF, failure rate and hazard rate.
4. To acquire knowledge of methods for evaluation of reliability of different systems.
5. Understand the concepts of maintainability and availability in reliability engineering
6. Understand the reliability design procedure
7. Know different methods to test reliability of the system.

Unit 1 Fundamental Concepts of Reliability and Reliability Measures (06 Hrs.)

Brief history, concepts, terms and definitions, applications, the life cycle of a system, concept of failure, typical engineering failures and their causes

Reliability Measures: Reliability function–R(t), cumulative distribution function (CDF)–F(t), probability density function (PDF) – f(t), hazard rate function-λ(t), Mean time to failure (MTTF) and Mean time between failures (MTBF), typical forms of hazard rate function, bathtub curve

Unit 2 Probability Concepts and Failure Data Analysis (06 Hrs.)

Theory of probability, rules of probability, Introduction to independence, mutually exclusive, conditional probability random variables, discrete and continuous probability distributions. Binomial, normal Comparison of probability distributions - , lognormal, Weibull, exponential, Standard deviation, variance, mean, mode and Central Limit Theorem.

Failure Data Analysis: Data collection and empirical methods, estimation of performance measures for ungrouped complete data, grouped complete data, analysis of censored data, fitting probability distributions graphically (Exponential and Weibull) and estimation of distribution parameters.

Unit 3 Reliability Evaluation of Systems (06 Hrs.)

Reliability Improvement Redundancy, element redundancy, unit redundancy, standby redundancy -types of stand by redundancy, parallel components single redundancy, multiple redundancies, cut and tie set approach for reliability evaluation. Star and delta method, matrix method (Numerical).

Unit 4 Maintainability and Availability (06 Hrs.)

Concept of maintainability, measures of maintainability, mean time to repair (MTTR), analysis of downtime, repair time distributions, stochastic point processes, maintenance concept and procedures, availability concepts and definitions, important availability measures.

Introduction to Reliability allocation or apportionment, reliability apportionment techniques- equal apportionment, AGREE, ARINC, Minimum effort method (Numerical)

Unit 5 Design for Reliability and Maintainability (06 Hrs.)

Reliability design process and design methods, reliability allocation, failure modes, effects and criticality analysis (FMECA), fault tree and success tree methods, symbols used, maintainability design process, quantifiable measures of maintainability, repair versus replacement.

Unit 6 Reliability Testing (06 Hrs.)

Introduction to reliability testing, Stress strength interaction, Introduction to Markov model, Testing for Reliability and Durability - Accelerated Life Testing and Highly Accelerated Life Testing (HALT), highly accelerated stress Screening (HASS)

Reference Books

1. Ebling C. E., 2004, "An Introduction to Reliability and Maintainability Engineering", Tata McGraw Hill Education Private Limited, New Delhi.
2. Srinath L. S., 1991, "Reliability Engineering", East West Press, New Delhi.
3. Birolini A., 2010, "Reliability Engineering: Theory and Practice", Springer.
4. Parkhi R. M., "Market Leadership by Quality and Reliability", Vidyanand Publications 2012.
5. Roy B. and Allan R. N., 1992, "Reliability evaluation of engineering systems: concepts and techniques", Springer.
6. Patrick D. T. Newton O'Conner, D., Bromley R., 2002, "Practical Reliability Engineering", John Wiley and Sons.
7. Rao S. S., 1992, "Reliability Based Design. McGraw-Hill
8. Andrew Kennedy, Skilling Jardine, Albert H. C. Tsang, 2006, "Maintenance, Replacement and Reliability: Theory and Applications", CRC/Taylor and Francis.
9. Nachlas Joel A., 2005, "Reliability Engineering: Probabilistic Models and Maintenance Methods" Taylor and Francis.
10. Dhillon B. S., Singh C., 1981, "Engineering Reliability – New Techniques and Applications", John Wiley and Sons.
11. Dhillon B. S., 1999, "Engineering Maintainability", Prentice Hall of India.

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV, V and VI

DESIGN OF PUMPS, BLOWERS AND COMPRESSORS

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 03 Hours / Week	End Semester Examination	60 Marks	03
	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Term Work / Oral	-- Marks	
	Total	100 Marks	03

Course Prerequisite:-	Student should have knowledge of 1. Fundamentals of fluid mechanics 2. Fundamentals of turbo machinery 3. Fundamentals of thermodynamics
Course Objective:-	To provide basic concept of design of rotary machines *viz.* pumps, lowers and compressors.
Course Outcomes:-	Student must be able to understand- 1. Efficiency, losses, power requirement and operating characteristics of pumps 2. Theoretical concepts related to pumps 3. Thermal and hydraulic design of pumps 4. Theoretical concepts related to fans and blowers 5. Design principles of fans and blowers 6. Design principles of centrifugal and axial compressors

Unit 1	**Review of Principles of Fluid Machinery**	**(06 Hrs.)**

- Basic equations of energy transfer between fluid and rotor.
- Performance characteristics.
- Dimensionless parameters, specific speed, stage velocity triangles, work and efficiency.

Unit 2	**Theory of Centrifugal Pumps**	**(06 Hrs.)**

- **C**alculation of tangential and axial thrust methods to minimize axial thrust. Impellers, casings, volutes, vane velocity vector diagrams, work done and head developed by pumps.
- Efficiency and losses in pumps (mechanical, hydraulic etc.), specific speed.
- Calculation of power requirement, NPSH for pump selection, effects of cavitation on pump performance, operating characteristics.

Unit 3	**Design of Pumps**	**(06 Hrs.)**

- Introduction to design procedure of pumps.
- Thermal design-selection of materials for high temperature and corrosive fluids.
- Hydraulic design- selection of impeller and casing dimension using industrial manuals.

Unit 4	**Theory of Fans and Blowers**	**(06 Hrs.)**

	• Classification of blowers, basics of stationary and moving air, Euler's characteristics, velocity triangles and operating pressure conditions. • Equations for blowers, losses and hydraulic efficiency, flow through impeller casing inlet nozzle, volute, diffusers, and mechanical losses. • Rotor design, airfoil theory, vortex theory, cascade effects, degree of reaction. • Blade twist stage design, surge and stall, stator and casing, mixed flow impellers, applications of blowers and fans.	
Unit 5	**Design of Fans and Blowers**	**(06 Hrs.)**
	• Design procedure for selection of blowers, stage pressure rise, stage parameters and design parameters. • Design of impeller and casing dimension in aerodynamic design.	
Unit 6	**Theory and Design of Compressors**	**(06 Hrs.)**
	• Basic theory, classification and application, working with enthalpy- entropy diagram, construction and approximate calculation of centrifugal compressors. • Impeller flow losses, slip factor, diffuser analysis, performance curves of centrifugal compressors. • Basic design features of axial flow compressors; velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple stage of axial flow compressors, applications of compressors.	

Reference Books

1. Shepherd, D. G., "Principles of Turbomachinery", Macmillan, 1969.
2. Chruch A. H., "Centrifugal pumps and blowers", John Wiley and Sons, 1980.
3. Yahya S. M., "Turbine, Compressors and Fans", Tata Mc-Graw Hill Publishing Company, 1996
4. Labanoff V. S. and Ross R., "Centrifugal Pumps Design and Applications", Jaico P House.
5. Karassik I., "Pump Hand Book", McGraw-Hill International Edition.
6. Sahu G. K. "Pump" New age international publishers.
7. Tuzson J., "Centrifugal Pump Design", Wiley Publication.
8. Stepanff, A. J., "Blowers and Pumps", John Wiley and Sons Inc., 1965.

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV,V and VI

MANAGEMENT INFORMATION SYSTEM

Teaching Scheme:	Examination Scheme:		Credits Allotted
Theory:- 03 Hours / Week	End Semester Examination	60 Marks	03
	Unit Test Assignments Internal Evaluation	20 Marks 10 Marks 10 Marks	
	Term Work / Oral	-- Marks	
	Total	100 Marks	03

Course Prerequisite:-	1. A student should be familiar in computer programming. 2. A student should be familiar with concept of database. 3. A student should be familiar with manufacturing sectors- personnel management, financial management, production management, material management, marketing management.
Course Objective:-	Student is able to understand 1. Operations management. 2. Role of computers in information systems. Management Information System (MIS) 3. Data management-concept and its need. 4. Application in Manufacturing sectors
Course Outcomes:-	The theory should be taught in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes. 1. To understand various basic concepts related to operations management and information system 2. To understand computer aided information system and the concept of information communication 3. To know the role of decision making in MIS. 4. To acquire knowledge of data base management system 5. To know the applications of MIS in different departments of an industry 6. To use different software for implementation of MIS in industries

Unit 1 Introduction (06 Hrs.)

Operations management: concept, meaning, definition, scope and functions. Optimization: concept, meaning, definition, need and scope. Types of production, their merits and demerits. Types of operations layouts: features, applications. Types of resources (7M). Data-meaning and types. Information-meaning and types.

Information system: need, concept, definition, features, objectives and examples. Need to integrate information systems and optimum utilization of 7M resources.

Unit 2 Information Systems (06 Hrs.)

Role of computers in information systems. Management Information System (MIS); concept, definition, need & applications.

Computer aided information systems: (such as inventory records, operation schedule, consumables issues, tools issues, inspection and quality control reports, failure frequencies with reasons, efficiency and utility reports, maintenance records, produced power units per day, temperature at certain interval, etc.) need, importance, design considerations, software selection criteria, examples.

Information communication: Communication process; computer networks and its types, structures, need and applications, protocols - types, features, applications.

Unit 3 **Decision Making** **(06 Hrs.)**

Concept, process behavioral decision making, organizational decision making, MIS and decision making. Building blocks of information system-Input, output, models, technology, database and control blocks. System development life cycle (SDLC) and its approach.

Unit 4 **Data Base Management System** **(06 Hrs.)**

Data management-concept, need, basic terminology used.

Data base: definition, meaning, importance, approach and architecture. Objectives of database organizations.

Data models: meaning, relationship and association, drawing schema, bubble chart &tree structure for suitable mechanical engineering application. Data Base Management System (DBMS) - definition, scope, importance, awareness about current software packages & their features, Relational Data Base Management System. (RDBMS) - concept, definition, features and applications. Preparation steps/ procedure for creating, storing, editing & retrieval of database on latest available database management software package.

Unit 5 **Applications in Manufacturing Sectors** **(06 Hrs.)**

Application in Manufacturing sectors- Personnel management, financial management, production management, material management, marketing management, supply chain management.

Unit 6 **System implementation** **(06 Hrs.)**

Modern software design techniques, verification and validation, methods, performance of software systems, software matrix and models, software standards, introduction to Capability maturity model (CMM), and quality management in software organization.

Text Books/ Reference Books

1. Jawadekar W. S., "Management Information System 4/e".
2. O Brien J. A., "Management Information System 4/e"
3. Burch and Gruditski, "Information system-Theory and practice 5/e".
4. Ian Sommerville, "Software Engineering 6/e".
5. Turban E., Leidner P., et. al., "Information Technology for Management 6/e".
6. Laudon and Laudon, "Management Information System11/e"
7. Sadagopan S., "Management information system", PHI publication
8. Charry S. N., "Production and operations management". TMGH publication.
9. Buffa E. S. and Sarin R. K., "Modern production & operations management", John willy & sons publication

Unit Tests-

Unit Test-I	Unit-I, II and III
Unit Test-II	Unit-IV, V and VI

PROFESSIONAL SKILLS DEVELOPMENT-VI

Designation of Course	**Workshop Technology**		
Teaching Scheme:	**Examination Scheme:**		**Credits Allotted**
Theory:- 4 Hours/ Week	End Semester Examination	100 Marks	Theory: 04 Practical: 00
Practical:- -- Hours/ Week	Unit Test Assignments Internal Evaluation	-- Marks -- Marks -- Marks	
	Term Work	-- Marks	
	Total	100 Marks	04

Course Pre-requisites	
The Students should have knowledge of	
1.	Concepts of Maths, Logical reasoning and English Grammar taught in the last semester.
2.	A basic knowledge of Group Discussion, DO's and Don'ts done in the previous sem.
3.	Basic knowledge of writing skills, importance of professionalism in emails and letters.
4.	Knowledge on the concepts of criticism, feedback and conflicts.
5.	Awareness of the interpersonal skills like team work and introduction to Leadership taught during the last semester.
6.	Brief idea about professional and business meeting etiquettes.
Course Objectives	
	The Professional Skills Development 6 is an extension of PSD- 5 with focus on the remaining topics of Aptitude and Grammar. The further complex concepts of Permutation and Combination, Probability and grammatical topics such as prepositions etc. would be dealt with. The objective here is to acquaint them with the level of complexity presented in recruitment tests and also provide them techniques to solve such question with tricks/methods in a very short period. The English communication and soft skills section of PSD-6 focuses on the other important aspects of soft skills training students such as techniques of effectively handling Personal Interviews during placement process and understand the dynamics of structured Resume and PIs.
Course Outcomes	
The student should be able to	
1.	Learn further concepts of Maths, Logical reasoning and English grammar and apply short cuts/ tricks to solve questions in less time. Learn remaining 25-30 rules of grammar topics such as prepositions, conjunctions etc relevant from the recruitment point of view.
2.	Learn to handle vocabulary questions such as synonyms and analogies in recruitment test and other competitive exams
3.	Understand and Learn techniques/Strategies of how to handle Personal interviews during recruitment process. Through Mock PIs students would be taught the appropriate ways of answering tricky questions in Interview and would learn the correct body language etc. to be demonstrated in an interview process.
4.	They would be acquainted with the differences between CV, Bio- Data and Resume and they would learn the correct format of a Résumé along with methods and styles to make their Resumes interesting.
5.	Students would learn to incorporate various rules of written communication in business writing scenario with the appropriate tone and words.
6.	Understand the importance of grooming, body language and etiquettes in the corporate sector. They would be able to conduct themselves in a professional and impressive way by conducting themselves according to situations in the professional sector.

Course Contents

Unit I	**Aptitude (Maths, Logical Reasoning, English)**	**(24 Hrs.)**

	• Maths
	  ▪ Permutation & Combination
	  ▪ Probability
	  ▪ Maths Revision -1
	  ▪ Maths Revision - 2
	• Logical Reasoning
	  ▪ Matching, Selection & Arrangement
	  ▪ Clocks & Calendars, Visual Reasoning	

	▪ Input, Output & Flow Chart. ▪ Reasoning Revision- 1 ▪ Reasoning Revision-2 • English ▪ Grammar – III– (Prepositions& Conjunctions) ▪ Grammar- (Articles & Parallelism) ▪ Verbal Ability Revision- I	
Unit II	**Soft Skills & English Communication**	**(24 Hrs.)**
	• Resume-I • Resume- II • Mock GD • Mock GD • Personal Interviews-I • Personal Interviews-II • Mock PI • Mock PI • Extempore Speeches, Group Interviews • Written Skills- Revision • Stress Management • Business Writing Tones.	
Text Books		
1. APAART: Verbal Ability		
2. APAART: Logical Reasoning		
3. APAART: Quantitative Aptitude		
4. APAART: Speak Well 1 (English Language and Communication)		
5. APAART: Speak Well 2 (Soft Skills)		

Rules regarding ATKT, Continuous Assessment and award of Class

Standards for Passing

- For all courses, both in UE (University Evaluation) and IA (Internal Assessment) there are constitute separate heads-of-passing (HoP).
  - The student must obtain a minimum grade point of 5.0 (40% marks) at UE as well as at IA.

  OR
  - The student failed in IA can also pass in the course provided he/ she obtains minimum of 25% marks in IA, and GPA (Grade Point Average) for the course is at least 6.0 (50% aggregate). The GPA for the course will be calculated only if the student passes in UE.
- The student who fails at UE in a course has to reapply only at UE as a backlog candidate and clear the HoP. Similarly, a student who fails in a course at IA has to reappear only at IA as backlog candidate and clear the HoP.

Rules of ATKT

- A student is allowed to carry backlog of courses prescribed for B. Tech. Sem. I, III, V, VII to B. Tech. Sem. II, IV, VI, VIII respectively.
- A student is allowed to keep term of Sem. III, if he/ she has failed in any number of courses in B. Tech. Sem. I and II.
- A student is allowed to keep term of Sem. V, if he/ she has failed in any number of courses in B. Tech. Sem. III and IV but passed in all courses in Sem. I and II.
- A student is allowed to keep term of Sem. VII, if he/ she has failed in any number of courses in B. Tech. Sem. V and VI but passed in all courses in Sem. III and IV.

Award of Class for the Degree Considering CGPA

A student who has completed the minimum credits specified for the program shall be declared to have passed in the program. The final result will be in terms of letter grade only and is based on the CGPA of all courses studied and passed. The criteria for the award of the honors at the end of the program are as given below:

Range of the CGPA	Final Grade	Performance Descriptor	Equivalent range of marks (%)
$9.50 \leq 10.00$	O	Outstanding	$80 \leq 100$
$9.00 \leq 9.49$	A^+	Excellent	$70 \leq 79$
$8.00 \leq 8.99$	A	Very Good	$60 \leq 69$
$7.00 \leq 7.99$	B^+	Good	$55 \leq 59$
$6.00 \leq 6.99$	B	Average	$50 \leq 54$
$5.00 \leq 5.99$	C	Satisfactory	$40 \leq 49$
Below 5.00	F	Fail	Below 40