# Syllabus

# Savitribai Phule Pune University

# Faculty of Engineering

## *Common for*

# Second Year Production Engineering

## and

# Second Year Industrial Engineering

# (Course 2015)

## (with effect from June 2016 )

# Savitribai Phule Pune University, Pune
# Syllabus Common for Second Year Production Engineering and Industrial Engineering (2015 Course)
**(With effect from Academic Year 2016-17)**

## Semester- I

| Course Code | Course | Teaching Scheme (Hrs/week) | | | Examination Scheme | | | | | | Credit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 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 | |
| 211103 | Welding and Foundry | 4 | | | 50 | 50 | | | | 100 | 4 | |
| 211104 | Material Science | 3 | | | 50 | 50 | | | | 100 | 3 | |
| 211105 | Heat and Fluid Engineering Lab | | 2 | | | | 25 | | | 25 | | 1 |
| 211106 | Welding and Foundry 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

| Course Code | Course | Teaching Scheme | | | Examination Scheme | | | | | | Credit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 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 | |
| 211111 | Machine Tool Operations | 4 | | | 50 | 50 | | | | 100 | 4 | |
| 211112 | Design of Machine Elements | 4 | | | 50 | 50 | | | | 100 | 4 | |
| 211113 | Engineering Metallurgy | 4 | | | 50 | 50 | | | | 100 | 4 | |
| 203051 | Electrical Technology Lab | | 2 | | | | 50 | | | 50 | | 1 |
| 211114 | Theory of Machines Lab | | 2 | | | | 25 | 50 | | 75 | | 1 |
| 211115 | Engineering Metallurgy Lab | | 2 | | | | | 50 | | 50 | | 1 |
| 211116 | Production Practice I | | 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 |

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**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.
5) 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 Vidyarthi

Griha Prakashan, 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

**Course objectives:**

- 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.

**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** **(8)**

**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** **(8)**

**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** **(8)**

**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** **(8)**

**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** **(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** **(8)**

**Reciprocating compressor:** 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.,DhanpatRai & 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

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**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**:
Basic 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** **(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

# Welding and Foundry

**211103**

**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

**Course objectives:**

- To study on different types of welding processes practiced in industry
- To understand the weld joint design, physics of welding and Symbols
- To provide basic understanding of foundry practices and processes

**Course Outcomes:**

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

- Classify and describe welding processes.
- Predict safety measures, inspection and testing of welding of welding.
- Describe and classify metal casting process and casting defects.
- Justify the pattern material, allowances, and effect of mould ingredients on mould strength.
- Design the gating system and risers.

**Unit I** **(8)**

Introduction & classification of welding processes, Basic electrical – Electrodes – coding of electrodes – Electrode efficiency, Welding symbol. Physics of welding – arc structure, characteristics and power – chemical heat source- contact resistance heat source- heat flow characteristics- cooling of weld.

Arc welding processes- carbon arc, submerged arc, Tungsten inert gas (TIG), Metal Inert gas (MIG), Plasma arc, stud welding- Theory, comparison on merits, limitations and applications. Fluxes used in arc welding.

**Unit II** **(8)**

GAS welding: - processes and equipment used, type of flames, adjustment of flames, oxyacetylene welding, gas cutting –merits, limitations and applications.

Electric resistance welding- processes and equipment used, spot, seam, projection, butt, percussion welding, resistance tube welding, - merits, limitations and applications.

**Unit III** **(8)**

Pressure welding, diffusion welding, ultrasonic, friction, explosive, forge, thermit welding, laser, electron beam welding- equipment used- merits, limitations and applications of above processes.

Brazing, braze welding and soldering processes.

Inspection and testing of welding: - visual inspection, destructive & non-destructive testing. Estimation of welding cost. Protection and safety in welding.

**Unit IV** **(8)**

Sand casting processes , Principles of casting, steps involved in casting, Introduction of sand casting. Patterns, Pattern materials, pattern allowances and design. Core prints and core seats. Mould strength, Ingredients of moulding materials and their effect on mould strength-testing of mould strength, testing of moulding sand.

Melting and pouring of metals:- melting furnace- types, Cupola, electric arc furnace, Induction furnace- Construction, operations and zones, cleaning, finishing of casting.

**Unit V** **(8)**

Special casting processes Pressure and gravity die casting (hot and cold chamber), shell moulding, centrifugal casting, continuous casting, investment casting, - their typical applications, merits and limitations.

Casting defects- defects, Inspection- analysis of casting defects- Quality control. Foundry mechanization and automation.

**Unit VI** **(8)**

Casting Design, Metal pouring, Gating system- design of gating system, solidification time, riser design, Principles of gating, risering and their design methods. Progressive and directional solidification, casting design consideration, Chvornov's rule, numerical on casting, defects in casting. Fluidity- method of measuring fluidity of metal by spiral technique.
Computer applications in casting design and software.

**Text Books**

1. Rao P.N., "Manufacturing Technology, Foundry, Forming and welding", 2ed., Tata McGraw-hill publishing, 2006, ISBN 0-07-463180-2.
2. Khanna O.P., "Welding Technology", Dhanpat Rai& sons, 1996.
3. Khanna O.P., "Foundry Technology", Dhanpat Rai& sons, 1999.
4. Parmar R.S., "Welding Process and Technology", 2ed.,Khanna Publishers, 1997.

**Reference Books**

1. KalpakjianSerope and Schmid Steven, "Manufacturing Engineering & Technology", 2004.
2. Degarmo E.P. and Black J.T., "Materials &Processes in Manufacturing", 9ed., Prentice hall of India Pvt.Ltd., 2002.
3. Little Richard., "Welding & Welding Technology",Tata Mc-graw hill Publishing, 1992, ISBN 0-07-099409-9.

# 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**
Practical: 2 hours / week

**Examination Scheme**
Term Work: 25 marks
Credit: 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

# Welding and Foundry Lab

**211106**

**Teaching Scheme**
Practical: 2 hours / week

**Examination Scheme**
Oral: 50 marks
Credit: 1

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

1. To find out grain fineness number by using sand sieve shaker test.
2. Permeability testing of green sand.
3. Green compression test for molding sand.
4. Fluidity testing of any metal using fluidity spiral.
5. Study of TIG/MIG welding process parameters for ferrous and nonferrous metals.
6. Tensile test on a welded specimen.
7. Impact test on a welded specimen.
8. Non-destructive test on a weldment- dye penetrant test.
9. Non-destructive test on a weldment- magnaflux test.
10. Industrial visit to any foundry.

**Workshop Jobs**

1. Making simple solid pattern involving wood turning operation and preparing mould and aluminium casting.(one job)
2. Gas welding / Arc welding (one job)

# Material Science Lab

**211107**

**Teaching Scheme**
Practical: 2 hours / week

**Examination Scheme**
Oral: 50 marks
Credits: 1

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**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**
Practical: 4 hours / week

**Examination Scheme**
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 and Mechanical 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
- Draw2D/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 nd Edition, 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, constructionand Working. 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 transforme**r: Types, KVA rating, approximate equivalent circuit, voltage regulation 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 phase induction 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 and shaded 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 drives depending 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, Dhanpat Rai& 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**
Lectures: 4 hours / week

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

**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.

**UnitVI** **(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.**,**Tata McGraw-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

# Machine Tool Operations

**211111**

**Teaching Scheme**
Lectures: 4 hours / week

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

**Prerequisites:** Basic mechanical Engineering

**Course Objectives:**

- To provide an overview of tools, of conventional machine tools such as lathe, drilling, milling, grinding, shaper, planner, slotter, broaching etc.
- To understand the different operations performed on conventional machine tools
- To calculate the machining time on different conventional machine tools

**Course Outcomes:**

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

- Understand specifications, constructional features, and principle of working of various manufacturing processes
- Identify and select appropriate cutting tools for various machining operations
- Select/Suggest what process is best used for producing some product
- Design simple process plans for parts and products

**Unit I** **(8)**

**Lathes**

Classification, Specification, lathe parts, bed, headstock, tailstock, lathe accessories and attachments, lathe operations, taper turning methods, thread mechanism, back geared, tumbler geared, all geared headstock, Capstan & turret lathe, comparison, Machining time calculations, Introduction to CNC lathe.

**Unit II** **(8)**

**Drilling, Boring and Reaming**

Classification, specification, sensitive, radial, gang, multi-spindle, spindle and drill head assembly, types of drills, twist drill nomenclature, reamer, types of reamer, taps, cutting parameters, tool holding devices. Classification of boring machines, specifications, types boring tools, various operations performed, Machining time calculations, Introduction to jig boring.

**Unit III** **(8)**

**Milling Machines**

Classification, specification, Column and knee type milling machine, milling operations, standard milling cutters, geometry of milling cutter, attachments, universal dividing head, methods of indexing, gear train calculations, machining time calculations, Introduction to CNC milling.

**Unit IV** **(8)**

**Shaper, Planer, Slotter and Broaching Machines**

Standard parts of shaper, planner, slotter and broaching machine, specification, Crank and slotted

link mechanism, hydraulic shaper mechanisms, auto feed mechanism, open and cross belt drive mechanism for planner, operations, Types of broaching machine, specification, broach geometry, machining time calculations.

**Unit V** **(8)**

**Grinding Machine**

Classification, Abrasives, bonds, grit, grade, structure of grinding wheels, wheel shape and sizes, standard marking system, dressing & truing, glazing, loading, mounting and balancing of grinding wheels, Selection of grinding wheels. Grinding operations, machining time calculations.

**Unit VI** **(8)**

**Surface finishing processes and coating**

Super finishing processes, honing, lapping, buffing, polishing, tumbling, electroplating, galvanizing, metal spraying, and burnishing. Hot dipping, Study of process parameters of above processes.

**Text Books**

1. S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, “Elements of Workshop Technology” Vol II, Media Promoters, ISBN-10: 8185099154
2. Rao P. N., “Manufacturing Technology & Foundry, Forming & Welding”, Vol I, II, Tata McGraw Hill Publishing Co., 2004, ISBN: 0 07 451863 1.
3. Jain R.K., “Production Technology”, Khanna Publishers, 2008, ISBN 81-7409-099-1.
4. Sharma P.C., “A Text Book of Production Technology- Manufacturing Processes”, S. Chand & Co., 2008, ISBN: 81-219-111-4-1.
5. Chapman W .A. J., “Workshop Technology” Vol. I, II & III, Edward Arnold Publishers, 1998, ISBN: 0 7131 3287 6.
6. HMT, “Production Technology”, Tata McGraw Hill Publishing Co., 1980. ISBN: 0-07-096443-2.
7. Degarmo, Black and Kosherth, “Materials & Processes in manufacturing”, 8th Edition, Prentice Hall of India Ltd, Delhi, 2002. ISBN: 8126525223.
8. Raghuwanshi B. S., “A course in Workshop Technology”, Vol. I, II, Dhanpat Rai& Co. ISBN: 81-7409-099-1

# Design of Machine Elements

**211112**

**Teaching Scheme**
Lectures: 4 hours / week

**Examination Scheme**
In-Sem (Online) :50 Marks
End-Sem (paper): 50 Marks
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 square and 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 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.

**Unit V** **(8)**

**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** **(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 paulH.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.

# Engineering Metallurgy

**211113**

**Teaching Scheme**
Lectures: 4 hours / week

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

**Prerequisites:** Material Science

**Course Objectives:**

- To acquaint students with the basic concepts of Metallography
- To impart knowledge of various heat treatment processes. Processing
- To acquaint student types, characteristics, processing and applications of different ferrous and non-ferrous Metal and Alloys
- To develop futuristic insight into Metals

**Course Outcomes:**

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

- Work with Iron-Iron carbide equilibrium diagram and apply this knowledge for classification of steels from microstructure observations
- Select proper Heat Treatment, Surface Hardening technique & Isothermal Treatments for the steels considering properties and service requirements
- Distinguish different Alloy Steels and Cast Irons based on chemical compositions and microstructures
- Familiarize with different types of non-ferrous alloys and Composites with their need, scope and applications

**Unit I:** **(8)**

**Steels:** Introduction to Metallographic, micro and macro examination, metallurgical microscope,etching. Steels: iron-iron carbide equilibrium diagram, Critical temperatures, Allotropy, cooling curve and volume changes of pure iron. Microstructure, non-equilibrium cooling of steel, widmanstatten structure, structure property relationship. Classification and applications of steels, specifications of some commonly used steels like BIS, EN, AISI, SAE.

**Unit II:** **(8)**

**Heat treatment of Steels:** Introduction to heat treatment furnaces and Furnace atmospheres,Transformation products of austenite, Time-temperature- transformation diagrams, Critical cooling rate, Continuous cooling transformation diagrams. Heat treatment of steels Quenching media, Annealing" Normalizing" Hardening" Retention of austenite" Effects of retained austenite" Elimination of retained austenite, Tempering" Secondary hardening, Temperature embrittlement, Quench cracks, Hardenability testing" Defects due to heat treatment and remedial measure.

**Unit III:** **(8)**

**Surface Hardening & Isothermal Treatments:** Carburising, heat treatment after

carburising,Nitriding, Carbonitriding, Flame hardening and Induction hardening. Commercial heat treatment practice of gears of different sizes, tools, springs. Isothermal heat treatments such as austempering, patenting, iso-forming, martempering, ausforrning.

**Unit IV:** **(8)**

**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, Heat treatments of cast iron. Applications of cast irons for different components of machine tool, automobiles, pumps etc.

**Unit V:** **(8)**

**Non-Ferrous Alloys:** Copper alloys - Brasses, Bronzes-: Tin, Aluminium, Beryllium, SiliconCopper nickel alloys, Nickel - Silver, Aluminium and aluminium alloys. Solders, Bearing materials and their applications, Precipitation hardening alloys. High Temperature materials such as Nimonics, Super alloys, Ti-alloys etc.

**Unit VI:** **(8)**

**Modern Engineering Materials:** Composites- Types, Characterization, Production techniques& applications. Metal -Matrix composites, Particulate &Fibre composites. Biomaterials, Nano materials, Sports materials.

**Text-books:**

1. Kodgire V. D., "Material science and metallurgy for Engineers", Everest Publishing House, Pune, ISBN 81 86314 00 8.
2. K. G. Bundinski, M. K. Bundinski , “Engineering Materials” Prentice Hall of India Pvt. Ltd., New- Delhi.
3. Higgins "Engineering Metallurgy", Part I Applied Physical Metallurgy, English Language book Society / Edward Arnold.
4. Smith W. F., “Principles of Material Science and Engineering", McGraw- Hill Inc. Book Company ISBN 0 07 122920 5.

**Reference Books:**

1. Rollason E. C., "Metallurgy for Engineering", ELBS Publishing.
2. Clark D.S.andVamey W. R. "Physical Metallurgy for Engineers", East-West PressPvt. Ltd., New Delhi.
3. Avner, *"An* introduction to physical metallurgy", TMH publication.
4. Donald R. Askeland&PradeepPhule. ,” The science and engineering of materials”,Thomson Asia Pvt.LTD, ISBN 981 243 855 6.

# Electrical Technology Lab

**203051**

**Teaching Scheme**
Practical: 2 hours / week

**Examination Scheme**
Term Work: 50 marks
Credit: 1

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**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

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**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.**

# Engineering Metallurgy Lab

**211115**

**Teaching Scheme**
Practical: 2 hours / week

**Examination Scheme**
Oral: 50 marks
Credit: 1

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

1. Study and drawing of microstructures of mild steel, medium carbon steel, eutectoid steel and hypereutectoid steel.
2. Study and drawing of microstructures of white, malleable, grey and nodular cast iron.
3. Study and drawing of microstructures of alpha brass, alpha-beta brass, aluminium bronze, tin bronze and bearing metal.
4. Study and drawing of microstructures of hardened steel, tempered steel.
5. Hardening of steel- study of effect of carbon on hardness of hardened steel.
6. Tempering of steels - study of effect of temperature on hardness of tempered steel.
7. Study of change in microstructure on annealing and normalizing of tempered steel.
8. Sulphur print test on a steel specimen & flow lines examination of a forged component.
9. Jominy hardenability test on a steel sample.
10. Testing of composite materials (Like Hardness, Impact, Tension etc.)

# Production Practice-I

**211116**

**Teaching Scheme**
Practical: 2 hours / week

**Examination Scheme**
Oral: 50 marks
Credit: 1

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**Course Objectives:**

- To Study and practice various operations that can be performed using lathe, drilling,and milling machines. and
- To impart practical knowledge required in the core manufacturing industries.

**Course Outcomes:**

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

- Operate various machines like lathe, milling etc.
- Perform plain turning, taper turning etc. on lathe machine
- Perform gear cutting operation on milling machine.
- Understand the all gear drive, back gear mechanism of lathe.
- Perform the forging operation for knife edge and Vee shape tool.

**Each candidate shall be required to complete and submit the following Term Work:**

**Part I: Assignments based on Machine Tools (any five)**

1. Major operations on a lathe.
2. Working principle of apron mechanism in a lathe.
3. Thread cutting operation on a lathe using half-nut and lead screw.
4. Indexing mechanism and universal dividing head in milling machine.
5. Operations on drilling machine and the different work and tool holding devices used.
6. Single and multi-point cutting tools used on the conventional machines.
7. Calculation of machining time for different operations on lathe, milling and drilling machines.
8. To prepare the process sheet for the job(s) manufactured in turning (machine) shop during the practical session.

**Part II: Jobs (any two)**

1. Plain & taper turning (one job)
2. Gear cutting (one job)
3. Forging and grinding of a tool with one end consisting of knife edge and other end of Vee shape (one job).

**Note: Oral examination will be based on the Term Work submitted by the candidate.**

**References**

1. S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, “Elements of Workshop Technology” Vol II, Media Promoters, ISBN-10: 8185099154.
2. Gerling H., All about machine tools, New Age International, ISBN-108122418260.
3. JutzzH., “Westermann Tables for the Metal Trade”, New Age International, ISBN-10: 8122417302.

# Soft Skills

**211117**

**Teaching Scheme**
Practical: 2 hours / week

**Examination Scheme**
Term Work: 25 marks
Credit: 1

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## 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 onlyin 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 ( 2 hours)**

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