Savitribai Phule Pune University

Faculty of Science & Technology

Curriculum for

Second Year

Production Engineering and Industrial Engineering

(2019 Course)

(with effect from June 2020)

Savitribai Phule Pune University, Pune
SE (Production Engineering and Industrial Engineering)
2019 Course
(With effect from Academic Year 2020-21)

Semester-III

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
207007	Engineering Mathematics-III	3		1	30	70	25			125	3		1	4
211081	Heat and Fluid Engineering	3			30	70				100	3			3
211082	Strength of Materials	3			30	70				100	3			3
211083	Manufacturing Processes –I	3			30	70				100	3			3
211084	Materials Science and Metallurgy	3			30	70				100	3			3
211085	Heat and Fluid Engineering Lab		2				25			25		1		1
211086	Strength of Materials Lab		2						25	25		1		1
211087	Manufacturing Processes 1 Lab		2					50		50		1		1
211088	Materials Science and Metallurgy Lab		2						25	25		1		1
211089	Machine Drawing & Computer Graphics Lab		4				50			50		2		2
211090	Mandatory Audit Course 3	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**15**	**12**	**1**	**150**	**350**	**100**	**50**	**50**	**700**	**15**	**6**	**1**	**22**

Savitribai Phule Pune University, Pune
SE (Production Engineering and Industrial Engineering)
2019 Course
(With effect from Academic Year 2020-21)

Semester-IV

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
203050	Electrical and Electronics Engineering	3			30	70				100	3			3
211091	Theory of Machines	3			30	70				100	3			3
211092	Design of Machine Elements	3			30	70				100	3			3
211093	Advanced Materials	3			30	70				100	3			3
211094	Industrial Engineering and Management	3			30	70				100	3			3
203051	Electrical and Electronics Engineering Lab		2					25		25		1		1
211095	Theory of Machines Lab		2				25	25		50		1		1
211096	Industrial Engineering and Management Lab		2						25	25		1		1
211097	Soft Skill		2				25			25		1		1
211098	Programming in C Language Lab		2						25	25		1		1
211099	Project Based Learning		4				50			50		2		2
211100	Mandatory Audit Course 4	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**15**	**14**	**0**	**150**	**350**	**100**	**50**	**50**	**700**	**15**	**7**	**0**	**22**

Abbreviations:
TH : Theory TW : Term Work PR : Practical
OR : Oral TUT : Tutorial

Engineering Mathematics III
207007

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Lectures: 3 Hrs./Week	Theory: 3	In-Sem Exam: 30 Marks
Tutorials: 1 Hr./Week	Tutorials: 1	End-Sem Exam: 70 Marks
		Term work: 25 Marks

Prerequisites: - Differential and Integral calculus, Differential equations of first order and first degree, Fourier series, Collection, classification and representation of data, Permutations & combinations and Vector algebra.

Course Objectives:
To make the students familiarize with concepts and techniques in Ordinary & Partial differential equations, Laplace transform & Fourier transform, Statistical methods, Probability theory and Vector calculus. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes: At the end of this course, students will be able to
1) Solve higher order linear differential equations and its applications to model and analyze mass spring systems.
2) Apply Integral transform techniques such as Laplace transform and Fourier transform to solve differential equations involved in vibration theory, heat transfer and related mechanical engineering applications.
3) Apply Statistical methods like correlation, regression in analyzing and interpreting experimental data applicable to Reliability engineering and probability theory in testing and quality control.
4) Perform Vector differentiation and integration, analyze the vector fields and apply to fluid flow problems.
5) Solve Partial differential equations such as wave equation, one and two dimensional heat flow equations.

Unit I:
Linear Differential Equations (LDE) and Applications (07)
LDE of nth order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE. Modelling of mass-spring systems, free and forced damped and undamped systems.

Unit II:
Transforms (07)
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:
Statistics (07)
Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates.

Unit IV:
Probability and Probability Distributions (07)
Probability, Theorems on Probability, Bayes Theorem, Random variables, Mathematical Expectation, Probability distributions: Binomial, Poisson, Normal, Test of Hypothesis: Chi-Square test, t-distribution.

Unit V:
Vector Calculus (07)
Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoidal and Irrotational fields, Vector identities. Line, Surface and Volume integrals, Green's Lemma, Gauss's Divergence theorem and Stoke's theorem.

Unit VI:

Applications of Partial Differential Equations (PDE) (07)

Basic concepts, modelling of Vibrating String, Solution of 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.

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).
4. Differential Equations, 3e by S. L. Ross (Wiley India).
5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press)
6. Partial Differential Equations for Scientists and Engineers by S. J. Farlow (Dover Publications, 1993)

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
211081

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 3 hours / week	Theory: 3	In-Sem: 30 Marks End-Sem: 70 Marks

Prerequisites: Basic Mechanical Engineering, Physics

Course Outcomes:
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 **(7)**
Introduction & Fluid properties
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 **(7)**
Fluid Flow
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 **(7)**
Losses through pipes
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 **(7)**
Fuels and lubricants
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, Cochran boilers (construction and working), boiler accessories, boiler performance, boiler efficiency, equivalent of evaporation and energy balance.(Numerical)

Unit V **(7)**
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 **(7)**

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. Kothandaraman C. P., Khajuria P. P., Arora S. and Domkundawar S, "A course in Thermodynamics and heat engines (Thermal engineering with solar energy)", 3 ed.,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 Co.

Strength of Materials
211082

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 3 hours / week	Theory: 3	In-Sem: 30 Marks End-Sem: 70 Marks

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Prerequisites: Engineering Mechanics, Physics

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 **(7)**

Simple stresses and strains:

Basic Concepts- Concept 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 **(7)**

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 **(7)**

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 **(7)**

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 **(7)**

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 **(7)**

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 - I

211083

Teaching Scheme	**Credit Scheme**	**Examination Scheme**
Lectures: 3 hours / week	Theory: 3	In-Sem: 30 Marks End-Sem: 70 Marks

Prerequisites: Systems of Mechanical Engineering, Physics, Engineering Metallurgy, Strength of Materials.

Course Outcomes

On completion of the course, students will be able to:

- Design mould for sand casting process
- Understand working principles and operations of metal cutting processes
- Demonstrate kinematics of conventional machines.
- Select appropriate joining process for a given application
- Identify applications of additive manufacturing processes

Unit I:

Casting processes: **(7)**

Introduction, Solidification: progressive and directional solidification; rate of solidification; Chvorinov's Rule, Riser design, gating system: types, characteristics, and design, pattern design, moulding and core making processes, melting and fluidity, casting design consideration, Inspection and Quality Control

Unit II:

Metal Joining **(7)**

Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG and MIG processes and their parameters. Resistance welding-spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. Adhesive bonding. Weld decay in HAZ.

Unit III:

Machine Tools-I **(7)**

Lathe: Lathe, Specifications, Parts of lathe machine, accessories, Kinematics of lathe, Turret and Capstan lathe, various lathe operations

Milling: Classification of milling machines**,** Various Milling operations, Indexing,

Unit IV:

Machine Tools-II **(7)**

Drilling: Types of drilling machines, specifications, parts of drilling machine, Difference between drilling, boring & reaming, Boring operations & boring machines.

Grinding: Types of grinding machines, specifications, cylindrical, surface, centerless grinding, Grinding operations, Grinding wheels and their selection.

Unit V:

Super finishing processes **(7)**

Honing, Lapping, Buffing, Polishing, Tumbling, Electroplating, Galvanizing, Metal spraying, Hot dipping and Burnishing. Study of input process parameters of above processes.

Unit VI:

Introduction to Additive manufacturing **(7)**

Types of additive manufacturing processes: material extrusion, powder bed fusion, material jetting, sheet lamination, direct energy deposition etc. Designing for Additive Manufacturing (DfAM) Software Tools vs. Requirements, Choosing Materials for Manufacturing Multiple Materials, and Applications of additive manufacturing.

Text Books:

1 S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, "Elements of Workshop Technology" Vol I , II, Media Promoters, ISBN-10: 8185099154
2 S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, "Elements of Workshop Technology" Vol I , Media Promoters, ISBN-10: 8185099154
3 Khanna O.P., "Welding Technology", Dhanpat Rai& sons, 1996.
4 Khanna O.P., " Foundry Technology", Dhanpat Rai& sons, 1999. Welding process and Technology", 2ed. Khanna Publishers, 1997.
5 Rao P. N., "Manufacturing Technology & Foundry, Forming & Welding", Vol I, II, Tata McGraw Hill Publishing Co. 2004, ISBN: 0 07 451863 1.
6 Jain R.K., "Production Technology", Khanna Publishers, 2008, ISBN 81-7409-099-1.
7 Sharma P.C., "A Text Book of Production Technology- Manufacturing Processes", S. Chand & Co., 2008, ISBN: 81-219-111-4-1.
8 Raghuwanshi B. S., "A course in Workshop Technology", Vol. I, II, Dhanpat Rai & Co. ISBN: 81-7409-099-1

Reference Books:

1. Chapman W.A. J., "Workshop Technology" Vol. I, II & III, Edward Arnold Publishers,1998, ISBN: 0 7131 3287
2. HMT, "Production Technology", Tata McGraw Hill Publishing Co., 1980. ISBN: 0-07- 096443-2
3. Degarmo, Black and Kosherth, "Materials & Processes in manufacturing", 8th Edition, Prentice Hall of India Ltd, Delhi, 2002. ISBN: 8126525223.
4. Andreas Gebhardt, Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing, Hanser Publishers, 2011.

Materials Science and Metallurgy
211084

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 3 hours / week	Theory: 3	In-Sem: 30 Marks End-Sem: 70 Marks

Prerequisites: Physics, Chemistry

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

- Draw and explain equilibrium diagrams for various alloy systems
- Define the mechanical properties of materials and conduct destructive and nondestructive tests to evaluate the properties of materials
- Explain various aspects of applications of powder metallurgy
- Impart knowledge of various heat treatment processes of metals.
- Acquaint about types, characteristics and applications of different ferrous, non-ferrous metals and their alloys.

Unit I: Fundamentals of materials science (6)
Mechanism of plastic deformation, Hume Rothery's rules of solid solubility, Gibb's phase rule, Solidification, Dendritic growth, Cooling curves, Lever rule, Iron-Iron carbide equilibrium diagram, Critical temperatures, Allotropy, volume changes of pure iron, Non-equilibrium cooling of steel, Widmanstatten structures.

Unit II: Material Testing (6)
Destructive Tests: 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, Impact tests.
Non-destructive tests: Visual Inspection, Magna flux test Dye penetrant test, Sonic and Ultrasonic test, Radiography, Eddy current test

Unit III: Powder Metallurgy (6)
Process in brief, powder characteristics, powder manufacturing, Applications of powder metallurgy in self-lubricated bearing, cemented carbide tools, cermets, refractory metals, electrical contact materials, friction materials, Diamond impregnated tools etc.

Unit IV: Steels and Heat treatments Processes (6)
Steel: Sample preparation, metallurgical microscope,Classification and applications of steels, specifications of some commonly used steels like BIS, EN, AISI, SAE, TTT diagram of Eutectoid steel.
Heat treatment processes: Annealing, Normalising, Hardening, Tempering, Martempering, Austempering, Ausforming, Patenting, Isoforming
Surface Hardening processes: Carburizing, heat treatment after carburizing,Nitriding, Carbonitriding, Flame hardening and Induction hardening

Unit V: Alloy Steels and Cast Irons (6)
Alloy Steels: Effects of alloying elements, classification of alloying elements. Stainless Steels, Sensitization of stainless steel, weld decay of stainless steel. Tool steels and tool materials, Heat treatment of high-speed steel. Special purpose steels with applications.

Cast irons: Classification, Gray cast iron, White cast iron, Malleable cast iron Ductile Iron, Chilled and alloy cast irons. Effects of various parameters on structures and properties of cast irons

Unit VI: Non-Ferrous Alloys (6)

Copper alloys: Brasses, Bronzes, Tin alloys, Aluminium alloys Beryllium, Silicon Copper nickel alloys, Nickel - Silver, Solders, Bearing materials and their applications, Precipitation hardening alloys

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

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. Murthy, "Structure and properties engineering materials", Tata McGraw Hill 2003.ISBN: 007048287X
4. Donald R. Askland, Phule P. P., "Science and engineering of materials", Thomson Learning, 2003.ISBN: 0534553966

Heat and Fluid Engineering Lab
211085

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

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 vapour 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

Strength of Materials Lab
211086

Teaching Scheme	**Credit Scheme**	**Examination Scheme**
Practical: 2 hours / week	Practical: 1	Oral: 25 marks

List of Practical

1) Stress and Deflection Analysis of Cantilever beam.
2) Stress and Deflection analysis of Simply Supported beam using ANSYS.
3) To draw Shear stress and Bending moment diagram for a Beam using ANSYS.
4) Stress and Deflection Analysis of Column using ANSYS
5) Computer program for truss subjected to plane forces.
6) Computer program for beams subjected to transverse forces and moments

Manufacturing Processes - I Lab
211087

Teaching Scheme	**Credit Scheme**	**Examination Scheme**
Practical: 2 hours / week	Practical: 1	Practical: 50 marks

Students have to perform mini-projects in workshop related to following topics

Job 1. Making simple solid pattern involving wood turning operation and preparing mould. (one job)

Job 2. Demonstration on MMA, TIG, MIG, Resistance welding (spot welding) and fabricate a job involve various welding processes like manual metal arc welding (MMA),TIG, MIG.(one job)

Job 3. Job involving various operations on lathe (step, taper turning, drilling, chamfering knurling etc.) and at list one operation on drilling machine, milling machine and cylindrical grinding. (one job)

Job 4: Prepare prototype using 3D Printing/additive manufacturing

Material Science and Metallurgy Lab

211088

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 2 hours / week	Practical: 1	Oral: 25 marks

Students should prepare practical report on any 8 of the following experiments. Oral will be based on the practical report.

1. Tensile test on mild steel and aluminum test pieces.
2. Izod and Charpy impact tests.
3. Non-destructive testings (Any Two) - magnaflux testing, dye penetrant test, ultrasonic testing, eddy-current testing
4. Hardness test on different metals (Poldi, Brinell and Vicker)
5. Rockwell on different metals with different Scales.
6. Study and drawing of microstructures of various Ferrous metals
7. Study and drawing of microstructures of non ferrous metals
8. Erichsen cupping test
9. Hardening and Tempering of steels
10. Jominy End quench or Hardenability Test

Machine Drawing and Computer Graphics Lab

211089

Teaching Scheme	**Credit Scheme**	**Examination Scheme**
Practical: 4 hours / week	Practical: 2	Term Work: 50 marks

Prerequisites:

1. Fundamentals of Engineering Graphics
2. Basics of 2-D drafting using graphics software

Course Outcomes:

1. To develop the ability to apply Limits, Fits, and Dimensional Tolerances, as well as Geometric Tolerances to components and assemblies on Engineering Drawings.
2. To develop an ability to Create Solid Models of machine components.
3. To develop an ability to create 2D drawings from 3D models

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

Geometric Dimensioning and Tolerancing

Limits, Fits & Dimensional Tolerances:- Terminology, Necessity of Limit system, Unilateral and Bilateral Tolerances, Relation between Tolerances and Manufacturing Processes, Methods of indicating tolerances on drawings, IT grades, Systems of fits, Types fits, Selection of fits, Selection of tolerances based on fits.

Geometrical Tolerances:- Need of Geometrical Tolerances, Terminology, Tolerances for Single Features such as Straightness, Flatness, Circularity, Cylindricity. Tolerances for Related Features such as Parallelism, Perpendicularity, Angularity, Concentricity, Tolerance Symbol and Value, Indicating Geometrical Tolerances on drawings, Introduction to ASME Y14.5 – 2009.

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

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.

Unit-V

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- VI

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.

Fundamentals of Parametric solid modeling

Production Drawing Production drawing – generation of 2-D sketches from parts and its appropriate dimensioning and tolerancing.

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- 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.
3. Mathematical representation of any two primitives.
4. 2D transformation of a simple two dimensional components.
5. Development of simple 3D model and Generation of production drawings of the parts and assembly with appropriate tolerancing.
6. Any two programs on parametric programming involving: Programming for standard machine components, Programming involving decision making and looping.

Audit Course 3: Road Safety

211090

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 and Electronics Engineering
203050

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 3 hours / week	Theory: 3	In-Sem: 30 Marks End-Sem: 70 Marks

Prerequisites: Basic Electrical Engineering, Basic Electronics Engineering

Course Outcomes:

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

- Describe and classify the types of single phase transformer, motors and generators
- Demonstrate understanding of fundamental feedback control system.
- Demonstrate the applications of power semiconductor devices
- Describe applications of operational amplifiers and other linear devices
- Write PLC program using ladder logic
- Select appropriate drive system for a given application

Unit I:

Electrical machines: **(7)**

Transformers (Single phase and three phase), Induction Motors (single phase), Synchronous Generator, D. C. machines, Special purpose motors: Construction, working principle, characteristic and applications of stepper motors, A.C. and D.C servomotors.

Unit II:

Automatic control system **(7)**

Components of Automatic control systems- Open loop and closed loop systems, Transfer function: Modeling of physical system (Mechanical and Electrical), Time domain analysis: Classification of continuous time systems: Linear- Nonlinear, Time variant- Time invariant, Static – Dynamic, Introduction to P, PI and PID modes of feedback control.

Unit III:

Semiconductor power devices: **(7)**

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 IV:

Linear integrated circuits **(7)**

Operational amplifiers characteristics: Linear and nonlinear applications, IC voltage regulators, Special function ICs: 555 Timer Functional block diagram and description, Mono-stable and Astable operation, Applications, 566 Voltage Controlled Oscillator, DAC and ADC converters

Unit V:

Programmable logic controllers **(7)**

Introduction, definition, Principles of Operation, Various Parts of a PLC, PLC input and output modules; Solid state memory, the processor, I/O modules, power supplies. PLC advantage and disadvantage; PLC Application.

Programming equipment; proper construction of PLC ladder diagrams.

Unit VI:

Introduction to Microcontrollers (7)

Introduction to microcontroller and microprocessors, role of embedded systems, open source embedded platforms, ATmega 328P- features, architecture, port structure, sensors and actuators, data acquisition systems, introduction to Arduino IDE- features, IDE overview, programming concepts: variables, functions, conditional statements. Concept of GPIO in ATmega 328P based Arduino board.

Text Books

1. Theodore Wildi, "Electrical Machine Drives and Power Systems", Pearson Education Asia, 2004, ISBN 81 7808 972 6.
2. Dr. Bhimbra P. S., "Power Electronics", Khanna Publication. ISBN: 817409279X.
3. Theraja B. L., "Electrical Technology", S. Chand Publication Co. Ltd. ISBN: 8121924405
4. Bell David A. "Operational amplifiers and Linear ICs", Oxford University Press, New Delhi, ISBN: 9780195696134
5. Bhattacharya S. K., "Electrical Machines", TATA McGraw Hill LTD, New Delhi, 2003, ISBN 0-07-463310 4.
6. Hughes E. and Smith I., "Electrical and Electronics Technology", Pearson Education Asia, New Delhi, 2008, ISBN 81 317 1468.
7. W. Bolton, Programmable Logic Controllers,5th Edition, Newnes, ISBN: 0750659866

Theory of Machines
211091

Teaching Scheme	Credit Scheme	Examination Scheme
Theory: 3 hours/week	Theory: 3	In-Sem: 30 marks End-Sem: 70 marks

Prerequisites: Engineering Mechanics, Basic Mechanical Engineering

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

- Understand the basic knowledge of mechanism, their inversions and applications.
- Understand the static and dynamic force analysis of mechanisms.
- Understand velocity and acceleration analysis of mechanisms.
- Understand the selection and use of belt drives in mechanical systems.
- Understand the application of brakes, dynamometer in machine tools.

Unit I **(6)**
Basics: Kinematic Link, Types of links, Difference between machines, mechanism and structure, Kinematics pair, Types of Constrained Motion, Classification of Kinematics Pairs, Inversions of kinematic chain, Degrees of freedom of mechanisms, Kutzbach and Grubler Criterion, Grasoff's law, Equivalent linkage concept,.
Mechanisms: Straight line mechanisms- Exact straight line and approximate straight line type, Intermittent Motion Mechanism, Steering gear mechanisms- Davis and Ackerman type.

Unit II **(6)**
Static and Dynamic Force Analysis
Theory and analysis of Compound Pendulum, Concept of equivalent length of simple pendulum, Bifilar suspension, Trifilar suspension.
Dynamics of reciprocating engines: Two mass statically and dynamically equivalent system, correction couple, static and dynamic force analysis of reciprocating engine mechanism (analytical method only), Crank shaft torque.

Unit III **(6)**
Kinematic Analysis of mechanisms (Velocity Analysis)
Concept of position, displacement and velocity of a point and link of a given mechanism, Kinematic analysis of mechanism by- Relative velocity method, Instantaneous center of rotation method, Klein's construction (Numerical treatment expected)

Unit IV **(6)**
Kinematic Analysis of Mechanisms: (Acceleration Analysis)
Concept of acceleration of a point and link of a given mechanism, Kinematic analysis of mechanisms by – Relative acceleration method, Graphical method, Analytical method, Coriolis component of acceleration, Klein's construction (Numerical treatment expected)

Unit V **(6)**
Friction: Types of friction, laws of friction, Application
Belt Drives:Types of belt drives, Materials for Belt. Velocity Ratio, Slip, Creep of belt. Length of open and cross belt drive. Tension ratio, maximum tension in a belt, Centrifugal tension, Initial tension in belt, Maximum power transmitted, Power transmission and Ratio of driving tension for V- Belt drive (Numerical treatment expected)

Unit VI **(6)**
Brakes: Types of brakes, Force analysis of brakes, block brakes, band brakes, band and block brakes, Internal expanding shoe brakes, braking torque. (Numerical treatment expected)
Dynamometer: Different types of absorption and transmission dynamometers.

Text Books

1. Ballaney P. L., "Theory of Machines and Mechanisms", Khanna Publisher Delhi, 1999. ISBN: 817409122X.
2. Rattan S.S., "Theory of Machines", 2nd edition, Tata McGraw-hill publishing, 2005, ISBN 007-059120-2.
3. Ashok G. Ambekar," Mechanism and Machine theory", 5th edition, PHI Learning Pvt. Ltd. Delhi, 2013, ISBN -978-81-203-3134-1.
4. Dr. R. K. Bansal and Dr. J.S. Brar, "A Textbook of Theory of Machines ",4th edition, Laxmi Publications (P) Ltd. 2008, ISBN 81-7008-418-0.

Reference Books

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

Design of Machine Elements
211092

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 3 hours / week	Theory: 3	In-Sem: 30 Marks End-Sem: 70 Marks

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

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

- Understand the basic principles and process of machine design
- Design the cotter joints and knuckle joints
- 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 **(7)**
Design Process: Machine Design, Traditional design methods, Basic procedure of Machine Design, 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: **(7)**
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 f or 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: **(7)**
Power Screws: Types of screw threads, multiple threaded screws, Torque analysis with square and trapezoidal threads, Self-locking screw, Collar friction torque, Stresses in power screws, design of screw and nut, design of Screw jack. Design of a C Clamp, Re-circulating Ball Screw

Unit IV: **(7)**
Mechanical Springs: Types, Applications and materials of springs, Stress and deflection equations for helical springs, Types of ends, Design of helical compression and tension springs, Springs in series and parallel, Helical torsion spring, surge in spring, Multi-leaf springs

Unit V: **(7)**
Spur Gears: Various design consideration, Beam Strength, tangential loading module calculations, width calculations, type of gear tooth failures, Estimation of dynamic load by velocity factors and Spott"s equation.

Unit VI: **(7)**
Rolling Contact Bearings: Type, static and dynamic loading capacity, Stribeck's equation, concept of equivalent load, load life relationship, selection of bearing from manufacturer's catalogue, design for variable load and speeds, bearing probability of survival other than 90%, lubrication and mounting of bearing.

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", 8 ed., 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, 4."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.
5. Hall Allens, Holowenko Alfred R., Laughlin Herman G., "Theory & Problems of Machine Design", McGraw-hill Book Company, 2000, ISBN 48333-7.

Advanced Materials
211093

Teaching Scheme	**Credit Scheme**	**Examination Scheme**
Lectures: 3 hours/week	Theory: 3	In-Sem: 30 marks End-Sem: 70 marks

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Prerequisites: Engineering Physics, Engineering Chemistry, Systems in Mechanical Engineering.

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

- Understand fundamentals of engineering materials.
- Know modern materials, their properties and applications.
- Understand non-metallic materials and their engineering applications.
- Know the composite materials, their fabrication and applications.
- Understand FGM, their behavior and performance.
- Know standards and codes used for advanced materials.

Unit I: **(7)**
Review of engineering materials- metals, alloys- ferrous and non-ferrous, plastics and polymers, ceramics and composites. Dual phase steels, micro alloyed steels, High strength low alloy steels, transformation inducted plasticity (TRIP) steels, Maraging steels. Heat treatment of ferrous and non- ferrous alloys for modification of structure and properties.

Unit II: **(7)**
Modern materials- Compositions, properties and applications of: Inter-metallic's, Ni and Ti aluminides, smart materials, shape memory alloys, Metallic glass- quassi crystals, Dielectrics, semiconductors, conductors & super conducting materials. Magnetic and photoelectric materials, optical materials, Bio materials, micro electronic materials and Nano materials.

Unit III: **(7)**
Non Metallic Materials- Polymer materials, formation of polymer structures, production techniques of fibers, foams, adhesives and coatings. Structure, properties and applications of engineering polymers. Advanced structural ceramics, WC, TiC, TaC, Al_2O_3, SiC, Si_3N_4, CBN and diamond- properties, processing and applications.

Unit IV: **(7)**
FGM & Composites: Functionally Graded materials: Introduction, Classification, Characteristics, behavior and Applications, Fabrication of FGM. Types of composites,
Types of fibers & matrix, Calulation of load sustained by fibres &matrix each under isostress condition & isostrain conditions, Numericals based on this calculation. Applications of MMCs.

Unit V: **(7)**
Special manufacturing processes of composites: Processing of polymer matrix composites: open mould process, bag molding, compression molding with BMC and SM- filament winding, pultrussion-centrifugal casting, injection molding, applications of PMC's. Processing of metal matrix polymers: solid state fabrication techniques- diffusion bonding, plasma spray, chemical and physical vapor deposition of matrix on fibers, Liquid state fabrication methods, Infiltration, squeeze casting, Rheo casting, compo casting.

Unit VI: **(7)**
Standards and codes for advanced materials: Introduction, standards, design codes and databases, National standards, ASTM standards, JISC standards, International standards, CEN Standards, ISO standards.

Reference Books:

1. "HMT Handbook" – Production Technology (TMH) 2) "Non- traditional machining processes", Willer, SME publications.
2. G.F. Benidict, "Advanced Manufacturing Processes", Marcel Dekker Publisher
3. E. Paul DeGarmo, J. T. Black & Ronald A. Kohser, "Materials & Processes in Manufacturing", (PHI)
5. Geoff Eckold, "Design & Manufacturing of Composite Structures", Jaico Publishing House
6. S. Kalpaljian & Steven R. Schmidt, "Manufacturing Processe for Engineering Materials", Pearson Education
7. Krishnan K. Chawla, "Composite Material Science and Engineering", Springer- Verlog, 1987
8. Agarwal D & Brontman L.J., "Analysis & Performance of fibre composites", John Willey Publications, 1990
9. Mallik P.K. & Newman S., "Composite Materials Technology", Henser Publications, 1990
10. Charles J A, Crane F.A.A. & Furness J A G ,"Selection and use of Engineering Materials", 3rd edition, Butterworth – Heiremann – 1977
11. P.K. Mishra (IIT, Kharagpur), "Materials and their applications", (4th edition)- Jaico- 1999
12. James K Wessel (Ed.), "The Handbook of advanced materials: Enabling new designs", Wiley Interscience publication, 2004.
13. Vijendra Singh, " Physical Metallurgy", Standard Publishers Distributors, New Delhi

Industrial Engineering and Management
211094

Teaching Scheme:	**Credit Scheme**	**Examination Scheme:**
Lectures: 3Hrs/Week	Theory: 3	In sem. Exam: 30 marks End Sem. Exam: 70 Marks

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Prerequisites:
Knowledge of machines used in manufacturing organizations.

Course Outcomes:

- Summarize the contribution of peoples to management.
- Differentiate between two employees on the basis of productivity.
- Prepare time schedule to complete the task.

Unit I **(7)**
Evolution of Management Practices:
Characteristics, objectives Functions, Principles and Types of Management., Scientific Management-Contribution of F. W. Taylor, Henry Fayol Gantt, Maynard and Indian contributors to the Management thought.
Organization: Definition, Principles, Function and Types of organization structure, Different forms of Business—Proprietor, Partnership Firm, Private & Public limited company, Cooperative, Private & Public Trusts.

Unit II **(7)**
Motivation:
Human Needs and Types of Motivation, Theories of Motivations-Maslow's theory, McGregor's Theory of X and Theory of Y, Herzberg's Theory of two factor, David C. McCelland's Theory of Achievement, Expectance/valence Theory of Victor Vroom, Porter & Lawler's Model. Group dynamics: Types, characteristics, objectives of Group Dynamics Leadership: Definition, styles & functions of leadership, qualities for good leadership, role of the leader, Theories of leadership, Managerial grid, professional and business ethics.

Unit III **(7)**
Entrepreneurship development:
Characteristics of successful entrepreneurs, communications skill, problem solving skill and process, Basic element of Business plans, Sources of finance, Selection of Business location, Record keeping system, Analysis financial performance, Break even analysis, Technology and Business, Strategies for Business Growth, Concept related to start-up and Intellectual Property Rights (IPR).

Unit IV **(7)**
Industrial Engineering:
History, Development, Definition, Functions & Applications of Industrial Engineering. Tools and techniques of Industrial Engineering, Introduction to work study and work content.
Productivity Engineering, Types of Productivity: factor productivity, total productivity; labour productivity, measurement of Productivity, Productivity improvement techniques. Productivity improvement programme.
Wages and incentives: Concept of wages, factors affecting wages, Job evaluation, Merit rating.

Unit V **(7)**
Method Study
Steps, Tools and Techniques used in the Method Study, outline Process Chart, Flow process Chart, Symbols, Flow Diagrams, Two Handed Chart, String diagram, Multiple Activity Chart, 5W and 1 H, Use of Motion Pictures and its analysis SIMO chart, Cyclegraph Chronocylegraph. Developing, Presentation, Installation & Maintenance of new Methods. Principles of motion economy.

Unit VI **(7)**

Work Measurement

Time Study: Aim & Objectives, Terminology & Tools, Use of stopwatch procedure in making Time Study. Time Study Forms, Performance rating, allowances and its types. Calculation of Standard Time.
Work Sampling: Introduction to work sampling. Determination of Standard time using Work Sampling.
Synthetic & Standard data Methods: Concepts, Introduction to PMTS, MTM1, WFS, and Basic Motion Time Study. MTM2 & Other second Generation Methods, MOST and other advanced work measurement techniques.

Text Books:

1. M. Telsang, "Industrial Engineering and Production Management", S. Chand Publication, ISBN 81 219 1773 5.
2. O. P. Khanna, "Work Study", Dhanpat Rai Publications, New Delhi.
3. Banga & Sharma, "Industrial Organisation & Engg. Economics", Khanna Publishers, 2001, ISBN 81-7409-078-9
4. Chabra T. N., "Principles & Practices of Management", Dhanpat lal & company
5. Mahajan M., "Industrial Engineering and Production Management" Dhanpat Rai and Sons Publishers, 2005, ISBN-81-7700-047-0

Reference Books:

1. H. B. Maynard and others, "Industrial Engineering Handbook", IVth edition McGraw Hill Publications, ISBN 0-07-041084-4.
2. "Introduction to Work Study", ILO Universal Pub. Co, B'bay,ISBN 81 85027 06
3. Ralph M. Barnes, "Motion and Time Study: Design and Measurement of Work" J. Wiley & Sons.
4. Koontz Harold and Weihrich Heinz, "Essentials of management", 7ed, Tata McGraw Hill publishing, 2008, ISBN 0-07-0623030-x.
5. Luthans f., "Organizational Behaviour", McGraw-Hill Company, 2008, ISBN 81-317-05021.
6. Cynthia L. Greene, "Entrepreneurship: Ideas in Action", Thomson, ISBN-981-243-257-1.

Electrical and Electronics Engineering Lab
203051

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 2 hours / week	Practical: 1	Practical: 25 marks

Term Work:

1. Study of a) D.C. motor starters, b) three phase induction motor starter.
2. Simulation of a typical second order system and determination of step response and evaluation of time domain specifications using MATLAB/SCILAB
3. To study the effect of P, PI, PD and PID controller on step response of a feedback control system
4. Study of V-I characteristics of SCR & TRAIC.
5. Design and setup a summing/inverting/noninverting amplifier circuit with OP AMP verify the output.
6. PLC program using ladder logic and its implementation to any one mechanical system
7. Speed control of a D. C. shunt motor by armature voltage and flux control methods.
8. Microprocessor/microcontroller programming

Theory of Machines Lab.
211095

Teaching Scheme	**Credit Scheme**	**Examination Scheme**
Practical: 2 hours/week	Practical: 1	Term-Work: 25 Marks Practical: 25 Marks

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Practical Report shall consist of the following:

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

Industrial Engineering and Management Lab.

211096

Teaching Scheme	**Credit Scheme**	**Examination Scheme**
Practical: 02 hours / week	Practical: 1	Oral: 25 Marks

Term work:
Term work shall consist of any assignments and/or case studies based on each unit of the syllabus: The topic should be from manufacturing or service sector.

1. Study of scientific management , International and National contributors to management thought
2. Leadership styles and Great leaders [student's opinion] and his characteristics
3. National and International successful entrepreneurs [student's opinion]. Success story of his/her business
4. Application of Productivity improvement techniques
5. Method study: Recording of the existing activity using charts and diagrams and propose new method
6. Calculation of standard time for given activity
7. Case study on Value analysis/ Value engineering

Soft Skills
211097

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

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 student's 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)

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)

Any one of the following activities may be conducted:

a. **Prepared speech** (topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver.
b. **Extempore speech (**students deliver speeches spontaneously for 5 minutes each on 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 by them)

3. Power-point Presentations (4)

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)

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)

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)

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)

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)

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)

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 (2)

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. Mark 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 University Press
12. Ham-Lyons & Heasley: Study 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

Programming in C Language Lab
211098

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 2 hours / week	Practical: 1	Oral: 25 marks

1. Syntax and structure of C-programming.
2. Data types, Operators and Expressions in C
3. Formatted and unformatted I/O in C with preprocessor directives
4. Programming knowledge using Decision Statements (if, if-else, if else if ladder, switch and GOTO)
5. Loop & nested loop Statements (for, while, do-while)
6. Programming with Pointer, String and Function call by reference.
7. Programming with Structure.
8. Creating data files and file handling in C.
9. Minimum 2 case studies of C-Programming related to Production Engineering

Project Based Learning
211099

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 4 hours / week	Practical: 2	Term Work: 50 marks

Preamble:
For better learning experience, along with traditional classroom teaching and laboratory learning; project based learning has been introduced with an objective to motivate students to learn by working in group cooperatively to solve a problem.
Project-based learning (PBL) is a student-centric pedagogy that involves a dynamic classroom approach in which it is believed that students acquire a deeper knowledge through active exploration of real-world challenges and problems. Students learn about a subject by working for an extended period of time to investigate and respond to a complex question, challenge, or problem. It is a style of active learning and inquiry-based learning.
Problem based learning will also redefine the role of teacher as mentor in learning process. Along with communicating knowledge to students, often in a lecture setting, the teacher will also to act as an initiator and facilitator in the collaborative process of knowledge transfer and development.

Course Outcomes:
1. Project based learning will increase their capacity and learning through shared cognition.
2. Students able to draw on lessons from several disciplines and apply them in practical way.
3. Learning by doing approach in PBL will promote long-term retention of material and replicable skill, as well as improve teachers' and students' attitudes towards learning.

Group Structure:
Working in supervisor/mentor – monitored groups. The students plan, manage and complete a task/project/activity which addresses the stated problem.
- There should be team/group of 5 -6 students
- A supervisor/mentor teacher assigned to individual groups

Selection of Project/ Problem:
The problem-based project oriented model for learning is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. Students design and analyze the problem within an articulated interdisciplinary or subject frame.
A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific and grows out of students' wondering within different disciplines and professional environments. A chosen problem has to be exemplary. The problem may involve an interdisciplinary approach in both the analysis and solving phases. By exemplarity, a problem needs to refer back to a particular practical, scientific, social and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry. There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content and structure of the activity.
- A few hands-on activities that may or may not be multidisciplinary
- Use of technology in meaningful ways to help them investigate, collaborate, analyze, synthesize and present their learning.
- Activities may include- Solving real life problem, investigation /study and Writing reports of in depth study, field work.

Assessment:
The institution/head/mentor is committed to assessing and evaluating both student performance and program effectiveness. Progress of PBL is monitored regularly on weekly basis. Weekly review of the work is necessary.

During process of monitoring and continuous assessment AND evaluation the individual and team performance is to be measured. PBL is monitored and continuous assessment is done by supervisor /mentor and authorities. Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes. Group may demonstrate their knowledge and skills by developing a public product and/or report and/or presentation.

- Individual assessment for each student (Understanding individual capacity, role and involvement in the project)
- Group assessment (roles defined, distribution of work, intra-team communication and togetherness)
- Documentation and presentation

Evaluation and Continuous Assessment:

It is recommended that the all activities are to be record and regularly, regular assessment of work to be done and proper documents are to be maintained at college end by both students as well as mentor (you may call it PBL work book).

Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department and institutes.

Recommended parameters for assessment, evaluation and weightage:

- Idea Inception (5%)
- Outcomes of PBL/ Prob'lem Solving Skills/ Solution provided/ Final product (50%) (Individual assessment and team assessment)
- Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents) (25%)
- Demonstration (Presentation, User Interface, Usability etc) (10%)
- Contest Participation/ publication (5%)
- Awareness /Consideration of -Environment/ Social /Ethics/ Safety measures/Legal aspects (5%)

PBL workbook will serve the purpose and facilitate the job of students, mentorand project coordinator. This workbook will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken.

References:

- Project-Based Learning, Edutopia, March 14, 2016.
- What is PBL? Buck Institute for Education.
- www.schoology.com
- www.howstuffworks.com

Audit Course 4

211100

Students should complete one of the NPTEL courses listed below:

NPTEL Courses:

1. Developing soft skills and personality, T. Ravichandran, IIT Kanpur
   https://swayam.gov.in/nd1_noc20_hs43/preview
2. Innovation by Design, By Prof. B.K. Chakravarthy, IIT Bombay
   https://swayam.gov.in/nd1_noc20_de08/preview
3. Design Thinking - A Primer, By Prof. Ashwin Mahalingam, Prof. Bala Ramadurai, IIT Madras
   https://swayam.gov.in/nd1_noc20_mg38/preview
4. Technical English for Engineers, By Prof. Isha Iqbal, IIT Madras
   https://swayam.gov.in/nd1_noc20_hs56/preview
5. Ethics in Engineering Practice, Susmita Mukhopadhyay, IIT Kharagpur
   https://swayam.gov.in/explorer?searchText=Ethics%20in%20Engineering%20Practice

Industrial visit/expert lectures should be organized for the audit courses undertaken by students. The group of students should be allocated to faculty members to keep the track of students' progress. The performance of the students may be evaluated using any appropriate method.