Syllabus

SavitribaiPhule Pune University

Faculty of Engineering

Second Year Production (Sandwich)

Engineering

(Course 2015)

(with effect from June 2016)

SavitribaiPhule Pune University, Pune
Second Year Production (sandwich) Engineering (2015 Course)
(With effect from Academic Year 2016-17)

Semester I

Subject Code	Subject	Teaching Scheme (Hrs/week)			Examination Scheme						Credits	
		Theory	Practical	Tutorial	Paper		TW	OR	PR	Total	TH/TW/TUT	PR/OR
					In-Sem	End-Sem						
207002	Engineering Mathematics III	4		1	50	50	25			125	5	
211101	Heat and Fluid Engineering	4			50	50				100	4	
211102	Mechanics of Materials	4			50	50				100	4	
211121	Manufacturing Processes	4			50	50				100	4	
211104	Material Science	3			50	50				100	3	
211105	Heat and Fluid Engineering Lab		2				25			25		1
211122	Manufacturing Processes Lab		2					50		50		1
211107	Material Science Lab		2					50		50		1
211108	Machine Drawing & Computer Graphics Lab		4					50	50	100		2
											20	5
211109	Audit Course 1										**Grade:**	
	Total	**19**	**10**	**1**	**250**	**250**	**100**	**150**		**750**	**25**	

Abbreviations:

TW: Term Work
TH: Theory
OR: Oral
TUT: Tutorial
PR: Practical
AP: Audit Course Pass

Semester II

Subject Code	Subject	Teaching Scheme			Examination Scheme							Credits	
		Theory	Practical	Tutorial	Paper		TW	OR	PR	Total		TH/TW/TUT	PR/OR
					In-Sem	End-Sem							
203050	Electrical Technology	4			50	50				100		4	
211110	Theory of Machines	4			50	50				100		4	
211123	Manufacturing Engineering & Metrology Practices	4			50	50				100		4	
211112	Design of Machine Elements	4			50	50				100		4	
211124	Production & Industrial Management I	4			50	50				100		4	
203051	Electrical Technology Lab		2				50			50			1
211114	Theory of Machines Lab		2				25	50		75			1
211125	Manufacturing Engineering & Metrology Practices Lab		2					50		50			1
211126	Computer Graphics Lab II		2					50		50			1
211117	Soft skills		2				25			25			1
												20	5
211118	Audit Course 2											Grade:	
	Total	20	10		250	250	100	150	-	750		25	

Abbreviations:

TW: Term Work
TH: Theory
OR: Oral
TUT: Tutorial
PR: Practical
AP: Audit Course Pass

207002: Engineering Mathematics III (Mechanical + SW / Production + SW / Industrial /Automobile Engineering)

Teaching Scheme	**Credit Scheme**	**Examination Scheme**
Lectures: 4 hours / week	Theory: 04	In-Sem: 50 Marks
Tutorials: 1 Hr/week	Tutorial: 01	End-Sem : 50 Marks
		Term work: 25 Marks

Prerequisites: Differential and Integral Calculus, Taylor series and Infinite series, Differential equations of first order and first degree, Fourier series, Measures of central tendency and dispersion, Vector algebra

Course Objectives:

- After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

- Ordinary and partial differential equations applied to Mechanical engineering problems such as mechanical vibrations and heat transfer.

- Integral Transform techniques such as Laplace transform, Fourier transform and applications to ordinary and partial differential equations in Vibration theory, Fluid dynamics, Heat transfer and Thermodynamics.

- Statistical methods such as correlation, regression analysis and probability theory in analyzing and interpreting experimental data applicable to Reliability engineering

- Vector differentiation and integration applied to problems in Fluid Mechanics.

Course Outcomes:

At the end of this course, students will be able to:

1) Solve higher order linear differential equations and apply to modeling and analyzing mass spring systems.

2) Apply Laplace transform and Fourier transform techniques to solve differential equations involved in Vibration theory, Heat transfer and related engineering applications.

3) Apply statistical methods like correlation, regression analysis in analyzing, interpreting experimental data and probability theory in testing and quality control.

4) Perform vector differentiation and integration, analyze the vector fields and apply to fluid flow problems.

Solve various partial differential equations such as wave equation, one and two dimensional heat flow equations.

Unit I
Linear Differential Equations (LDE) and Applications   (9)

LDE of nth order with constant coefficients, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous & Symmetric simultaneous DE. Modeling of mass-spring systems, free and forced damped and undamped systems.

Unit II   (9)
Transforms
Laplace Transform (LT): LT of standard functions, properties and theorems, Inverse LT, Application of LT to solve LDE.

Fourier Transform (FT): Fourier integral theorem, Fourier transform, Fourier Sine & Cosine transform, Inverse Fourier Transforms.

Unit III   (9)
Statistics and Probability

Measure of central tendency, Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Probability, Probability distributions: Binomial, Poisson and Normal distributions, Population and sample, Sampling distributions, t-distribution, Chi-square distribution.

Unit IV
Vector Differential Calculus

Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit V   (9)
Vector Integral Calculus and Applications

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Fluid Mechanics, Continuity equations, Streamlines, Equations of motion, Bernoulli's equation.

Unit VI
Applications of Partial Differential Equations (PDE)   (9)

Basic concepts, modeling of Vibrating String, Wave equation, one and two dimensional Heat flow equations, method of separation of variables, use of Fourier series. Solution of Heat equation by Fourier Transforms, Two-dimensional wave equation.

Text Books:

1. Advanced Engineering Mathematics, 9e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).

Reference Books:

1. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
2. Advanced Engineering Mathematics, Wylie C.R. & Barrett L.C. (McGraw-Hill, Inc.)
3. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

4. Applied Mathematics (Volumes I and II) by P. N. Wartikar& J. N. Wartikar (Pune VidyarthiGrihaPrakashan, Pune).
5. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
6. Advanced Engineering Mathematics with MATLAB, 2e, by Thomas L. Harman, James Dabney and Norman Richert (Brooks/Cole, Thomson Learning).

Guidelines for Tutorial and Term Work:

i)   Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
ii) Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

Heat and Fluid Engineering

211101

Teaching Scheme

Lectures: 4 hours / week

Examination Scheme

In-Sem(Online):50 Marks
End-Sem(paper):50 Marks
Credits: 4

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Prerequisites: Basic Mechanical Engineering, Physics

Courseobjectives:

- Understand the concept of fluid along with its different properties and pressure measurement
- Development of ability in students to identify types of flow, various losses during flow of fluid
- Acquiring knowledge of different types of fuels and their analysis, steam and its properties, refrigeration system and properties of air
- Understanding the basics of compressors, engines, turbines, pumps, compressors, boiler, and refrigerators.

CourseOutcomes:

On successful completion of the course students should be able to:

- Understand the basic principles and laws of fluid mechanics to recognize and analyze the type of fluid and fluid flow along with its application.
- Develop the understanding of basic pressure measurement and its application in throughout fluid mechanics.
- Analyze boiler and energy balance concept. Also understand the properties and behavior of steam and different types of fuels.
- Understand basic working principle and application of Vapour compression cycle, turbines and compressor and analyze its performance characteristics.
- Perform individually or in a group to formulate and solve the engineering problem and to conclude the result of the outcome.

Unit I

Introduction & Fluid properties **(8)**

Definition of fluid, Newton's law of Viscosity, classification of fluid: Newtonian & Non - Newtonian fluids, Ideal & Real fluids, Fluid properties: viscosity, compressibility, cohesion, adhesion, surface tension, capillarity, vapour pressure, cavitations. (Numerical)

Static's of Fluid, Pascal's law, Pressure on plane/curved surface, pressure measurements, Manometers, centre of pressure, metacentric height.

Unit II

Fluid Flow **(8)**

Types of flow, examples, forces acting on fluid flow, Stream lines, Path lines, Streak lines. Velocity potential, Euler's equation of motion along a stream line, Bernoulli's equation, applications of Bernoulli's equation, orifice meter, venturimeter, Pitot tube (Numerical)

Unit III

Losses through pipes **(8)**

Flow through pipes ,Laminar and turbulent flow through circular pipes, major loss-Darcy-Weisbach equation, minor losses, , water hammer, Buckingham's pie theorem, dimensionless

numbers Fluid Machinery, Construction, working and applications of hydraulic turbines, centrifugal pumps and reciprocating pumps.

Unit IV
Fuels and lubricants   **(8)**
Mass function, combustion equation, proximate and ultimate analysis of fuel, stoichiometric analysis of combustion products, volumetric and gravimetric analysis, types & properties of lubricants, flash point, fire point, viscosity, Vapour pressure

Steam generators: Steam generation, steam properties, Babcock and Wilcox boiler, Cochranboilers(construction and working),boiler accessories, boiler performance, boiler efficiency, equivalent of evaporation and energy balance.(Numerical)

Unit V   **(8)**
Refrigeration
Air refrigeration, vapour compression refrigeration system, various refrigerants used in refrigeration systems, their effect on environment
Air conditioning
Psychometry, properties of air, types of air conditioning, central, unit and industrial air conditioning, introduction to HVSC.
Heat transfer- Applications of conduction, convection and radiation in manufacturing.

Unit VI
Reciprocating compressor   **(8)**
FAD, work done, efficiency-volumetric (with clearance volume), isothermal, multistage compression (Numerical)
IC engines, Cycle diagram, diesel and otto cycle (no numerical) IC engine systems --starting, ignition, cooling and lubrication systems, testing and performance of IC engine (Numerical)

Text Books
1. Bansal R.K., "Fluid Mechanics and Hydraulic Machines", 9th Edition, Laxmi Publication, 1990, ISBN 81-7008-311-7.
2. Jain A.K., "Fluid Mechanics including Hydraulic Machines", Khanna Publishers, 1990, ISBN 81-7409-194-7.
3. Munson, Young, Okiishi and Huebsch, "Fundamentals of Fluid Mechanics, Sixth Edition, Wiley – India Edition, 2010.
4. Kumar A., "Thermal Engineering", Narosa Publishing House, ISBN 97-88-1731-95281

Reference Books
1. Kothanaraman C. P., Khajuria   P. P., Arora S. and Domkundawar S, "A course inThermodynamics and heat engines Thermal engineering with solar energy", 3ed.,Dhanpat rai & sons, 1989.
2. Modi P. N. and Seth S. M, "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 1987.
3. Deshpande V. M., "Hydraulics Machinery Textbook of Fluid Machinery", Everest Publication, 1998.
4. Khurmi R. S. and Gupta J. K., "Textbook of Refrigeration and Air Conditioning", S. Chand and Co.

Mechanics of Materials
211102

Teaching Scheme

Lectures: 4 hours / week

Examination Scheme

In-Sem(Online) :50 Marks
End-Sem(paper):50 Marks
Credits: 4

Prerequisites: Engineering Mechanics, Physics

Course objectives:

- To provide basic knowledge in mechanics of materials so that the students can solve real engineering problems and design engineering systems.
- To establish an understanding of the fundamental concepts of mechanics of deformable solids; including static equilibrium, geometry of deformation, and material constitutive behavior.
- To discuss the basic mechanical principles underlying modern approaches for design of various types of structural members subjected to axial load, torsion, bending, transverse shear, and combined loading.
- To build the necessary theoretical background for further structural analysis and design courses.

Course Outcomes:

On successful completion of the course students should be able to-
- Understand the concepts of stress and strain at a point as well as the stress-strain relationship for homogeneous, isotropic materials.
- Understand the analysis and design the members subjected to tension, compression, torsion, bending and combined stresses using fundamental concepts of stress, strain and elastic behavior of materials.
- Understand the procedure of determining the stresses and strains in members subjected to combined loading and apply the theories of failure for static loading.
- Understand analysis of slender, long columns and determine and illustrate principal stresses, maximum shearing stress and stresses acting on a structural member.

Unit I (8)
Simple stresses and strains
BasicConcept of stress and strain (linear, lateral. shear and volumetric), Hooke's law, Poisson's ratio, modulus of elasticity, modulus of rigidity, stress strain diagrams for ductile and brittle materials, factor; of safety, working stress, generalized Hooke's law, concept of 3-D stress state, bulk modulus, interrelation between elastic constants**.**

Unit II (8)
Axially Loaded Components
Axial force diagram, stresses, strains, strains & deformations in determinate and indeterminate, homogenous and composite bars under concentrated loads, self-weight and temperature changes.

Transversely Loaded Components

Shear Force and Bending Moment in Determinate Beams due to Concentrated Loads, Uniformly Distributed Loads. Relation between SF and BM Diagrams for Cantilevers, Simple and Compound Beams, Bends Defining Critical and Maximum Values and Positions of Points of Contra Flexure- Construction of Loading Diagram and BMD from SFD and Construction of Loading Diagram and SFD from BMD.

Unit III   **(8)**

Bending stresses

Theory of simple bending, assumptions, derivation of flexure formula, second moment of area of common cross sections with respect to centroidal and parallel axes. bending stress

Shear stresses:

Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common symmetrical sections, maximum and average shear stress, shear connection between flange and web.

Unit IV   **(8)**

Transformation of Stresses and Strains

Normal and shear stresses on any oblique plane. Concept of principal planes. Derivation of expressions for principal stresses and maximum shear stress, position of principal planes and planes of maximum shear, graphical solution using Mohr's circle of stresses.

Strain energy and impact

Concept of strain energy, derivation and use of expressions for deformations of axially loaded members under gradual impact loads. Strain energy due to self-weight.

Unit V   **(8)**

Torsion of circular shafts

Stresses, strains and deformations in determinate and indeterminate shafts of solid and hollow homogeneous and composite circular cross section subjected to twisting moment. Derivation of torsion equation. Stresses due to combined torsion, bending and axial force on shafts.

Cylinders and spherical shells

Thin and thick cylinders, thin spheres, volumetric strains, pre-stress in cylinders, cylinders under combined loading, compound cylinders analysis, spherical shells analysis.

Unit VI   **(8)**

Slope and deflection of Beams:

Relation between BM and slope, slope and deflection of determinate beams, Double Integration Method (Macaulay's Method).Derivation of Formulae for Slope and Deflection for Standard Cases.

Buckling

Concept of buckling of columns. Derivation of Euler's formula for buckling load for column with hinged ends. Concept of equivalent length for various end conditions. Limitations of Euler's formula. Rankin's formula. Johnson's formula, safe load on columns.

Reference Books

1. Ramamrutham S. and Narayanan R., "Strength of Materials", Dhanapat Rai and sons,1992, ISBN: 818743354X

2. Rao Prakash "Strength Of Materials- A Practical Approach", Vol I, Universities Press India Limited, ISBN: 8173711259

3. Rattan S. S., "Strength of Materials", Tata McGraw-Hill Education,2011, ISBN: 007107256X

4. Junnarkar and Shah H J., "Mechanics of Structures", Charotar Press, 2002, ISBN: 81-85594-06-6.

5. Rajput R. K., "Strength of Materials", S. Chand Publication. ISBN-10 : 8188458104

6. Khurmi R. S., "Strength of Materials", S. Chand Publication., ISBN:8121928222

7. Beer F. P., Johnston E. R and Dewolf J. T., "Mechanics of Materials", McGraw Hill Higher Education, 5th edition, 2004, ISBN: 978-007 3529 387.

8. Gere J. M. and Timoshenko S. P., "Mechanics of Materials", 4th Edition, PWS Pub. Co, 2001, ISBN 978-0534934293.

9. Popov E. P., "Engineering Mechanics of Solids", Prentice Hall of India LTD, New Delhi, 2008.ISBN-10 :0137261594

10. Singer and Pytel, "Strength of Materials", Addison Wesley Publishing Corporation, 1999, ISBN 0 321 04541 6.

11. Timoshenko S P. and Young D. N., "Strength of Materials", Affiliated East-West Press Pvt. Ltd. New Delhi, 2006, ISBN: 8176710199

Manufacturing Processes

211121

Teaching Scheme   **Examination Scheme**

Lectures: 4 hours / week   In-Sem(Online):50 Marks
                                                           End-Sem(paper):50 Marks
                                                           Credits: 4

Prerequisites: Basic Mechanical Engineering, Physics

Course Objectives:

- To impart knowledge of basic manufacturing processes like casting, joining, machining and forming
- To introduce various equipments and tools used in these processes
- To demonstrate effect of proper selection of these processes on product characterization

Course Outcomes:

On successful completion of the course students should be able to-
- Understand principle of working of various manufacturing processes
- Acquire knowledge of required tools/dies/molds used for various manufacturing processes
- Select/Suggest what process is best used for producing some product
- Design simple process plans for parts and products

UNIT I
Pattern Making, Moulding and Casting   (8)
Sand casting, Pattern types, materials, pattern making allowances, Moulding sand types, properties and testing, hand and machine moulding process and equipments, core-type and manufacturing, Furnaces – types- cupolas – construction, operation , zones and chemistry etc. Gating system. Cleaning and finishing of castings, Defects in casting.
Special moulding and casting processes Shell moulding, investment casting, Die casting(Hot& Cold chamber), Centrifugal casting, Continuous casting

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UNIT II
Hot Working and Cold Working Processes   (8)
Principle - Rolling, Forging-drop, press, upset. Roll forging – Extrusion, drawing, spinning. Effects of hot working. Cold rolling, swaging, forging, extrusion **–** forward, backward, impact. Roll forming, tube drawing, wire drawing, spinning, shot peening, HERF.

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UNIT III
Joining Processes   (8)
Arc Welding – Theory, SMAW, GTAW, GMAW, FCAW, submerged arc welding, stud welding.
Resistance Welding – Theory, spot, seam, projection, butt, percussion welding processes. Gaswelding, friction welding, ultrasonic welding, thermit welding, electron beam and laser welding, explosive and plasma welding. Soldering, brazing and braze welding.
Use of adhesives for joining – Classification of adhesives, types of adhesives, applications,

Surface preparation and various joints.

UNIT IV   (8)
 Lathe Machines
Introduction to lathe, types, Construction, specifications, accessories, various mechanism, various operations such as taper turning, eccentric turning, thread cutting. Concept of Speed, Feed, Depth of cut, process parameters, machining time estimation. Single point cutting tool geometry.

UNIT V   (8)
Milling Machines
Fundamentals of milling process, milling cutters,. Operations performed on milling machines. Dividing head, methods of indexing. Gear train calculations for helical and cam milling. Process parameters, machining time estimation.

Drilling Machines
Fundamentals of drilling process, Types of drilling machines. Operations performed on drilling machines. Tool holders, types of drill, drill geometry, process parameters, machining time estimation. Reaming processes, types of reamers and geometry. Tap and its geometry.

UNIT VI
Grinding Machines   (8)
Abrasive types, grinding wheels, wheel making, marking, selection, mounting, types of grinding machines, grinding faults.
Special grinding machines – honing, lapping, super finishing, buffing, burnishing.

Text Books:

1. HajaraChoudhari, Bose S. K,." Elements of Workshop Technology"' Vol I, II ,Asia Publishing House.
2. Rao P.N.,"Manufacturing Technology & Foundry, Forming & Welding", Vol I, II, Tata McGraw Hill Publishing Co. ISBN-0 07 451863 1

Reference Books:

1. Jain R.K., "Production Technology" , Khanna Publishers,ISBN 81-7409-099-1.
2. Sharma P.C., "A Text Book of Production Technology- Manufacturing Processes" ,S. Chand & Co. ISBN 81-219-111-4-1.
3. Chapman W A J., "Workshop Technology" Vol. I, II & III, Edward Arnold Publishers. ISBN- 0 7131 3287 6
4. HMT, "Production Technology", Tata McGraw Hill Publishing Co.
5. Degarmo, Black &Kosherth, "Materials & Processes in Manufacturing", 8 [th] Edition, Prentice Hall of India Ltd, Delhi.
6. Raghuwanshi B.S.,"A Course in Workshop Technology", Vol. I, II, Dhanpat Rai & Co.

Material Science

211104

Teaching Scheme

Lectures: 3 hours / week

Examination Scheme

In-Sem(Online) :50 Marks
End-Sem(paper):50 Marks
Credits: 3

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Prerequisites: Physics, Chemistry

Course Objectives:

- To present the fundamentals of materials science and engineering
- To develop understanding of behavior of materials, structure-property correlation, their testing and strengthening mechanisms
- To select suitable materials for particular application

Course Outcomes:

On successful completion of the course students should be able to-

- Explain the mechanism of plastic deformation
- Define the mechanical properties of materials and conduct destructive and non destructive tests to evaluate and test the properties of materials
- Draw and explain equilibrium diagrams for various alloy systems
- Understand various strengthening mechanisms
- Describe various pyrometers with a neat sketch and explain their working and application
- Understand corrosion and suggest various means to prevent corrosion
- Explain various aspects of powder metallurgy

Unit I   **(8)**
Introduction
Classification of Engineering Materials, Structures and their property relationship in relation to engineering materials, indexing of planes and directions. Plastic deformation - Mechanisms. Deformation of Single crystal and Polycrystalline materials. Numerical based on it. Imperfections in crystals. Dislocations, work hardening. Cold and Hot working of metals. Numericals based on plastic deformation, future trends in new materials & applications.

Unit II   **(8)**
Material Testing: Destructive Testing
Engineering and True Stress - True strain curves, conversion Relationships, Evaluation of properties. Numericals based on Tension Test. Engineering stress - Strain curves of different materials. Compression Test, Cupping Test on Sheet metal, Hardness Tests – Brinell, Poldi, Vickers, Rockwell Shore scleroscope, Durometer, Moh's test, Microhardness test and hardness conversions. Impact tests, Fatigue and Creep tests. Shear and Bend Test, Torsion Test.

Non-destructive tests
Visual Inspection, Magna flux test Dye penetrant test, Sonic and Ultrasonic test, Radiography. Examples of selection of NDT & mechanical testing methods for selected components like crankshafts,gears, razor blades, welded joints, steel and cast iron castings, rolled products,

forged products.

Unit III   (8)
Equilibrium diagrams
Related terms and definitions Hume Rothery's rule of solid solubility.Gibb's phase rule. Polymorphism, Solidification, Dendritic growth. Cooling curves, plotting of equilibrium diagrams, Lever rule, Isomorphous system. Coring.Eutectic systems, Partial eutectic systems.Uses of eutectic alloys. Layer type system, other transformation, non-equilibrium cooling and its effects

Unit IV   (8)
Strengthening Mechanisms
Refinement of grain size, Solid solution hardening, Dispersion hardening, Age hardening, Martensitic transformation, Composite materials etc.
Pyrometry
Principle, Operation and uses of various pyrometers like thermocouples Resistance pyrometer, Disappearing filament pyrometer, Total radiation pyrometer.

Unit V   (8)
Methods of Surface Improvements and Corrosion Prevention
Corrosion Prevention Methods: Design and material selection, atmosphere control, electroplating, Inhibitors, Cathodic and anodic protection, Coatings etc. Introduction to surface modification techniques such as Electro deposition, Diffusion coatings, Vapour deposition Thermal Spray Coatings, Ion implantation etc

Unit VI   (8)
Powder Metallurgy
Process in brief, powder characteristics, powder manufacturing, Production of sintered structural components such as self lubricated bearing, cemented carbide tools, cermets, refractory metals, electrical contact materials, friction materials, Diamond impregnated tools etc.

Text Books
1. Kodgire V. D., "Material Science and Metallurgy for Engineers", Everest Publishing House, Pune, 2008, ISBN 81-86314-00-8.
2. Smith W.F., "Principles of Material Science and Engineering", McGraw Hill Book Co., 2002.ISBN: 0070591695
3. Shigley J. E., "Applied Mechanics of Materials", McGraw Hill Book Company, 1985.ISBN:0070568456

Reference Books
1. Davis H. E., Troxell G.E. and Wiskocil C. T., "Testing of Engineering Materials", McGraw Hill Book Co.ISBN:0070662479
2. Van Vlack L.H., "Elements of Material Science", Addison- Wesley Publishing Co., 1998.ISBN: 8131706001
3. Baldev Raj, Jayakumar T. and M. Thavsimuthu, "Practical Non-Destructive Testing", Narosa Publishing House.Delhi, 1999.ISBN: 8173197970
4. Hull and T. W. Clyne, "An introduction to Composite Materials", Second Edition Cambridge

Solid State Science Series.ISBN:0521735483

5. Structure and Properties of Materials II, Willey Eastern (P) Ltd.

6. Murthy, "Structure and properties engineering materials", Tata McGraw Hill 2003.ISBN: 007048287X

7. Donald R. Askland, Phule P. P., "Science and engineering of materials", Thomson Learning, 2003.ISBN: 0534553966

Heat and Fluid Engineering Lab
211105

Teaching Scheme   **Examination Scheme**
Practical: 2 hours / week   Term Work: 25 marks
                                                         Credits: 1

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Practical and Term Work
Any eight, (Any one trail should be computer interfaced)

1. Verification of Bernoulli's equation
2. Determination of friction factor for laminar and turbulent flow through pipes
3. Determination of losses in various pipe fitting /Assignment on major and minor losses
4. Calibration of venture meter/orifice meter
5. Trial/Assignment on boilers.
6. Trial on vapor compression refrigeration system
7. Trial/Assignment on petrol engine
8. Trial on diesel engine
9. Trial on air compressor.
10. Trail / Assignment on Air conditioning system

Manufacturing Processes Lab
211122

Teaching Scheme

Practical: 2 hours / week

Examination Scheme

Oral: 50 marks

Credit: 1

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Students should prepare practical report on following experiments and workshop jobs. Oral will be based on the practical report.

1. Jobs
a. Plane turning, taper turning, drilling and thread cutting and knurling.- One Job
b. Gas welding/Arc welding – One Job
c. Demonstration on milling machine for gear cutting, use of indexing mechanism with calculations.
d. Demonstration on forging and grinding of lathe tool with one knife and other end vee- One Job

2. Journal based on following
1. Report on industrial visit to any casting/ foundry industry.
2. Study of lathe machine
3. Study of arc and gas welding processes.
4. Study of milling machine and drilling machine
5. Study of grinding machine.
6. Study of hot working and cold working processes.

Material Science Lab
211107

Teaching Scheme   **Examination Scheme**

Practical: 2 hours / week   Oral: 50 marks

                                                       Credit: 1

Students should prepare practical report on following experiments. Oral will be based on the practical report.

1. Tensile test on mild steel and aluminium test pieces.
2. Compression test on cast iron and brass test pieces.
3. Brinell hardness test on different materials.
4. Poldi hardness test on different materials.
5. Vickers hardness test on different materials.
6. Rockwell and Rockwell superficial test on different materials with different Scales.
7. Izod and Charpy impact tests.
8. Erichsen cupping test on minimum three different sheet metal samples.
9. Non- destructive testing - magnaflux testing, dye penetrant test, ultrasonic testing, eddy-current testing

Machine Drawing & Computer Graphics Lab
211108

Teaching Scheme   **Examination Scheme**

Practical: 4 hours / week   Term Work: 50 marks

                                                       Oral: 50 marks

                                                       Credits: 2

Prerequisites: Engineering Graphics-I, Engineering Graphics-II

Course Objectives:

- To develop the technical skills necessary to generate an engineering drawing and an engineering assembly using a modern CAD system
- To introduce the elements of engineering communications; including graphical representation of Machines end its elements.
- To model simple assembly drawings and prepare detailed part drawings with geometric dimensioning and tolerancing

Course Outcomes:

On successful completion of the course students should be able to-
- Represent different kinds of materials andMechanical components conventionally as per standards
- Identify and indicate appropriate surface roughness, tolerances and fits on drawing of machine components
- Identify the elements of a detailed drawing and produce the assembly drawing using part drawings
- Draw 2D/3D models and assembly of machine elements using computer graphics
- Prepare parametric programming of standard machine parts using Autolisp.

Unit-I
Conventions in Machine Drawing

Introduction to machine drawing, Dimensioning technique for machine components, Conventional representation of machine components as per IS code: SP-46 such as screw threads, springs, gears, bearing, tapped holes, knurling, splined shafts, tapers, chamfers, countersunk and counter bores, keys, & welded joints,

Surface Roughness

Introduction, terminology**,** machining symbol with all parameters, roughness values (Ra) and roughness grade numbers, indicating surface roughness on drawing.

Unit-II
Tolerances&Fits

Definitions applied to tolerances, types of tolerance, types of fits, fit system. Geometrical tolerances – Nomenclature, tolerance frame, types of geometrical tolerances & their symbols, indicating geometric tolerances on drawing,

Standard Fasteners & Rivets.

Thread terminology, thread forms, thread designations, single and multi-start threads, right and left hand threads, types of screws , bolts and nuts, nut locking arrangements using pins, washers & screws.

Rivets: forms & proportions of rivet heads, types of riveted joints.

Unit-III
Assembly & Details of Machine Parts
Introduction to assembly & part drawing ,examples-Revolving Centers, Machine Vice, Tool post, Screw Jack, jigs & fixtures, tailstock, Cotter Joint, Knuckle Joint, Flange Joint, Rigid and Flexible Coupling, Drawing reading. – Title block, part list / bill of material, revision block etc.

Unit IV
Basics of computer graphics
Software configurations, functions of graphics package, constructing the geometry, mathematical representation of various graphics elements such as line, circle, rectangle, ellipse, arc, spline etc.
2-D transformations
Geometric transformations, translations, rotation, mirror, concatenations.

Unit V
Fundaments of solid modeling
Geometry and topology use of primitives in solid modeling, Basics of Boolean operations, and representations schemes of solids, B-rep and CSG, Development of simple solids.

Unit VI
Autolisp programming:
Introduction to Autolisp, data types in Autolisp-integers, Real numbers, strings, Data type conversion, Math functions, logical functions, working with list and entities, filtering from lists, entity handling, list operators, string functions, branching and looping, introduction to visual lisp. Parametric programming.

Term Work:The term work shall consist of following:

Part I: Sketches of conventional representation of machine components as per **IS code: SP 46** such as: screw threads, tapped holes, holes on circular pitch, bearing, knurling, splined shaft, springs, gears, tapers, chamfer, countersunk and counter bore, keys, welded joints, structural sections etc., drawn neatly in the sketch book.

Part II: To compile the AutoCAD drawing prints etc., as mentioned below:
1. On half imperial drawing sheet - Conventional representation of machine components as per **IS Code: SP 46** such as: Screw threads, Tapped hole, Holes on circular pitch, Bearing,Knurling, Splined shaft, Springs, Gears, Tapers, Chamfer, Countersunk and counter bore.
2. On half imperial drawing sheet- Types of screws, Bolts and nuts, Nut locking arrangement.
3. On half imperial drawing sheet- Assembly and details of any one of machine component: Cotter joint, Knuckle joint, Flange joint, Rigid and flexible coupling, Stop valve, Non return valve, Revolving centers, Machine vice, Tool holder.
4. Mathematical representation of any two primitives.
5. 2D transformation of a simple two dimensional component.
6. Development of simple 3D model & Boolean algebra.
7. Any two programs on parametric programming involving :Programming for standardmachine components, Programming involving decision making and looping.

Text Books

1. Gill P. S., "A Text book of Machine Drawing", Revised Edition K. Kataria and Sons, New Delhi, 2008, ISBN: 81-85749-79-5.
2. FarazdakHaideri, "Machine Drawing and Computer Graphics", NiraliPrakashan, Pune, 1998.ISBN: 9380725272
3. William M. Oliver, "Illustrated Autolisp", BPB Publications, New Delhi, 1997. ISBN: 1556221614
4. George Omura, "ABC's of Autolisp", BPB Publications, 2002.ISBN: 0895886200
5. Bhagat N. K., "Autolisp and Customisation Made Simple", BPB Publication, 1997, ISBN: 817029712 5.
6. Zeid Ibrahim, "Mastering CAD/CAM", Tata McGraw Hill.ISBN: 0070634343
7. Xiang Z. & Roy P., "Computer Graphics", 2nd Edition, McGraw-Hill International Edition, 2001, ISBN 0-07-118885-1.
8. Groover M. P., "Automation Production Systems & Computer Integrated Manufacturing", Prentice Hall of India, 1999, ISBN 81-203-0618-X.

Reference Books

1. Narayana K. L., Kannaiah P., VenkatataReaddy K., "Machine Drawing", 2 ndEdition, New age international Publishers, Delhi, 2008, ISBN 81-224-1917-8.
2. Bhat N. D., Panchal , "Machine Drawing", Charotar Pub. House, 2000.ISBN: 9380358466
3. Auto LISP Reference Manual".
4. John Hood D., "Using AutoCAD with Auto LISP", McGraw Hill Book Company 1990.ISBN:0070297487

Audit Course 1: Road Safety

211109

Road transport remains the least safe mode of transport, with road accidents representing the main cause of death of people. The boom in the vehicle population without adequate road infrastructure, poor attention to driver training and unsatisfactory regulation has been responsible for increase in the number of accidents. India's vehicle population is negligible as compared to the World statistics; but the comparable proportion for accidents is substantially large.

The need for stricter enforcement of law to ensure greater safety on roads and an environment-friendly road transport operation is of paramount importance. Safety and security are growing concerns for businesses, governments and the traveling public around the world, as also in India. It is, therefore, essential to take new initiatives in raising awareness, skill and knowledge of students as one of the ibid stake holders who are expected to follow the rules and policies of the government in order to facilitate safety of individual and safe mobility of others.

Course Contents:

1. Existing Road Transport Scenario
2. Accident Causes & Remedies
3. Road Accident Investigation & Investigation Methods
4. Vehicle Technology – CMVR & Road Safety
5. Regulatory / Legislative Provisions for Improving Road Safety
6. Behavioral Training for Drivers for Improving Road Safety
7. Road Safety Education
8. Road Engineering Measures for Improving Road Safety

Electrical Technology
203050

Teaching Scheme

Lectures: 4 hours / week

Examination Scheme

In-Sem(Online) :50 Marks

End-Sem(paper):50 Marks

Credits: 4

Prerequisites: Basic Electrical Engineering

Course Objectives:

- To understand essential concepts and applications of electrical machines and drives.
- To understand concepts of semiconductor power devices

Course Outcomes:

On successful completion of the course students should be able to-

- Understand and perform power measurement of single phase and three phases. Be able to understand the concept of Terrif and illumination
- Describe and classify the types of single phase transformer, tree phase transformer and three phase induction motor.
- Describe and classify the types of single phase induction motors and synchronous generators
- Understand construction and working of DC motors, generators and servo and stepper motors.
- Understand semiconductor devices and be able to predict their applications.
- Predict the advantages of various electric drives and speed control.

Unit I **(8)**
Electrical Power Measurement: Measurement of active power in three phase balanced loadsby using one wattmeter & two wattmeter, Concept of reactive power using two wattmeter, effect of power factor on wattmeter readings.

Electrical Energy Measurement: Single Phase and three phase energy meter, constructionandWorking. Use of CT & PT for measurement of Power / Energy in single phase and three phase system (Theoretical Treatment only). Standard specifications of single and three phase energy meter, CT & PT for LT & HT measurements.

Tariff: Introduction, objectives & Details of H.T. and L.T tariff, TOD tariff, advantages andimprovement of power factor (Theoretical Treatment only)

Illumination: Various terms related to illumination, types and requirement good lightingscheme, special purpose lighting.

Unit II **(8)**
Single phase transformer: Types, KVA rating, approximate equivalent circuit, voltageregulation and efficiency of transformer, condition for maximum efficiency.

Three phase transformers: Types of transformer connection (star/star, star/delta, delta/star,and delta/delta) and applications based on connections. (Theoretical Treatment only) Introduction of power transformer, distribution transformer, study of typical distribution transformer substation, specifications of transformer (KVA rating, voltage ratio, current rating)

Three phase Induction Motor: Constructional feature, working principle of three phaseinduction motors, types; torque equation, torque slip characteristics; power stages; efficiency; types of starters; methods of speed control, Industrial applications.

Unit III   (8)
Single phase induction motors: Types, construction, working principle of split phase andshaded pole type induction motors, applications. Specifications of induction motors (KW rating, rated voltage, current rating, frequency, speed, class of insulation)

Synchronous Generator: Constructional features, (Salient and non- salient),working principle,emf equation, synchronous speed of an alternator, concept of synchronous reactance and impedance, phasor diagram of loaded alternator, voltage regulation of alternator by direct loading method and synchronous impedance method. Specifications of synchronous generator

Unit IV   (8)
D.C. Machines
Construction, working principle of D.C. generator, emf equation of D C generator.(Theoretical concept only).Working principle of D.C. motor. Types of D. C. motor, back emf , torque equation for D.C. motor, characteristics of D. C. motor (series, shunt and compound), starters of D.C. shunt and series motor, methods for speed control of D.C shunt and series motors, Industrial applications.

Special purpose motors: Construction, working principle, characteristic and applications ofstepper motors, A.C. and D.C servomotors, universal motors.

Unit V   (8)
Semiconductor power devices:
SCR: Construction detail, V-I Characteristics, Methods to turn ON, switching action during ON &OFF, specification, Concept of commutation of SCR. Applications. **DIAC**: Construction, V-I Characteristics. **TRIAC**: Construction, V-I Characteristics, turning ON process. **MOSFET**: Construction, transfer Characteristics, output characteristics, Methods to turn ON & OFF, applications. **IGBT**:- Construction detail, transfer Characteristics, output characteristics, Methods to turn ON & OFF, applications.. **GTO**: Construction, working, advantages and disadvantages

Unit VI   (8)
Drives: Advantages of Electrical Drives, Individual & Group drives, selection of drivesdepending on load characteristics.

Speed Control: Single phase full converter fed D.C. Drives, Three phase converter fed D.C.Drives, Chopper Drives, two quadrant & four quadrant chopper drives, stator voltage control of three phase induction motor, frequency control of three phase induction motor, V/F

control of three phase induction motor.

Text Books
1. Harold G, "Electrical Machinery Transformers and Controls", Prentice Hall Publication ISBN: 0132473208.
2. Theodore Wildi, "Electrical Machine Drives and Power Systems", Pearson Education Asia, 2004, ISBN 81 7808 972 6.
3. Bhag S., Guru and Hussein R. Hiziroglu, "Electrical Machinery and Transformers", Oxford University Press, 2007, ISBN 0-19-5685-77-6.
4. Dr.Bhimbra P. S., "Power Electronics", Khanna Publication. ISBN: 817409279X.
5. Pratap H., "Art & Science of utilization of Electrical Energy", 3rd Edition, DhanpatRai& Sons.
6. Theraja B. L., "Electrical Technology", S. Chand Publication Co. Ltd. ISBN: 8121924405
7. Rao P. V., "Power Semiconductor Drives", BS Publication, Hyderabad. ISBN: 8178001608

Reference Books
1. Bhattacharya S. K., "Electrical Machines", TATA McGraw Hill LTD, New Delhi, 2003, ISBN 0-07-463310 4.
2. Hughes E. and Smith I., "Electrical and Electronics Technology", Pearson Education Asia, New Delhi, 2008, ISBN 81 317 1468.
3. Syed A. Nasar, "Electrical Machine Drives and Power Systems", Vol. I, Pearson Education Asia, ISBN 81 7808 9726.
4. Veinott C. G. and Martits J. E., "Fractional and sub fractional Horse power Electrical Motors", McGraw Hill Inc.US; 3rd Edition, 1993, ISBN 978-0070673908.
5. Siemens, "Electrical Engineering Handbook", Wiley Eastern LTD, 1986. ISBN: 0855012315.
6. Kothari D. P. and Nagrath I. J., "Electrical Machines", 3rd edition, Tata McGraw Hill. ISBN: 0070699674

Theory of Machines
211110

Teaching Scheme   **Examination Scheme**
Lectures: 4 hours / week   In-Sem(Online) :50 Marks
                                                                End-Sem(paper):50 Marks

Credits: 4

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Prerequisites: Engineering Mechanics, Basic Mechanical Engineering

Course Objectives:

- To provide a fair understanding of the performance of various mechanisms and principal machine elements as regards their Kinematics and dynamics & Forming a base for studies in machine tool applications
- To develop the ability to analyze and understand the dynamic (position, velocity, acceleration, force and torque) characteristics of mechanisms such as linkages and cams.
- To develop the ability to systematically design and optimize mechanisms to perform a specified task.

Course Outcomes:

On successful completion of the course students should be able to-

- Understand the basic knowledge of mechanism, their inversions, applications and velocity and acceleration analysis.
- Understand the use of mechanical elements like drives, brakes, dynamometer in machine tools.
- Understand theories of wear and friction, their effects, measurement and methods to minimize their effects in various mechanisms and machine tools.
- Understand the static and dynamic force analysis of mechanisms.
- Analyze experimentally mass moment of inertia and radius of gyration

Unit I   **(8)**
Basics : Kinematic Link ,Types of links, Difference between machines, mechanism and structure, Kinematics pair, Types of constrained motion, Classification of Kinematics pairs, Kinematics chain, Degrees of freedom of mechanisms, Kutzbach and Grubler criterion, Equivalent linkage concept, Inversion of mechanism Mechanisms: Straight line mechanisms-Exact straight line and approximate straight line type, Steering gear mechanisms -Davis and Ackerman type.

Unit II   **(8)**
Kinematic Analysis of Mechanisms: (Velocity Analysis) Concept of position, displacement and velocity of a point and link of a given mechanism, Kinematic analysis of mechanisms by -- Relative velocity method, graphical method, analytical method, Instantaneous Center method, (Numerical treatment expected) Kinematic Analysis of Mechanisms: (Acceleration Analysis) Concept of acceleration of a point and link of a given mechanism, Kinematic analysis of mechanisms by -- Relative velocity method, graphical method, analytical method, Coriolis Component of Acceleration, Klein's construction (Numerical treatment expected)

Unit III   **(8)**
Friction and Wear: Laws of friction, Types of friction, mechanism of friction, friction analysis, types of wear, mechanism of wear, wear equation, factors responsible wear and friction,

methods of reducing wear, lubrication and its mode, lubrication technique, tribology in metal cutting and working.

Unit IV   (8)
Belt Drives : Types of belt drives, Types, Materials used for Belt. Velocity Ratio, Slip, Creep of belt. Length of an open and cross belt drive, Maximum power transmitted, Tension ratio, maximum tension in a belt, Advantage and disadvantages of a V-Belt Drive, Ratio of Driving Tension for V-Belt.

Unit V   (8)
Brakes: - Types of brakes, Force analysis of brakes, external and internal expanding shoe brakes, block brakes, band brakes, block and band brakes, Breaking torque. (Numerical treatment expected)
Dynamometer: - Different types of Absorption and transmission dynamometers.

Unit VI   (8)
Static force analysis of slider-crank mechanism, Theory of compound pendulum, Bifilar and Trifler suspension methods, dynamically equivalent two mass systems, correction couple, Dynamic force analysis of slider crank mechanism (Analytical and Graphical method)

Text Books
1. Ballaney P. L., "Theory of Machines and Mechanisms", Khanna Publisher Delhi, 1999. ISBN: 817409122X.
2. Rattan S.S.**,** "Theory of Machines", 2ed.,TataMcGraw-hill publishing, 2005, ISBN 007-059120-2.
3. Ghosh Amitabh and Malik Ashok Kumar, "Theory of mechanisms and Machines", 3ed, Affiliated East West press, 2000, ISBN 81-85938-93-8.

Reference Books
1. Shigley Joseph Edward and Vicker John Joseph**.** "Theory of Machines and Mechanisms" **,** 3ed., 1995, Oxford University Press. ISBN 0-19-515598-x.
2. Thomas Bevan, "Theory of machines", CBS publishers and Distributors, 1984. ISBN: 8131729656

Manufacturing Engineering & Metrology Practices
211123

Teaching Scheme

Lectures: 4 hours / week

Examination Scheme

In-Sem(Online):50Marks
End-Sem(paper):50Marks
Credits: 4

Prerequisites: Basic Mechanical Engineering,Manufacturing Processes

Course Objectives:

- To demonstrate practical aspects of design and analysis of cutting tools, press tools and jigs and fixtures
- To provide understanding of manufacturing aspects of threads and gears
- Introduction to automats and NC/CNC technology

Course Outcomes:

On successful completion of the course students should be able to-
- Design cutting tools, press tools and jigs and fixtures
- Draw cam layout for automats
- Understand principle of working of gear and thread manufacturing their tools & dies
- Able to generate part program for CNC

Unit I (8)
Theory of Metal Cutting

Cutting tools, tool geometry, concept of speed, feed, depth of cut and cutting action and effect of these on cutting forces. Types of chips, Merchants circle of forces. Estimation of cutting forces, machinability. Tool life for minimum cost and maximum production. Cutting fluids. New technology in metal cutting for higher productivity. Measurement of cutting forces and power required.
Design of Cutting Tools – Single point cutting tool, drill

Unit II (8)
Production Machines
Turret and capstan lathe, automatic and semiautomatic lathe, single & multi spindle automats, setup, tool layout, operation sheet, cam layout, for single spindle automats, concept of transfer lines. Planning, Shaping & Slotting machines.

UnitIII (8)
Broaching
Types of broaching machines. Parts of the machines and their functions. Components machined on broaching machine. Broach geometry.
Gear Manufacturing
Gear cutting processes- Gear hobbing, Gear shaping, Gear shaving, Gear lapping and gear grinding. Construction and working of the machines.

Thread Manufacturing

Thread cutting, chasers and dies. Thread milling, thread rolling, thread lapping and thread Grinding

UnitIV   **(8)**

Introduction to NC, CNC Machines

Introduction to NC, CNC machines, machining centers-Principles, working, advantages and applications. Parts programming. Introduction to FMS.

Unit V   **(8)**

Sheet Metal Working

Study of various press tools and presses. Study of Piercing, Notching, Forming, Coining, Drawing processes. Elements of dies and punch set. Types of dies and punches of different press working operations.

Calculations of clearances, center of pressure, different forces, press tonnage, blank size, number of draws, strip layout, sheet utilization ratio, methods of reducing forces.

UnitVI   **(8)**

Jigs and Fixtures

Introduction, Definitions, elements, basic principles. Introductions to locators and clamping - basic principles, types. Types of jigs and fixtures.

Design of Jigs & Fixtures, General Guidelines & Procedures for design of jigs & fixtures.

Text Books:

1. Rao P. N., "Manufacturing Technology & Foundry, Forming & Welding", Vol.

I, II, Tata McGraw Hill Publishing Co., 2004, ISBN 0-07-451863-1.

2. Sharma P.C., "A Text Book of Production Technology- Manufacturing

Processes", S. Chand & Co., 2008, ISBN 81-219-111-4-1

Reference Books:

1. Jain R.K., "Production Technology", Khanna Publishers, 2008, ISBN 81-7409-099-1.

2. Chapman W .A. J., "Workshop Technology" Vol. I, II & III, Edward Arnold Publishers, 1998, ISBN – 0 7131 3287 6

3. HMT, "Production Technology", Tata McGraw Hill Publishing Co., 1980.

4. Hoffman E.G., "Jigs & Fixtures Design", Thomson Asia Pvt Ltd., ISBN 981-243- 508-

5. Raghuwanshi B. S., "A course in Workshop Technology", Vol. I, II, Dhanpat Rai & Co.

6. HajaraChoudhari, Bose S. K., "Elements of Workshop Technology" Vol. II,

Asia Publishing House, 2002.

7. Drozda T. J., "Tool Engineering Handbook", ASTME, Vol. I, ISBN 0-87263-085- 4

8. Joshi P. H., "Press Tool Design & Productions", Wheeler Publishing, ISBN 81- 85814-46- 5.

Design of Machine Elements
211112

Teaching Scheme

Lectures: 4 hours / week

Examination Scheme

In-Sem(Online):50Marks
End-Sem(paper):50Marks
Credits: 4

Prerequisites: Basic mechanical Engineering, Engineering Mechanics, Mechanics of Materials,

Course objectives:

- To apply engineering design principles and methods to the proper analysis of a variety of common mechanical system components.
- To design these mechanical system components confirming to appropriate codes and standards so as to perform safely their intended functions in harmony with other components of the system

Course Outcomes:

On successful completion of the course students should be able to-

- Understand the basic principles and process of machine design
- Analyze the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts such as shaft, power screws, mechanical springs, gears, and bearings.
- Demonstrate knowledge on basic machine elements used in design of machine elements to withstand the loads and deformations for a given practical application.

Unit I **(8)**

Design Process: Machine Design, Traditional design methods, Basic procedure of MachineDesign, Requisites of design engineer, Design of machine elements, Sources of design data, Use of standards in design, Selection of preferred sizes.

Design of Simple Machine Parts: Factor of safety, Service factor, Design of simple machine parts-Cotter joint, Knuckle joint and lever.

Unit II **(8)**

Shafts: Design considerations in Transmission shafts with spur gear and pulley, splined shafts,Shaft design on strength basis, Shaft design on torsional rigidity basis, A.S.M.E. code for shaft design.

Keys: Classification of keys, Design considerations in parallel and tapered sunk keys, Design of square, flat and Kennedy keys.

Couplings: Design considerations, Classification, Design of Rigid, Muff coupling, Flange coupling and Flexible bushed pin coupling.

Unit III **(8)**

Power Screws: Types of screw threads, multiple threaded screws, Torque analysis with squareand trapezoidal threads, Self-locking screw, Collar friction torque, Stresses in power screws, design of screw and nut, design of Screw jack.

Unit IV   **(8)**
Mechanical Springs: Types, Applications and materials of springs, Stress and deflectionequations for helical springs, Types of ends, Design of helical compression and tension springs, Springs in series and parallel, Helical torsion spring, surge in spring.

Unit V   **(8)**
Spur Gears: Various design consideration, Beam Strength, tangential loading modulecalculations, width calculations, type of gear tooth failures, Estimation of dynamic load by velocity factors and Spott's equation.

Unit VI   **(8)**
Rolling Contact Bearings: Type, static and dynamic loading capacity, stribeck's equation,concept of equivalent load, load life relationship, selection of bearing from manufacturers catalogue, design for variable load and speeds, bearing probability of survival other than 90%, lubrication and mounting of bearing.

Term Work:
   1) Term work shall consist of ONE design project. Design project shall consist of two imperial size sheets –one involving assembly drawing with a part list and overall dimensions and other sheet involving drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified so as to make it working drawing. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design projects should be in the form of 'Design of Mechanical System' comprising of machine elements studied and topics covered in the syllabus. Design data book shall be used wherever necessary to achieve selection of standardized components.
   2) Problem based assignment on each unit

Text Books
1. Shigley J. E. and Mischke C. R., "Mechanical Engineering Design", McGraw- Hill publication Co. Ltd., 1989, ISBN 0-07-049462-2.
2. Spotts M. F. and Shoup T. E., "Design of Machine Elements", 8ed., Pearson Education pvt. Ltd., 2008, ISBN 81 -7758- 4219.
3. Bhandari V.B., "Design of Machine Elements", Tata Mcgraw-hill publishing, 1984,ISBN 0-07-0611416 4. Kannaiah, "Machine Design", Scitech publications Pvt. Ltd., 2003, ISBN 81-88429-10-4.
5. PSG, "Design Data", M/S DPV Printers, 1984.

Reference Books
1. Orthewein and William C. Orthewein, "Machine Component Design".
2. Robert C. Juvinall, "Fundamentals of Machine Component Design", 1999.
3. "PSG Design data", M/S DPV printers, Coimbatore, 2000.
4. Black Paul H.and Adams O. Eugene, "Machine Design", 3ed.,McGraw-hill Book Company, 1999, ISBN 0–07-085037-2.
6. Hall Allens, Holowenko Alfred R., Laughlin Herman G., "Theory & Problems of Machine Design", McGraw-hill Book Company, 2000, ISBN 48333-7.

Production & Industrial Management- I
211124

Teaching Scheme
Lectures: 4 hours / week

Credits: 4

Examination Scheme
In-Sem(Online):50Marks
End-Sem(paper):50Marks

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Prerequisites: Manufacturing Processes

Course Objectives:

- To make students aware of various management practices used in the industries
- To demonstrate tools and techniques of production management and industrial engineering
- To impart knowledge of behavioral science

Course Outcomes:
On successful completion of the course students should be able to-
- Understand evolution of management practices
- Understand the concept and contribution of various constituents of production management such as Location planning, Layout planning and Capacity planning
- Understand the concept and contribution of various constituents of Industrial engineering such as method study, time study, synthetic and standard data methods
- Understand concept of financial management, prepare the cost Statement and compute break-even Point
- Understand and learn the effective interpersonal, team building, motivation and leadership skills

Unit I (8)
Evolution of Management Practices
Characteristics, Objectives, Functions, Principles & Types of Management, Scientific Management - Contribution of F.W. Taylor & H. Fayol& Others to the Management thoughts.

Organization
Definition, Principles, Functions & Types of Organization

Group dynamics
Definition, Types, Characteristics, Functions & Objectives, Groups & Group Dynamics Objectives of Business Enterprise, Concept of Firm & Industry, Different forms of Business Ownership - Proprietor, Partnership Firm, Private & Public Limited Company, Cooperatives, Private & Public Trusts.

Unit II (8)
Production Management

The Production function, Operations Concept, Productivity, Objective of Production Management, Elements of Production function

Industrial Engineering- History, Development, Definitions, Functioning & Application of Industrial Engineering, Contribution of various persons to the field of Industrial

Types of Production (Job, batch etc,) & their characteristics, Degree of repetitiveness & Volume of Production Engineering

Facilities (Plant) Location & Layout Introduction to Production Planning & Control Process Planning, Maintenance Function

Unit III   (8)
Method Study
Steps, Tools & Techniques used in the Method Study, Process Chart, Symbols, Flow Diagrams, Two Hand Chart, Multiple Activity Chart, 5W & 1H, Use of Motion Pictures & its analysis. SIMO chart, Chronocylograph. Developing, Presentation, Installation & Maintenance of new Methods. Meaning, Definition & Importance of Ergonomics in Industry.

Unit IV   (8)
Work Measurement
Time Study: Aim & Objectives, Terminology & Tools, Use of stopwatch procedure in makingTime Study. Time Study Forms, Performance rating, allowances and its types. Calculations of standard Time. Time study for indirect functions such as Maintenance & Marketing. Criticism of Time Study.

Synthetic & Standard data Methods: Concepts, Introduction to PMTS, MTM1, WFS, & BasicMotion Time Study. MTM2 & Other second Generation Methods, MOST.23

Unit V   (8)
Motivation
Human Needs & Different Theories of Human Needs. Definition, Types of Motivation, Theories of Motivations - McGregor's Theory of X & Theory of Y, Herzberg's Theory of Two Factor, David C. McCelland's Theory of Achievements, Expectance, Valence Theory of Victor Vroom & Porter & Lawler's Model.

Leadership: Definition, Styles & functions of Leadership. Qualities for good leadership. Role ofthe Leader.

Entrepreneurship: Concept & Qualities of Good Entrepreneur.

Unit VI   (8)
A. Human Resources Management
Introduction & Importance, Difference between HRM & Personnel Management. Man power planning, Job Evaluation & Merit Ratings. Training & Development. Meaning & Types of Remuneration & Incentive Systems.
B. Financial Management.
Costing, Definition & types of costs. Elements of costs. Types & methods of costing. Break Even Analysis.

Types & Sources of Finance, Different Financial Intuitions and their role in Industrial Development.

Text Books:

1. Banga& Sharma, "Industrial Organisation&Engg. Economics", Khanna

Publishers, 2001, ISBN 81-7409-078-9
2. Jhamb L. C., "Production (Operations) Management", Everest Publishing House, ISBN 81-86314-24-5

Reference Books:
1. "Introduction to Work Study", ILO Publication, ISBN 81-85027-27-7.
2. Mansoor Ali &Dalela, "Industrial Engineering and Management Systems", StandaraPublisher Distributor, ISBN 81-86308-36-9.
3. Memoria C. B. &Gankar S. V., "Personnel Management", 12th Edition 1994, Himalaya Publications, 2003, ISBN 81-7040-875

Electrical Technology Lab
203051

Teaching Scheme

Practical: 2 hours / week

Examination Scheme

Term Work: 50 marks

Credits: 1

Term Work:

Term work shall consist of experiments as listed below. Any 6 experiments from 1 to 8 in the list should be performed, and expt. no. 9 and 10 are compulsory.

1. Speed control of a D. C. shunt motor by armature voltage and flux control methods.
2. Load test on a D. C. shunt motor.
3. Load test on a D. C. series motor.
4. Measurement of active power in a three phase balanced inductive load using two wattmeter methods.
5. Regulation of an alternator by synchronous impedance method.
6. Regulation of an alternator by direct loading method.
7. Load test on a three phase induction motor.
8. Study of a) D.C. motor starters, b) three phase induction motor starter.
9. Study of V-I characteristics of SCR & TRAIC.
10. Study of a distribution transformer substation and HT/LT energy bill.

Theory of Machines Lab
211114

Teaching Scheme

Practical: 2 hours / week

Examination Scheme

Term Work: 25marks

Oral: 50 marks

Credit: 1

Term work shall consist of the following:

1. Study of straight line mechanisms.
2. Velocity analysis of mechanism by relative velocity, Klein's construction and ICR method.
3. Acceleration analysis of mechanism by relative velocity and acceleration (Coriolis component),Klein's construction method.
4. Study of friction and wear of materials.
5. Study of belt drives.
6. Study of different types of brakes and dynamometer.
7. Determine mass MI of rigid body using bifilar and trifler suspension method.
8. Determine radius of gyration & mass MI of rigid body using compound pendulum method

Oral will be based on practical report on above mentioned topics.

Manufacturing Engineering & Metrology Practices Lab
211125

Teaching Scheme   **Examination Scheme**

Practical: 2 hours / week   Oral: 50 marks

Credits: 1

Students should prepare practical report on at least eight experiments on the topics mentioned below. Oral will be based on the practical report.

1. Demonstration on chip formation and effect of tool geometry, cutting speed, feed etc. on machining operations.
2. Demonstration of measurement of cutting forces.
3. Demonstration on single spindle automats/ production lathe along with tool layout/cam layout.
4. Preparing part programming & demonstration of same job on CNC lathe.
5. Design and working drawing of drilling jig and milling fixture.
6. Determination of Linear/Angular dimension of a part using precision and non precision Measuring instrument.
7. Machine tool alignment test on any one machine like lathe, milling, drilling.
8. Go-NoGo gauge design by Taylor's principle.
9. Measurement of gear tooth thickness by Gear tooth Vernier caliper/ constant chord/base Tangent method.
10. Study and application of Profile Projector.
11. Surface Finish Measurement by using any suitable method.

Before conducting the above practical's, teacher should explain the meaning of Metrology, Precision, Accuracy, Errors in measurement, Calibration, Line & End standard.

Computer Graphics Lab II
211126

Teaching Scheme   **Examination Scheme**

Practical: 2 hours / week   Oral: 50 marks

Credits: 1

Term work consists of writing the Journal based on following topics after performing minimum of two assignments each.

A) Customization of AutoCAD

Introduction to Auto Lisp.

1) A program for customization of any one Menu using Auto Lisp.

2) A program for customization of any one Toolbar using Auto Lisp.

B) CAD Modeling

1) One assignment based on assembly modeling and drafting of any assembly consisting of at least four to five components with one of CAD packages like Pro- E, Ideas, UG – NX, CATIA, Solid Edge, Solid Works, etc.

2) Surface modeling of at least one component using Pro- E, Ideas, UG – NX, CATIA, Solid Edge, Solid Works, etc.

C) Finite Element Analysis

1) Introduction to Finite Element Analysis and concepts like meshing, Stiffness Matrix, etc with a demonstration using any one of the packages like Nastran, Ansys, Hypermesh, LS Dyna, etc

2) Introduction of Product Life Cycle Management and Product Development

Text Books:

[1]Auto CAD by Paul F. Aubin.

[2] Auto LISP by George Omura .

[3]Finite Element Analysis By P. Seshu , PHI Publication ISBN -81-203-2315-7.

Soft Skills
211117

Teaching Scheme

Practical: 2 hours / week

Examination Scheme

Term Work: 25 marks
Credits: 1

Objectives

- To encourage all round development of students by training them in necessary soft skills.
- To make the engineering students realize the importance of soft skills in the holistic development of personality.
- To foster the students soft skills with a special emphasis on improving their communicative competence in English.

Overview

Soft skills are a set of skills required for a holistic development of an individual. Through this course, the students of engineering will be trained in the necessary soft skills which are required for them not only to do well academically but also to excel in each significant aspect of life. Effective communication skills in English have become a prerequisite for students to enhance their academic performance as well as earn a good placement. These skills are also essential for their professional growth. Therefore, the necessary soft skills will be taught with a special emphasis on communication skills in English. Today, the employability of a student is defined by not only his command over technical skills but also his sound soft skills. The soft skills improve students' confidence and enable them to implement the technical skills learnt more efficiently. Training in soft skills infuses in students positive attitude and makes them self assured. They can do well in every walk of life and achieve success in their endeavors. Thus, soft skills contribute significantly to the all round development of students and therefore need to be taught effectively with an emphasis on adequate practical exposure.

Teaching Methodology

Each class should be divided into three batches of 20-25 students each. The sessions should be activity based and should give students adequate opportunity to participate actively in each activity. Teachers and students must communicate only in English during the session. Specific details about the teaching methodology have been explained in every activity given below.

Practical Activities (Term work)

Following 10 activities are compulsory and teachers must complete them during the practical sessions within the semester. The teacher should give students 10 assignments on the basis of the 10 activities conducted in the practical sessions. Students will submit these 10 assignments as their term work at the end of the semester but it should be noted that the teacher should assess their assignment as soon as an activity is conducted. The continual assessment process should be followed.

1. Self Assessment: (2 hours)

The students should be made aware of their goals, strengths and weaknesses, attitude, moral values, self confidence, etiquettes, non-verbal skills, achievements etc. through this activity. The teacher should explain to them on how to set goals, SWOT Analysis, Confidence improvement, values, positive attitude, positive thinking and self esteem. The teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects.

2. Public Speaking (4 hours)

Any one of the following activities may be conducted :

   a. **Prepared speech** (topics are given in advance, students get 10 minutes to preparethe speech and 5 minutes to deliver.
   b. **Extempore speech (**students deliver speeches spontaneously for 5 minutes eachon a given topic)
   c. **Story telling (Each student narrates a fictional or real life story for 5 minutes each)**
   d. **Oral review** (Each student orally presents a review on a story or a book read bythem)

3. Power-point Presentations (4 hours)

Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical. The teacher should guide them on effective presentation skills. Each student should make a presentation for at least 10 minutes.

4. Formal Group Discussion (4 hours)

Each batch is divided into two groups of 12 to 14 students each. Two rounds of a GD for each group should be conducted and teacher should give them feedback.

5. English Language Proficiency Test (2 hours)

The teacher should conduct a 50 mark English proficiency test in the lab and discuss the answers with explanation and more illustrations.

6. Mock Meetings (2 hours)

In order to enhance students' formal oral communication, mock meetings can be conducted. Teacher should give a topic for the meeting and teach students how a notice and agenda for a meeting is prepared. Students will participate in the meeting assuming the roles assigned by the teacher. After the meeting, teacher should guide students on how minutes of meeting are recorded.

7. Letter, Report & Resume writing (4 hours)

Each student will write one formal letter, one report and a resume. The teacher should teach the students how to write the letter, report and build resume. The teacher should give proper format and layouts.

8. Reading and Listening skills (4 hours)

The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be asked questions on the article by the readers. Students will get marks for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills. The teacher should also give passages on various topics to students for evaluating their reading comprehension.

9. Conflict Management and decision making skills (2 hours)

The teacher should teach students how to make sound and practical decisions by dealing with conflicts. Students should know how to manage internal and external conflicts. The teacher can conduct a case study activity to train students in these skills.

10. Stress management (2hours)

The teacher should conduct a session on stress management and guide students on how to manage stress. The teacher may conduct a stress relieving activity in the class. He/she may counsel students individually to know their problems and guide them on dealing with them effectively.

Scheme of Evaluation

The teacher should give marks out of 10 for each activity. The total marks for all 10 activities will be 100 marks. At the end of semester, the marks scored by a student out of 100 will be scaled down to marks out of 25. Thus, each student will get marks out of 25 for this subject.

References

1. Rutherford A. J. : Communication skills for Technical Communication, Pearson Education
2. Meenakshi Raman, Sangeeta Sharma : Technical Communication – Principles and practice, Oxford
3. Scot Ober : Contemporary Business Communication (Indian adaptation) Biztantra
4. Dutt et.al. : A course in Communication Skills, Foundation
5. Ibbotson: Cambridge English for Engineering, Cambridge
6. Turk: Effective Speaking, Taylor & Francis
7. Patnaik: Group Discussion and Interview Skills, Foundation
8. Mishra: A companion to communication skills in English, PHI
9. Lynch: listening, Cambridge
10. Sasikumar, Dutt&Rajeevan: A course in Listening & Speaking I & II, Foundation
11. Malcom Goodale: Professional Presentations, Cambridge
12. Ham-Lyons &Heasley: Writing, 2nd Edition, Cambridge
13. ASTD: 10 steps to successful meetings, Cengage Learning
14. E. Suresh Kumar, P. Sreehari, J. Savitri: Communication Skills & Soft Skills An Integrated Approach, Pearson
15. Barun K. Mishra: Personality Development and Group Discussions, Oxford University Press
16. Accenture, Convergys, Dell et.al: NASSCOM - Global Business Foundation Skills: A Foundation Books, Cambridge University Press

Audit Course 2: Environmental Studies
211118

Environmental studies are the field that examines this relationship between people and the environment. An environmental study is an interdisciplinary subject examining the interplay between the social, legal, management, and scientific aspects of environmental issues.

Course Objectives:
- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures.
- Understand and realize the multi-disciplinary nature of the environment, its components, and inter-relationship between man and environment
- Understand the relevance and importance of the natural resources in the sustenance of life on earth and living standard

Course Outcomes:

On completion of the course, learner will be able to–
- Comprehend the importance of ecosystem and biodiversity
- To correlate the human population growth and its trend to the environmental degradation and develop the awareness about his/her role towards environmental protection and prevention
- Identify different types of environmental pollution and control measures
- To correlate the exploitation and utilization of conventional and non-conventional resources

Course Contents:
1. Natural Resources: Introduction, Renewable and non-renewable, Forest, water, mineral, food, energy and land resources, Individual and conservation of resources, Equitable use of resources.
2. Ecosystems: Concept, Structure, Function, Energy flow, Ecological succession, Forest, grassland, desert and aquatic ecosystems - Introduction, characteristic features, structure and function.
3. Biodiversity: Genetic, Species and ecological diversity, Biogeographical classification of India, Value and hot spots, Biodiversity at global, national and local levels, India as mega-biodiversity nation, Threats to biodiversity, Endangered and endemic species of India, Conservation of Biodiversity, Endangered and endemic species, Conservation of biodiversity.
4. Pollution: Definition, Causes, effects and control measures of the pollution – Air, soil, Noise, Water, Marine and Thermal and Nuclear Pollution, Solid waste management, Role of Individual in Prevention of Pollution, Pollution case studies, Disaster management

References:
1. Bharucha, E., "Textbook of Environmental Studies", Universities Press (2005), ISBN-10:8173715408
2. Chapman, J.L. and Reiss, M.J., "Ecology- Principles and Application", Cambridge University Press (LPE) (1999), ISBN-9780521588027
3. Joseph, B., "Environmental Studies", Tata McGraw-Hill (2006), ISBN-0070590923
4. Miller, G.T., "Environmental Science- Working with Earth", Thomson (2006), ISBN-13:978-0-

495-55671-8

5. Wright, R.T., "Environmental Science-Towards a sustainable Future", Prentice Hall (2008), ISBN-13:978-0130936547, 9th Edition