

# Savitribai Phule Pune University



## Syllabus

FOR

**S.E. Mechanical and Automobile Engineering**

**2015 Course**

**UNDER FACULTY OF ENGINEERING**

**EFFECTIVE FROM June 2016**

**Structure of S.E. (Mechanical Engineering/ Automobile Engineering)  
2015 Course**

**Semester-I**

Subject Code	Subject	Teaching Scheme			Examination Scheme					Total Marks	Credits	
		Hours/Week			In-Sem (online)	End-Sem	TW	Pr.	Oral		Lect/Tut	Pr/Or
		L	Tut.	P.								
207002	Engineering Mathematics – III	04	01	-	50	50	25	-	-	125	05	-
202041	Manufacturing Process-I	03	-	02	50	50	50	-	-	150	03	01
202042	Computer Aided Machine Drawing	01	-	02	--	--		50	-	50	01	01
202043	Thermodynamics	04	-	02	50	50	-	-	50	150	04	01
202044	Material Science	03	01	-	50	50	25	-	-	125	03	01
202051	Strength of Materials	04	-	02	50	50	-	-	50	150	04	01
202055	Audit course											
					--	--						
	<b>Total</b>	<b>19</b>	<b>02</b>	<b>08</b>	<b>250</b>	<b>250</b>	<b>100</b>	<b>50</b>	<b>100</b>	<b>750</b>	<b>20</b>	<b>05</b>
	<b>Total of Part-I</b>	<b>29 Hrs</b>			<b>750</b>					<b>25</b>		

**Note:** Material Science and Engineering Mathematics-III practical may be carried out fortnightly for two hours, so that the tutorial hours may be used as practical.

**Semester-II**

Subject Code	Subject	Teaching Scheme			Examination Scheme					Total Marks	Credits	
		Hours/Week			In-Sem (online)	End-Sem	TW	Pr.	Oral		Lect/Tut	Pr/Or
		L	Tut.	P.								
202045	Fluid Mechanics	04	-	02	50	50	-	50	-	150	04	01
202047	Soft Skills	-	-	02	--	--	25	-	-	25	-	01
202048	Theory of Machines – I	04	01	-	50	50	25	-	25	150	04	01
202049	Engineering Metallurgy	03	01	-	50	50	-	-	25	125	03	01
202050	Applied Thermodynamics	04	-	02	50	50	-	50	-	150	04	01
203152	Electrical and Electronics Engineering	03	-	02	50	50	25	-	-	125	03	01
202053	Machine Shop – I	-	-	02	--	--	25	-	-	25	-	01
	<b>Total</b>	<b>18</b>	<b>02</b>	<b>10</b>	<b>250</b>	<b>250</b>	<b>100</b>	<b>100</b>	<b>50</b>	<b>750</b>	<b>18</b>	<b>07</b>
	<b>Total of Part-II</b>	<b>30 Hrs</b>			<b>750</b>					<b>25</b>		

**Note:** Theory of Machine-I and Engineering Metallurgy practical may be carried out fortnightly for two hours, so that the tutorial hours may be used as practical.

## Audit Course1

In addition to credits courses, it is recommended that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses, starting in second year first semester. Though not mandatory, such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in each semester is provided in curriculum. Student can choose one audit course from the list. Evaluation of audit course will be done at institute level. Method of conduction and method of assessment for audit courses is suggested.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

(Ref-[http://www.unipune.ac.in/Syllabi\\_PDF/revised-2015/engineering/UG\\_RULE\\_REGULATIONS\\_FOR\\_CREDIT\\_SYSTEM-2015\\_18June.pdf](http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf))

Guidelines for Conduction and Assessment (Any one or more of following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands on experience on specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

### List of courses under Audit Course1

Course Code	Audit Course Title
202054 A	Road Safety
202054 B	Innovations in engineering field / Agriculture
202054 C	Value Education

The detail course contents of above mentioned audit courses are available in Mechanical Engineering 2015 course syllabus. Moreover students can opt for any other audit course from the list of Audit Course1 of any branch of engineering.

# SEMESTER-I

**207002: Engineering Mathematics III (Mechanical + SW / Production + SW / Industrial /Automobile Engineering)****Teaching Scheme:****Lectures:** 4 Hrs./Week**Tutorials:** 1 Hr./Week**Credit Scheme:****Theory:** 04**Tutorial:** 01**Examination Scheme:****Ins-Sem:** 50 Marks**End-Sem:** 50 Marks**Term work:** 25 Marks

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

**Course Objectives:**

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

1. Ordinary and partial differential equations applied to Mechanical engineering problems such as mechanical vibrations and heat transfer.
2. 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.
3. Statistical methods such as correlation, regression analysis and probability theory in analyzing and interpreting experimental data applicable to Reliability engineering
4. 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 (09 Hours)**

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: Transforms (09 Hours)**

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 and Probability (09 Hours)**

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 (09 Hours)**

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: Vector Integral Calculus and Applications (09 Hours)**

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) (09 Hours)**

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.

## 202041: Manufacturing Process - I

Teaching Scheme:	Credits	Examination Scheme:
TH: <b>03</b> hr/week	Th: 03	In-Sem: 50
	Tut:--	End-Sem: 50
PR: <b>02</b> hrs/week	PR/OR/TW: 01	PR: --
		OR: --
		TW: 50

### Course Objectives:

- To make acquaintance of foundry processes pattern making and casting
- To study metal forming processes such forging, rolling, extrusion and wire drawing.
- To make study of different plastic molding processes
- To study metal joining processes
- To design and development of product with Sheet metal working process
- Introduction to center lathe

### Course Outcomes:

On completion of the course, learner will be able to–

- Understand and analyze foundry practices like pattern making, mold making, Core making and Inspection of defects.
- Understand and analyze Hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes.
- Understand different plastic molding processes, Extrusion of Plastic and Thermoforming
- Understand different Welding and joining processes and its defects
- Understand, Design and Analyze different sheet metal working processes
- Understand the constructional details and Working of Centre Lathe

### Course Contents

#### Unit I Casting Processes:

(9 Hrs)

SAND CASTING – Pattern- types, material and allowances, Molding sand- types, properties and testing, Molding – types, equipment's, tools and machines, Core – types and manufacturing, Gating system and Riser – types and design (Numerical), Heating and pouring, cooling and solidification- process and time estimation (Numerical), Cleaning and Finishing, Defects and remedies, Inspection techniques. Die casting, Investment casting, Centrifugal Casting, Continuous Casting- Types, equipment, process parameters, material to cast.



**Unit II Metal Forming Processes:****(8 Hrs)**

Hot and Cold Working – Concepts and comparative study, Material behavior in metal forming, strain rate sensitivity, friction and lubrication in metal forming Rolling – Types of rolling mills, flat rolling analysis, power required per roll for simple single pass two rollers. (Simple Numerical) Forging – Types, process parameter, Analysis of open die forging (Numerical) Extrusion – Types, process parameter, Extrusion dies, Shape factor (Numerical), Drawing – Wire drawing and its analysis (Numerical), tube drawing

**Unit III Plastic Processing:****(6Hrs)**

Molding – Compression molding, Transfer molding, Blow molding, Injection molding – Process and equipment. Extrusion of Plastic – Type of extruder, extrusion of film, pipe, cable and sheet Thermoforming – Principle, pressure forming and vacuum forming

**Unit IV Joining Processes:****(6Hrs)**

Surface preparation and types of joints. Welding Classification Arc welding – Theory, SMAW, GTAW, FCAW, Submerged arc welding, Stud welding. Resistance welding – Theory, Spot, seam and projection weld process. Gas welding. Soldering, brazing and braze welding. Joint through Adhesive – classification of adhesive, types of adhesive, applications. Weld inspection, Defects in various joints and their remedies.

**Unit V Sheet Metal Working:****(7Hrs)**

Types of sheet metal operations, Types of dies and punches, material for dies and punches, Die design for Progressive and Drawing Die, clearance analysis, center of pressure, blank size determination (Numerical), strip layout, sheet utilization ratio (Numerical), method of reducing forces

**Unit VI Centre lathe:****(7Hrs)**

Introduction to centre lathe, types of lathe, construction and working of lathe, attachments and accessories, various operations on lathe, taper turning and thread cutting methods (numerical), machining time calculation (numerical)

**Books:****Text**

1. Hajara Choudhari, Bose S.K. – Elements of workshop Technology Vol. I &II , Asian Publishing House
2. D. K. Singh – Fundamentals of Manufacturing Engineering – Ane's Books. Pvt. Ltd.

**Reference:**

1. B. Ravi – Metal Casting – Computer Aided design and analysis- Prentice Hall of India
2. Reikher – Casting: An analytical approach – Springer
3. Wang – Rapid tooling guidelines for sand casting – Springer
2. J. T. Black – Degormos Materials and process in manufacturing – John Willey and sons
3. M.P Grover – Fundamentals of modern manufacturing: Materials and systems
4. A.S Athalye – Processing of plastic – Colour Publication (Pvt.)Ltd. U.K
5. Cryil Donaldson and George H LeCain – Tool Design – Tata McGraw Hill Education Pvt. Ltd.
6. Dr. R. S. Parmar, Welding Processes And Technology, Khanna Publishers, New Delhi.

**Lab Assignments**

1. Manufacturing of any one assembly consisting of minimum two components and involving all the lathe operations
2. Demonstration of Sand Moulding Processes
3. Job on TIG/ MIG/ Resistance welding

**Guidelines for Term Work assessment**

Each student must complete and submit following Term Work

- i) Assgmenyt-1 and assignment-3 w.r.t. above mentioned laboratory assignments
- ii) Journal consisting of following write-ups:
  - a) Study of casting processes
  - b) Study of plasting moulding processes
  - c) Study of welding processes
  - d) Study of centre lathe and single point cutting tool geometry

## 202042: Computer Aided Machine Drawing

Teaching Scheme:	Credits	Examination Scheme:
TH: 01 hr/week	Th:01	TH In-Sem: 50
		End-Sem: 50
PR: 02 hrs/week	PR/OR/TW:01	PR: 50
		OR: --
		TW: --

### Prerequisites: -

1. Fundamentals Engineering Drawing
2. Projection of Solids
3. Basic knowledge of 2-D drafting using graphics software

### Course Objectives:

- To understand Parametric Modeling Fundamentals, Procedure, and "Shape before Size" Approach.
- To develop an ability to Create Parametric 2-D Sketches, and Create and Edit Parametric Dimensions.
- To develop an ability to Create Solid Models of machine components. The student should be able to apply these skills to the solution of a variety of practical problems and be able to employ their knowledge to solve more complicated problems.
- To develop an ability to Create assembly models of simple machine (minimum 5 components). The student should be prepared to continue the study of computer aided machine drawing through further subjects/projects in further years of engineering.
- To develop the ability to apply Limits, Fits, and Dimensional Tolerances, as well as Geometric Tolerances to components and assemblies on Engineering Drawings.
- To develop an ability to create 2D drawings from 3D models

### Course Outcomes:

On completion of the course, learner will be able to–

- Understand the importance of CAD in the light of allied technologies such as CAM, CAE, FEA, CFD, PLM.
- Understand the significance of parametric technology and its application in 2D sketching.
- Understand the significance of parametric feature-based modeling and its application in 3D machine components modeling.
- Ability to create 3D assemblies that represent static or dynamic Mechanical Systems.
- Ability to ensure manufacturability and proper assembly of components and assemblies.
- Ability to communicate between Design and Manufacturing using 2D drawings.

## Course Contents

- Unit I Introduction** (2 Hrs)  
Introduction – evolution of CAD, importance of CAD in the light of allied technologies, solid modeling, introduction to Graphical User Interface (GUI) of any commercially used solid modeling software
- Unit II Parametric Sketching** (2 Hrs)  
Parametric sketching - draw and modify 2D entities, apply/modify constraints and dimensions
- Unit III Parametric Solid Modelling** (2 Hrs)  
Parametric solid modeling - fundamentals, transform the parametric 2-D sketch into a 3D solid, feature operations, Free form feature modeling, design by features, feature recognition.
- Unit IV Assembly Modelling** (2 Hrs)  
Assembly modeling - defining relationship between various parts of machine, creation of constraints, generation of exploded view
- Unit V Geometric Dimensioning and Tolerancing** (2 Hrs)  
Geometric dimensioning and tolerancing - Limits, Fits, Dimensional Tolerances, Geometric Tolerances, Introduction to ASME Y14.5 – 2009
- Unit VI Production Drawing** (2 Hrs)  
Production drawing – generation of 2-D sketches from parts and assembly 3-D model, appropriate dimensioning and tolerancing

### Books:

#### Text Books:

1. Bhat N. D., “Machine Drawing”, Charotar Publications, New Delhi 2014
2. Ajeet Siingh, “ Machine Drawing”, Mc Graw Hill Publications, New Delhi 2012
3. ASME Y14.5 -2009, ASME, 2009

#### Lab Work:

1. Assignment on 2-D sketching with geometrical and dimensional constraints (2 hrs.)
2. Assignment on parametric solid modeling of a machine component (4 hrs.)
3. Assignment on solid modeling of the parts of a machine (min. 5 components) (10 hrs.)
4. Assignment on assembly modeling of the parts modeled in assignment 3 using proper mating conditions and generation of exploded view. (4 hrs.)
5. Generation of production drawings of the parts and assembly with appropriate tolerancing. (4 hrs.)

**2043: Thermodynamics**

Teaching Scheme:	Credits	Examination Scheme:
TH: 04 Hr/week	Th:04	TH In-Sem: 50 End-Sem: 50
PR: 02 Hrs/week	PR/OR/TW:01	PR: -- OR: 50 TW: --

**Prerequisites: -**

1. Engg. Mathematics
2. Engg. Physics/Chemistry
3. Fundamental Concepts and laws of Thermodynamics.

**Course Objectives:**

- Identify and use units and notations in Thermodynamics.
- State and illustrate first and second laws of Thermodynamics.
- Explain the concepts of entropy, enthalpy, reversibility and irreversibility.
- Apply the first and second laws of Thermodynamics to various gas processes and cycles.
- To get conversant with properties of steam, dryness fraction measurement, vapor processes and Thermodynamic vapor cycles, performance estimation.
- To get conversant with Psychrometric Charts, Psychrometric processes, human comfort conditions.

**Course Outcomes:**

- On completion of the course, learner will be able to–
- Apply various laws of thermodynamics to various processes and real systems.
- Apply the concept of Entropy, Calculate heat, work and other important thermodynamic properties for various ideal gas processes.
- Estimate performance of various Thermodynamic gas power cycles and gas refrigeration cycle and availability in each case.
- Estimate the condition of steam and performance of vapour power cycle and vapour compression cycle.
- Estimate Stoichiometric air required for combustion, performance of steam generators and natural draught requirements in boiler plants.
- Use Psychrometric charts and estimate various essential properties related to Psychrometry and processes

**Course Contents**

<p><b>Unit I Laws of thermodynamics</b> <span style="float: right;"><b>(6 Hrs)</b></span>  Introduction of thermodynamics, Review of basic definitions, Zeroth law of thermodynamics, Macro and Microscopic Approach, State Postulate, State, Process and Thermodynamic Cycles, First law of thermodynamics, Joules experiment, Applications of first law to flow and non flow processes and cycles. Steady flow energy equation and its application to different devices. Equivalence of Clausius and Kelvin Planck Statement, PMM I and II, Concept of Reversibility and Irreversibility.</p>
<p><b>Unit II Entropy</b> <span style="float: right;"><b>(4 Hrs)</b></span>  Entropy as a property, Clausius inequality, Principle of increase of Entropy, Change of entropy for an ideal gas and pure substance.</p> <p><b>Ideal Gas</b> <span style="float: right;"><b>(6 Hrs )</b></span>  <b>Ideal Gas definition Gas Laws:</b> Boyle's law, Charle's law, Avagadro's Law, Equation of State, Ideal Gas constant and Universal Gas constant, Ideal gas processes- on P-V and T-S diagrams Constant Pressure, Constant Volume, Isothermal, Adiabatic, Polytropic, Throttling Processes, Calculations of heat transfer, work done, internal energy. Change in entropy, enthalpy.</p>
<p><b>Unit III Thermodynamic cycles</b> <span style="float: right;"><b>(6 Hrs)</b></span>  <b>Gas Power Cycles:</b> Air Standard Cycle, Efficiency and Mean Effective Pressure, Carnot Cycle, Otto Cycle, Diesel cycle, Dual cycle, Comparison of cycles, Brayton cycle, <b>Gas Refrigeration Cycle:</b> Reversed Carnot, Bell Coleman Cycle.</p> <p><b>Availability</b> <span style="float: right;"><b>(4 Hrs)</b></span>  Available and unavailable energy, concept of availability, availability of heat source at constant temperature and variable temperature, Availability of non flow and steady flow systems, Helmholtz and Gibbs function, irreversibility and second law efficiency.</p>
<p><b>Unit IV Properties of Pure substances</b> <span style="float: right;"><b>( 5 Hrs)</b></span>  Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-v, T-s and Mollier diagram for steam, Dryness fraction and its determination, Study of steam calorimeters (Barrel, Separating, Throttling and combined)  Non-flow and Steady flow vapour processes, Change of properties, Work and heat transfer.</p> <p><b>Thermodynamic Vapour Cycle</b> <span style="float: right;"><b>(5 Hrs)</b></span>  <b>Vapour Power Cycles:</b> Carnot cycle, Rankine cycle, Comparison of Carnot cycle and Rankine cycle, Efficiency of Rankine cycle, Relative efficiency, Effect of superheat, boiler and condenser pressure on performance of Rankine cycle, <b>Vapour Refrigeration Cycles:</b> Reversed Carnot Vapor Cycle, Vapor Compression Cycle and representation of cycle on P-h and T-s diagram, Refrigerating effect, Compressor power and COP estimation <b>(Numerical treatment using R134a only and enthalpy Cp, Cv data should be provided in tabulated form).</b></p>

<b>Unit V Steam Generators</b> ( 6 Hrs) Introduction to fuels, Theoretical amount of Oxygen / Air required for combustion. Stoichiometric Air: Fuel ratio, Excess air, lean and rich mixtures, Stoichiometric A: F ratio for petrol <b>(No Numerical Treatment on fuels and combustion, only basic definitions and terminologies to be covered)</b> . Classification, Constructional details of low pressure boilers, Features of high pressure (power) boilers, Introduction to IBR, Boiler performance calculations-Equivalent evaporation, Boiler efficiency Energy balance, Boiler draught (natural draught numerical only).
<b>Unit VI Psychrometry</b> (6 Hrs) Psychrometry and Psychrometric Properties, Basic Terminologies, Psychrometric Relations, Psychrometric Chart, Psychrometric Processes, Thermodynamics of Human Body, Comfort Conditions <b>(Numerical treatment using Psychrometric chart only)</b> .
<b>Books:</b>
<b>Text:</b> 1. R. K. Rajput, Engineering Thermodynamics, EVSS Thermo Laxmi Publications 2. P. K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publications 3.
<b>Reference:</b> 1. Y. Cengel & Boles: Thermodynamics – An Engineering Approach, 2. P. L Ballany: Thermal Engineering, Khanna Publishers 3. C.P. Arora: Engineering Thermodynamics, Tata McGraw Hill. 4. S. Domkundwar, C. P. Kothandaraman, Anand Domkundwar, Thermal Engineering, Dhanpat Rai Publishers.

**List of Practical's:**

1. Joule's experiment to validate first law of thermodynamics.
2. Determination of  $C_p$  and  $C_v$  for Ideal gas.
3. Performance estimation of Air standard cycle using standard simulation software's (MATLAB, VC++ etc.).
4. Determination of dryness fraction of steam (At least two Calorimeters).
5. Experiment to Calculate COP of Simple Vapor Compression Cycle (VCC).
6. Performance estimation of VCC using any professional software (CoolPack etc.)
7. Study of Boiler Mountings.
8. Study of Boiler Accessories.
9. Trial on boiler to determine boiler efficiency, equivalent evaporation and Energy Balance.
10. Industrial visit to any process industry which uses boiler and submission of detailed report.
11. Demonstration of Psychrometric processes (At least four).

**Notes:**

1. Minimum 8 experiments should be performed.
2. Experiment No. 9 and 10 are compulsory.



## 202044: Material Science

Teaching Scheme:	Credits	Examination Scheme:
TH: 03 Hrs/week	Theory: 03	TH In-Sem: 50
TUT: 01 Hr/week	Tutorial: 01	End-Sem: 50
		PR: 50
		OR: --
		TW: 25

### Course Objectives:

- To acquaint students with the basic concepts and properties of Material Science
- To impart a fundamental knowledge of Materials Processing
- Selection and application of different Metals & Alloys
- To understand the structure of Engineering Materials
- To develop futuristic insight into Materials

### Course Outcomes:

On completion of the course, learner will be able to–

- Understand the basic concepts and properties of Material.
- Understand about material fundamental and processing.
- Select proper metal, alloys, nonmetal and powder metallurgical component for specific requirement
- Detect the defects in crystal and its effect on crystal properties.
- Evaluate the different properties of material by studying different test
- Recognize how metals can be strengthened by cold-working and hot working

### Course Contents

#### Unit I Structure of Metals & Materials. (6 Hrs)

Basic concepts of Crystal structures, Types of crystal systems , Crystal structure of metals( BCC, FCC and HCP systems), ceramics & molecular arrangement of polymers , Miller indices , indexing of lattice planes & directions, Lattice parameters (coordination number, no. of atoms per unit cell, atomic packing factor, density)

<p><b>Unit II Mechanical Behaviors of Metal &amp; Materials (6 Hrs)</b></p> <p>Introduction to Crystal imperfections &amp; Classification , Crystal imperfections : point defects, line defects- edge and screw dislocations, surface defects, volume defects, Mechanism of Elastic &amp; plastic deformation (slip and twinning) ,Theory of dislocation , deformation of single crystal by slip, plastic deformation of polycrystalline materials, work hardening theory, Changes in properties due to cold working &amp; hot working.</p>
<p><b>Unit III Destructive &amp; Non-destructive Testing (8 Hrs)</b></p> <p>Study of destructive testing, Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, Numerical based on Evolution of properties, compression test, different hardness tests-Vickers, Rockwell, Brinell, Poldi, Micro Hardness Test, Durometers, Impact test, fatigue test, creep test, Erichsen Cupping Test.</p> <p>Non Destructive testing: Principals &amp; procedure, advantages, disadvantages and Industrial applications of NDT, such as Visual Inspection ,Liquid /dye penetrate test, Magnaflux test, Eddy current test, Sonic &amp; Ultrasonic testing and Radiography testing.</p>
<p><b>Unit IV Metals Corrosion &amp; Its Prevention (4 Hrs)</b></p> <p>Classification of corrosion : Dry corrosion &amp; wet corrosion, Mechanism of corrosion ,Types of corrosion : Pitting corrosion, stress corrosion , season cracking, cavitation corrosion, caustic embrittlement , intergranular corrosion , crevice corrosion , erosion corrosion, uniform corrosion, galvanic corrosion,</p> <p>Corrosion prevention methods : classification of different methods, e.g, inhibitors, cathodic &amp; anodic protection, internal &amp; external coatings, Low &amp; High temperature corrosion. Design against corrosion.</p>
<p><b>Unit V Surface Modification Methods. (6 Hrs)</b></p> <p>Importance of surface modification, classification of different methods &amp; factors affecting : electroplating , PVD , CVD ,IVD, powder coating, shot blasting, ion implantation, plasma nitriding , anodizing, Surface preparation before coating &amp; coating defects.</p>

**Unit VI Powder Metallurgical Technology (6 Hrs)**

Basic steps of powder metallurgy process, classification & methods of powder manufacturing, characteristics of metal powders, Conditioning of metal powders (Screening, Blending & mixing, annealing), Compaction techniques (cold compaction, hot compaction, Isostatic compaction & powder rolling) , mechanism & importance of sintering , Pre-sintering & sintering secondary operations

Advantages, limitations and applications of powder metallurgy. Production of typical P/M components (with flow charts), self lubricated bearing, cemented carbides, cermets, refractory metals, electrical contact materials, friction materials, and diamond impregnated tools, friction plate, clutch plate, commutator brushes.

**Books:****Text:**

1. Kodgire V. D. "Material Science and Metallurgy"
2. "Material Science & Engg." Raghvan V., Prentice Hall of India , New Delhi. 2003

**Reference:**

1. Science of Engineering Materials, Smith, Prentice-Hall
2. Materials Science and Engineering, Callister W. D., John Wiley
3. "Engineering Metallurgy", Higgins R. A., Viva books Pvt. Ltd., 2004.
4. Introduction to Physical Metallurgy, Avner, S.H., Tata McGraw-Hill, 1997.
5. Mechanical Metallurgy, Dieter, G.E., McGraw-Hill, 1988.

**List of Tutorials**

1. Numerical based on Indexing, Atomic packing factor, Density.
2. Study and Trial of Tensile Test & numerical based on Tensile test.
3. Study of Compression Test
4. Study and Trial of Rockwell Hardness Test & Hardness conversion number.
5. Study of Ultra Sonic Test.
6. Vickers Hardness Test.
7. Brinell Hardness Test
8. Poldi Hardness Test
9. Magnetic Particle Test.
10. Dye Penetrant Test.
11. Impact Test.
12. Study of Self lubricated Bearings / Cemented carbide tips ,in Powder Metallurgy

**Note : Out of above Twelve Tutorials , any Eight Tutorials should be conducted .**

**202051: Strength of Materials**

Teaching Scheme:	Credits	Examination Scheme:
TH: <b>04</b> hr/week	Th:04	TH In-Sem: <b>50</b>
PR: <b>02</b> hrs/week	PR/OR/TW:01	End-Sem: <b>50</b>
		PR: --
		OR: <b>50</b>
		TW: --

**Prerequisites: -**

1. Fundamentals of engineering mechanics
2. Analysis of forces and moments
3. Laws of motion, kinetics, kinematics
4. Algebra and trigonometry

**Course Objectives:****To understand**

- Mechanical behavior of the body by determining the stresses, strains and deflections produced by the loads up to the elastic limit.
- Fundamental concepts related to deformation, strain energy, moment of inertia, load carrying capacity, slope and deflection of beams, shear forces, bending moments, torsional moments, column and struts, principal stresses and strains and theories of failure

**Course Outcomes:****Student should be able to**

- Apply knowledge of mathematics, science for engineering applications
- Design and conduct experiments, as well as to analyze and interpret data
- Design a component to meet desired needs within realistic constraints of health and safety
- Identify, formulate, and solve engineering problems
- Practice professional and ethical responsibility
- Use the techniques, skills, and modern engineering tools necessary for engineering practice

**Course Contents**

<p><b>Unit I Simple stresses and strains</b> <span style="float: right;"><b>(8 Hrs)</b></span>  Stress, strain, Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants,  Stress-strain diagram for ductile and brittle materials, factor of safety.  Stresses and strains in determinate and indeterminate, homogeneous and composite bars under concentrated loads and self weight.  Temperature stresses in simple members.</p>
<p><b>Unit II Shear Force and Bending Moment Diagrams</b> <span style="float: right;"><b>(8 Hrs)</b></span>  Shear force and bending moment diagrams for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load and couple, Relationship between rate of loading, shear force and bending moment.  Maximum bending moment and position of points of contra flexure.</p>
<p><b>Unit III Stresses in Machine Elements</b> <span style="float: right;"><b>(8 Hrs)</b></span>  <b>Bending stresses :</b> Theory of simple bending, assumptions, derivation of flexural formula, second moment of area of common cross sections (rectangular, I,T,C ) with respect to centroidal and parallel axes, bending stress distribution diagrams, moment of resistance and section modulus.  <b>Shear stresses:</b> Concept, derivation of shear stress distribution formula, shear stress distribution diagrams for common symmetrical sections, maximum and average shears stresses, shear connection between flange and web.</p>
<p><b>Unit IV</b> <span style="float: right;"><b>(8 Hrs)</b></span>  <b>Slope and deflection of beams:</b> Relation between bending moment and slope, slope and deflection of determinate beams, double integration method (Macaulay's method), derivation of formula for slope and deflection for standard cases.  <b>Strain energy:</b> Strain energy due to axial load (gradual, sudden and impact), strain energy due to bending and torsion.</p>
<p><b>Unit V</b> <span style="float: right;"><b>(8 Hrs)</b></span>  <b>Torsion:</b> Stresses, strain and deformations in determinate 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.  <b>Buckling of columns:</b> 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, Rankine's formula, safe load on columns</p>

<b>Unit VI</b>	<b>(8 Hrs)</b>
<p><b>Principal stresses and strains:</b> Normal and shear stresses on any oblique plane. Concept of principal planes, derivation of expression for principal stresses and maximum shear stress, position of principal planes and planes of maximum shear.</p> <p>Graphical solution using Mohr's circle of stresses. Principal stresses in shaft subjected to torsion, bending moment and axial thrust (solid as well as hollow),</p> <p>Concept of equivalent torsional and bending moments.</p> <p><b>Theories of elastic failure:</b> Maximum principal stress theory, maximum shear stress theory, maximum distortion energy theory – their applications and limitations.</p>	
<b>Books:</b>	
<b>Text:</b>	
<ol style="list-style-type: none"> <li>1. G. H. Ryder- Strength of Materials- 3rd Edition, Macmillan Pub, India</li> <li>2. S.S. Rattan - Strength of Material – Tata McGraw Hill Publication Co. Ltd. S.</li> <li>3. Ramamurtham - Strength of material - Dhanpat Rai Publication.</li> <li>4. Timoshenko and Young - Strength of Materials - CBS Publication</li> </ol>	
<b>Reference:</b>	
<ol style="list-style-type: none"> <li>1. Beer and Johnston - Strength of materials - CBS Publication.</li> <li>2. E.P. Popov - Introduction to Mechanics of Solids - Prentice Hall Publication.</li> <li>3. Singer and Pytel - Strength of materials - Harper and row Publication.</li> <li>4. B.K. Sarkar - Strength of Material - Tata McGraw Hill New Delhi.</li> </ol>	
<b>List of Practicals:</b>	
<b>(Any 6 out of 1 to 8 and any 2 out of 9 to 11)</b>	
<ol style="list-style-type: none"> <li>1. Tension test for aluminum alloy and mild steel using extensometer.</li> <li>2. Tension test for brass using extensometer</li> <li>3. Shear test of ductile material on Universal Testing Machine.</li> <li>4. Experimental verification of flexural formula in bending for cantilever beam.</li> <li>5. Experimental verification of flexural formula in bending for simply supported beam.</li> <li>6. Measurement of stresses and strains in beams for different end conditions using strain gauges.</li> <li>7. Experimental verification of torsion formula for circular bar.</li> <li>8. Experimental verification of von Mises theory of failure.</li> </ol> <p><b>Graphical simulation of -</b> (using suitable software like MD-Solids, Matlab, MS-Excel etc.)</p> <ol style="list-style-type: none"> <li>9. Shear force and bending moment diagrams with different end conditions.</li> <li>10. Slope and deflection.</li> <li>11. Principal stresses through graphical and analytical method.</li> </ol>	

**202054: Value Education**

Teaching Scheme:	Credits	Examination Scheme:
TH: --	Tut:01	TH In-Sem: --
		End-Sem: --
Tutorial: 01 hr/ week	TW:--	PR: --
		OR: --
		TW: 25

**Course Objectives:**

- To enable the students to understand meaning of values and select their goals by self-investigation based on personal values.
- To enable the students to understand value of truth, commitments, honesty, sacrifice, care, unity, team work and relationship.
- To educate and make the young generation students aware of their social responsibilities.
- To increase awareness among students about environment and create attitude towards sustainable lifestyle.

**Course Outcomes:**

On completion of the course, learner will be able to–

- Understood human values, their significance and role in life.
- Promote self-reflection and critical inquiry that foster critical thinking of one's value and the values of others.
- Practice respect for human rights and democratic principles.
- Familiarized with various living and non-living organisms and their interaction with environment.
- Understood the basics regarding the leadership and to become a conscious professional.

**Course Contents****UNIT 1: Introduction of Value Education (2 Hrs)**

**Value Education:** Definition, Need, Content, Process and relevance to present day. Concept of Human Values, self introspection.

**UNIT 2: Salient values for life (2 Hrs)**

Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, punctuality, Interpersonal and Intra personal relationship, Team work , Positive and creative thinking.

<p><b>UNIT 3: Human Rights</b> <span style="float: right;"><b>(2 Hrs)</b></span></p> <p>Universal Declaration of Human Rights, Right to Information Act -2005, National Integration, Peace and non-violence, Dr. A P J Kalam's ten points for enlightened Citizenship. The role of media in value building.</p>
<p><b>UNIT 4: Environment and Ecology</b> <span style="float: right;"><b>(2 Hrs)</b></span></p> <p>Ecological balance, interdependence of all beings – living and non-living. Man and nature, Environment conservation and enrichment...</p>
<p><b>UNIT 5: Social values &amp; Ethical values</b> <span style="float: right;"><b>(2 Hrs)</b></span></p> <p><b>Social values</b> - Social consciousness and responsibility, Consumer rights and responsibilities.</p> <p><b>Ethical values</b> - Professional ethics, Code of ethics of engineers, Influence of ethics on family life, Leadership qualities and Personality development.</p>
<p><b>Books:</b></p>
<p><b>Text:</b></p> <ol style="list-style-type: none"> <li>1. Dr. N. Venkataiah, "Value Education", APH Publishing Corporation, 2007</li> <li>2. M. Govindarajan, S. Natarajan, V. S. Senthil Kumar, "Professional Ethics &amp; Human Values", PHI Learning Press, 2013.</li> </ol>
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Chakravarthy S. K., "Values and ethics for Organizations: Theory and Practice", Oxford University Press, New Delhi, 1999.</li> <li>2. Man Singh Das, Vijay Kumar Gupta, "Social values among young adults: A changing scenario", MD Publications Pvt. Ltd, 1995.</li> <li>3. Ram Ahuja, "Social Problems in India", Rawat Publications, 2012.</li> <li>4. Leah Levin, "HUMAN RIGHTS Questions and Answers", UNESCO Publishing, 2012.</li> <li>5. <a href="#">P D Sharma</a>, Ecology and Environment, Rastogi publications, 2005.</li> <li>6. Kalam A P J, Arun Tiwari, "Wings of Fire", University Press Publications, 2003.</li> <li>7. <a href="http://www.ncert.nic.in/recent/env_edu.html">http://www.ncert.nic.in/recent/env_edu.html</a></li> <li>8. <a href="http://www.unipune.ac.in/pdf_files/Final%20Book_03042012.pdf">http://www.unipune.ac.in/pdf_files/Final%20Book_03042012.pdf</a></li> <li>9. <a href="https://engineering.purdue.edu/MSE/Academics/Undergrad/ethics.pdf">https://engineering.purdue.edu/MSE/Academics/Undergrad/ethics.pdf</a></li> </ol>



**Term Work shall consist of following assignments:**

1. Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? What have been your achievements and shortcomings in your life?  
(Observe and analyze by student themselves and write outcome.)
2. Visit to Non Governmental Organizations (NGO), charitable trusts working for welfare of people in society and submit visit report.
3. (a) Presentation given by Teacher in the class on the Dr. A P J Kalam's ten points for enlightened Citizenship.  
  
(b) Conduct Guest Lecturer on: The role of media in value building and Right to Information Act - 2005 - a Tool for Good Governance. (Make report on seminars outcome)
4. Arrange a **Group Discussion** on topics:  
Energy and natural resource depletion, Environmental pollution, Global warming, Ozone depletion, Deforestation, Soil degradation, Drought, Water harvesting etc. Make a report on outcomes.  
(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. Write outcomes.)
5. Make Report on Code of ethics for engineers, Consumer rights and responsibilities and report conclude with role of Value, value Education and its relevance in present days.

## 202054 A: Innovations in Engineering Field/ Agriculture

### Prerequisites:

1. Knowledge of Mathematics, Physics, and Chemistry is necessary.
2. Out of box/ unconventional thinking for solving typical problems.
3. Adapting analytical tools traditionally.
4. Application oriented thinking of learnt topics

### Course Objectives:

- To develop holistically built thinking habit needed for innovative ideas.
- To make students aware about key field of agriculture contributing to sustenance and development of a mankind.
- To expose students to their roles and responsibilities of building a nation through engineering insights in agriculture
- To be updated with innovations and technological advancements in respective fields of engineering.

### Course Outcomes:

On completion of the course, learner will be able to -

- Understand what is thinking, its tools and process and its application to innovation
- Practice application of innovation in engineering
- Understand important terms like national productivity, sustainable development and inclusive growth
- Throw a light on developing technologies in agriculture
- Learn Interdisciplinary Engineering applications in Agriculture

### Course Contents

#### Unit I: Thinking and thinking process (2 Hrs)

Thinking and thinking tools: Thinking, Types of thinking, Top-Down (Analysis) & Bottom-Up (Synthesis) thinking and combination of both, Judgement and Creativity, Concept Maps-Connecting the ideas, Generating ideas. Communicating ideas. Systems thinking and beyond. Critical thinking. Definition of innovation. Example of application of thinking process to any one practical innovation.

#### Unit II: Engineering Innovation and its scope (2 Hrs)

Incremental, radical and disruptive Innovation. Scope of innovation: Product innovation, Process innovation, Position innovation, Paradigm innovation. Innovation within the engineering profession. Awareness about latest technological advancements.

<p><b>Unit III: Agriculture and innovation</b> <span style="float: right;"><b>(2 Hrs)</b></span></p> <p>Definition of agriculture? Role of Agriculture in our life and in national productivity. Concept of sustainable development and inclusive growth. India's urban awakening. Innovation in agriculture and its types. Importance of agriculture innovation.</p>
<p><b>Unit IV: Developing technologies in agriculture</b> <span style="float: right;"><b>(2 Hrs)</b></span></p> <p>Favorable conditions for Agriculture innovation. Dynamics of Innovation System. Role and responsibility of Engineers in agricultural innovations and making India the net exporter of major agricultural produces. FINOvation Awards. Ideas on developing technologies in agriculture viz. Vehicle automation, Engine emissions technology, Fire suppression technology etc. The future of robotics on farms.</p>
<p><b>Unit V: Interdisciplinary Engineering in Agriculture</b> <span style="float: right;"><b>(2 Hrs)</b></span></p> <p>Technological innovations that are revolutionizing Indian agriculture. Case study presenting Interdisciplinary Engineering application in Agriculture.</p>
<p><b>Books:</b></p>
<p><b>Text:</b></p> <ol style="list-style-type: none"> <li>1. Kasser, J., E., 2015. Holistic Thinking: Creating Innovative Solutions to Complex Problems: Volume 1 (Solution Engineering). Create Space Independent Publishing Platform; 2 edition.</li> <li>2. Wenwu Zhang, 2011. Intelligent Energy Field Manufacturing: Interdisciplinary Process Innovations. CRC Press, Taylor &amp; Francis Group.</li> <li>3. Educating engineers to drive the innovation economy, 2012. Publisher: The Royal Academy of Engineering, London.</li> </ol>
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Crowder, J., A., Carbone, J., N., Demijohn, R., 2016. Multidisciplinary Systems Engineering: Architecting the Design Process. Springer Publishing.</li> <li>2. India's urban awakening: Building inclusive cities, sustaining economic growth, 2010. Mckinsey Global Institute report.</li> </ol>

**List of Tutorials/Assignments:**

1. What is 'thinking?' What are different tools of thinking? Write a note on Analysis and Synthesis and combination of both. Give any one example of application of thinking process to a practical innovation.
2. What are the types of innovations? What is its scope? Write a note on Innovation within engineering. State and explain 10 engineering innovations took place in last year.
3. What is agriculture? Explain its role in our life and in national productivity. What is sustainable development? What is inclusive growth? What is innovation in agriculture? What is importance of agriculture innovation?
4. What is favorable condition for agriculture innovation? Write a note on dynamics of innovation system. Discuss the ideas of developing technologies in agriculture. Write a note on future of robotics in agriculture.
5. State and explain minimum 10 Technological innovations that are revolutionizing Indian agriculture. Discuss any one case study encompassing Interdisciplinary Engineering application in Agriculture

**Notes:** All above 5 tutorials/ assignments are compulsory

## 202054 B : Road Safety

### Prerequisites:

1. Awareness about traffic rules and road accidents.
2. Understanding the need of studying such topics.
3. Considerations to other, sensitivity and care while travelling/ driving.

### Course Objectives:

- To acquire knowledge and understanding of the road environment.
- To inculcate decision making and behavioral skills necessary to survive in the road environment.
- To impart knowledge and understanding of the causes and consequences of accidents.
- To understand roles and responsibilities in ensuring road safety.

### Course Outcomes:

On completion of the course, learner will be able to–

- Generate awareness about number of people dying every year in road accidents, traffic rules and characteristics of accident.
- Gain information and knowledge about people responsible for accidents and their duties
- Understand the importance of multidisciplinary approach to planning for traffic safety and rehabilitation
- Acquire a certificate of coordination/ participation in compulsory events based on the topic under study

### Course Contents

#### **Unit I: Introduction to Road Safety (2 Hrs)**

Road traffic accidents scenario in India and in world. Road Safety and its importance. Traffic Rules and Driving Behavior. Characteristics of accidents, accidents vs. crash.

#### **Unit II: Planning for Road safety (2 Hrs)**

Awareness about rules and regulations of traffic. Assisting Traffic control authorities. Multidisciplinary approach to planning for traffic safety and injury control. Vulnerable road users: crashes related to pedestrian and bicyclists, their safety, provision for disabled.

#### **Unit III: Responsibility of Road accidents and Safety measures (2 Hrs)**

People responsible for accident prevention: Police, Politicians, Community members, Policy makers, Teachers, Parents, Infrastructure authorities, Drivers and Official road safety body. Reasons of students/ children have accidents. 4 E's of Accidents Prevention: 1. Engineering - by altering the environment 2. Enforcement - by imposing laws 3. Encouragement - by the use of publicity campaigns 4. Education - by gaining and using knowledge.

<p><b>Unit IV: Road Safety Education</b> <span style="float: right;"><b>(2 Hrs)</b></span></p> <p>Introduction to Road Safety Education. 5 P's of Road safety education: 1. Pre-school road safety education 2. Practical rather than theory education 3. Principles of own development as regards to road safety education 4. Presentations on road safety education 5. Place for road safety education in syllabus</p>
<p><b>Unit V: Road Safety Events</b> <span style="float: right;"><b>(2 Hrs)</b></span></p> <p>Discussions on efforts done by Government on Road Safety. Celebration of Road Safety week or Workshop on Road Safety week/ Organization of seminar on Road Safety. This is to be entirely organized by students under the mentorship of concerned Head of the Department.</p>
<p><b>Books:</b></p>
<p><b>Text:</b></p> <ol style="list-style-type: none"> <li>4. Kadiyali L.R., Traffic Engineering &amp; Transport Planning, Khanna Publishers, 2003</li> <li>5. CROWN AGENTS Ref: TEA/A369, 1995. (Unpublished contractors report for Ministry of Transport and Communications, Ghana). Road safety study and the institutional strengthening of the vehicle examination and licensing division.</li> <li>6. TRRL OVERSEAS UNIT, 1991. Towards safer roads in developing countries: a guide for planners and engineers. Crow Thorne: Transport and Road Research Laboratory.</li> </ol>
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>3. Indian Roads Congress, Highway Safety Code, IRC: SP-44:1996</li> <li>4. Indian Roads Congress, Road Safety Audit Manual, IRC:SP-88-2010</li> </ol>
<p><b>List of Tutorials/ Assignments:</b></p> <ol style="list-style-type: none"> <li>6. Discussion and presentations on: Road traffic accidents scenario in India. Traffic Rules and Driving Behavior. Characteristics of accidents, accidents vs. crash.</li> <li>7. Discussion and presentations on: Assisting Traffic control authorities, Multidisciplinary approach to planning for traffic safety and injury control. Vulnerable road users: crashes related to pedestrian and bicyclists, their safety, provision for disabled.</li> <li>8. Discussion and presentations on: People responsible for accident prevention, 4 E's of Accidents Prevention.</li> <li>9. Introduction to Road Safety Education. 5 P's of Road safety education</li> <li>10. Organization of One Day seminar/ workshop by students on Road Safety. Participation for every student is compulsory. They are expected to prepare brief report of about 3 to 4 pages of this event.</li> </ol>
<p><b>Notes:</b> All above 5 tutorials/ assignments are compulsory</p>

## 202054 C: Value Education

### Course Contents

**UNIT 1: Introduction of Value Education (2 Hrs)**

**Value Education:** Definition, Need, Content, Process and relevance to present day. Concept of Human Values, self introspection.

**UNIT 2: Salient values for life (2 Hrs)**

Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, punctuality, Interpersonal and Intra personal relationship, Team work , Positive and creative thinking.

**UNIT 3: Human Rights (2 Hrs)**

Universal Declaration of Human Rights, Right to Information Act -2005, National Integration, Peace and non-violence, Dr. A P J Kalam's ten points for enlightened Citizenship. The role of media in value building.

**UNIT 4: Environment and Ecology (2 Hrs)**

Ecological balance, interdependence of all beings – living and non-living. Man and nature, Environment conservation and enrichment...

**UNIT 5: Social values & Ethical values (2 Hrs)**

**Social values** - Social consciousness and responsibility, Consumer rights and responsibilities.

**Ethical values** - Professional ethics, Code of ethics of engineers, Influence of ethics on family life, Leadership qualities and Personality development.

**Books:**

**Text:**

3. Dr. N. Venkataiah, "Value Education", APH Publishing Corporation, 2007
4. M. Govindarajan, S. Natarajan, V. S. Senthil Kumar, "Professional Ethics & Human Values", PHI Learning Press, 2013.

**References:**

10. Chakravarthy S. K., “Values and ethics for Organizations: Theory and Practice”, Oxford University Press, New Delhi, 1999.
11. Man Singh Das, Vijay Kumar Gupta, “Social values among young adults: A changing scenario”, MD Publications Pvt. Ltd, 1995.
12. Ram Ahuja, “Social Problems in India”, Rawat Publications, 2012.
13. Leah Levin, “HUMAN RIGHTS Questions and Answers”, UNESCO Publishing, 2012.
14. [P D Sharma](#), Ecology and Environment, Rastogi publications, 2005.
15. Kalam A P J, Arun Tiwari, “Wings of Fire”, University Press Publications, 2003.
16. [http://www.ncert.nic.in/recent/env\\_edu.html](http://www.ncert.nic.in/recent/env_edu.html)
17. [http://www.unipune.ac.in/pdf\\_files/Final%20Book\\_03042012.pdf](http://www.unipune.ac.in/pdf_files/Final%20Book_03042012.pdf)
18. <https://engineering.purdue.edu/MSE/Academics/Undergrad/ethics.pdf>



# SEMESTER-II

### 202045: Fluid Mechanics

Teaching Scheme:	Credits	Examination Scheme:
TH: 04 hr/week	Th:04	TH In-Sem: 50
PR: 02 hrs/week	PR/OR/TW:01	End-Sem: 50
		PR: 50
		OR: --
		TW: --

**Prerequisites: -**

1. Engineering Mathematics
2. Engineering Physics

**Course Objectives:**

- To understand of various properties of fluids
- To learn fluid statics and dynamics.
- To understand of Boundary layer, Drag, and Lift
- To understand of Bernoulli's equation
- To Know of various applications of Bernoulli's equation

**Course Outcomes:**

On completion of the course, learner will be able to–

- Use of various properties in solving the problems in fluids
- Use of Bernoulli's equation for solutions in fluids
- Determination of forces drag and lift on immersed bodies

#### Course Contents

**Unit I Fundamentals of Fluid Mechanics (8 Hrs)**  
**Properties of Fluids:-** Definition of fluid, concept of continuum, Density, Specific Weight, Specific Gravity, Dynamic Viscosity, Kinematic Viscosity, Newton's law of viscosity, types of fluid, Rheological diagram, Surface Tension, Capillarity, Compressibility, Vapour pressure  
**Fluid Statics: -** Pascal's Law, Pressure at a point, Total Pressure & Centre of pressure for inclined flat plate, Buoyancy, metacenter and floatation.  
 (No numerical treatment for Buoyancy, metacenter and floatation)

<p><b>Unit II: Kinematics of Fluid Motion</b> <span style="float: right;"><b>(8 Hrs)</b></span></p> <p>Eulerian and Lagrangian approach of fluid flow, total or material derivative for velocity field, Continuity equation, types of flows (One, two, three dimensional, steady unsteady, uniform, non-uniform, laminar, turbulent, compressible, incompressible, rotational, Irrotational) . Visualization of flow field (Stream, Path and Streak line), vorticity in two dimensional flow, stream function and velocity potential function</p>
<p><b>Unit III: Fluid Dynamics</b> <span style="float: right;"><b>(8 Hrs)</b></span></p> <p>Introduction to flow models- control volume and infinitesimally small element, Linear momentum Equation using differential Approach, Introduction to Navier – Stokes Equation,</p> <p>Euler equation of motion, derivation of Bernoulli's equation along stream line , concept of HGL and THL or TEL, application of Bernoulli's equation to venturimeter, Pitot tube, Submerged Orifices, Orifice meter, V-notch</p>
<p><b>Unit IV: Internal Flow</b> <span style="float: right;"><b>(8 Hrs)</b></span></p> <p>Laminar and Turbulent flow physics, entrance region and fully developed flow. Velocity and shear Stress distribution for laminar flow in a pipe, fixed parallel plates and Couette flow, hydro dynamically smooth and rough boundaries, Velocity profile of Turbulent flow.</p>
<p><b>Unit V: Flow through Pipes</b> <span style="float: right;"><b>(8 Hrs)</b></span></p> <p>Energy losses through pipe-Major and Minor losses, Darcy-Weisbach equation, pipes in series, pipes in parallel and concept of equivalent pipe, Moody's diagram, Siphons, Transmission of power, (No derivations for minor losses)</p> <p>Dimensional Analysis: Dimensions of Physical Quantities, dimensional homogeneity, Buckingham <math>\pi</math> Theorem and important dimensionless numbers.</p>
<p><b>Unit VI: External flows</b> <span style="float: right;"><b>(8 Hrs)</b></span></p> <p>Boundary layer formation for flow over Flat plate, boundary layer thickness:-displacement, momentum and energy, Separation of Boundary Layer and Methods of Controlling Forces on immersed bodies: -Lift and Drag (No derivation on lift), flow around cylinder and aerofoil (Pressure distribution and Circulation).</p>
<p><b>Books:</b></p>

**Text:**

1. Fundamentals of Fluid Mechanics- Munson, Young and Okiishi- Wiley India
2. Fluid Mechanics- Potter Wiggert –Cengage Learning
3. Introduction to Fluid Mechanics- Fox, Pichard , McDonald- Wiley
4. Fluid Mechanics,- Dr. R.K. Bansal- Laxmi Publication (P) Ltd. New Delhi
5. Hydraulics and Fluid Mechanics, - Modi P. N. and Seth S. M -Standard Book House.
6. Fluid Mechanics,- Cengel&Cimbla- TATA McGraw-Hill
7. Fluid Mechanics- White- TATA McGraw-Hill

**Reference:**

1. Fluid Mechanics- Kundu, Cohen, Dowling- Elsevier India
2. Fluid Mechanics – Chaim Gutfinger David Pnueli-Cambridge University press.
3. Introduction to Fluid Mechanics-Edward Shaughnessy, Ira Katz James Schaffer- OXFORD University Press.

**List of Practical**

(Any ten of the following out of which experiment number 3 is compulsory)

1. Pressure measurement using any two types of manometer.
2. Determination of viscosity of liquids and its variation with temperature.
3. Determination of metacentric height of floating object.
4. Laminar and Turbulent flow by Reynolds's apparatus.
5. Draw flow net using electrical analogy apparatus.
6. Verification of modified Bernoulli's equation.
7. Calibration of Orifice meter/ Venturimeter.
8. Determination of hydraulic coefficients of orifice.
9. Calibration of V-notch
10. Determination of minor losses due to pipe fittings.
11. Determination of Major losses through metal & non-metal pipes.

**Notes:**

3. Minimum 10 experiments should be performed.
4. Experiment No. 3 is compulsory.

<b>202047: Soft Skills</b>		
<b>Teaching Scheme:</b>	<b>Credits</b>	<b>Examination Scheme:</b>
<b>TH:</b> -- hr/week	<b>Th/Tut:</b> --	<b>TH In-Sem:</b> --
<b>PR:</b> 02 hrs/week	<b>PR:</b> 01	<b>End-Sem:</b> --
		<b>PR:</b> --
		<b>OR:</b> --
		<b>TW:</b> 25
<b>Course Objectives:</b>		
<ul style="list-style-type: none"> <li>To develop students overall personality.</li> <li>To understand and aware about importance, role and contents of soft skills through instructions, knowledge aquisition, demonstration and practice. To improve his writing and documentation skills.</li> </ul>		
<b>Course Outcomes:</b>		
On completion of the course, learner will be able to–		
<ul style="list-style-type: none"> <li>Improved communication, interaction and presentation of ideas.</li> <li>Right attitudinal and behavioural change</li> <li>Developed right-attitudinal and behavioral change</li> </ul>		
<b>Course Contents</b>		
<b>Term Work/Assignments</b>		
Term work will consist the record of any 6 assignments of following exercises		
<b>1. SWOT analysis</b>		<b>(4 Hrs)</b>
Student should do his/her SWOT analysis & submit the report.		
<b>Method of Execution</b>		
Explain the meaning & benefits of SWOT analysis to students. Give them time to think on their strength, weakesses, opportunities & threats. Ask them to write their own SWOT anlalysis		
<b>2. Listening Skills</b>		<b>(4 Hrs)</b>
Listen to a short audio book and make notes out of it & make a report.		
<b>Method of Execution</b>		
Ask every students to download any freely available english audio book of one hour duration. Also ask them to listen it carefully and write it's review on journal paper		

<p><b>3. Oral presentation skills/Speaking Skills</b> (4 Hrs)</p> <p>Hold the poster of any inspirational personality &amp; speak about his/her life for five minutes.</p> <p><b>Method of Execution</b></p> <p>The personality can be from the fields like sports, politics, literature, entertainment etc. Ask every students to read &amp; study about therespective personality &amp; deliver the oral presentation infront of his/her batchmates.</p>
<p><b>4. Resume writing</b> (4 Hrs)</p> <p>Design a cover letter &amp; resume for yourself.</p> <p><b>Method of Execution</b></p> <p>Show some of the different resumes according to respective job profiles to students &amp; ask them to prepare their own resume. Also guide them to write a cover letter for any job application.</p>
<p><b>5. Corporate / Business Etiquettes</b> (4 Hrs)</p> <p>Apply to any five internship openings over internet by writing an email to the company HR. Students must submit email print.</p> <p><b>Method of Execution:</b> Tell students about any five recent internship openings &amp; ask them to apply for same through email with resume as an attachment. Ask students to take a sent mail print for submission record</p>
<p><b>6. Group Discussion</b> (4 Hrs)</p> <p>Organize the group discussion on a current topics in a batch of ten students &amp; ask every student to make minutes of meeting &amp; submit.</p> <p><b>Method of Execution:</b> Take some of the current topics for group discussion, divide students in two batches of ten students in each, Allot 10 minutes time &amp; one topic for discussion, meanwhile instructor have to assess each student's performance &amp; give feedback to respective student. Also ask students to write the minutes of the meeting from same GD</p>
<p><b>7. Team Activity</b> (4 Hrs)</p> <p>Make a 20 minutes english video documentary &amp; post it on a social media. Also provide the link of the same as submission record.</p> <p><b>Method of Execution:</b> Make a group of four students &amp; guide them to choose a topic for making a video documenatry. Video can be posted on facebook, twitter or youtube.The video can be recorded on cellphone as well</p>
<p><b>Books:</b></p>
<p><b>Text:</b></p> <ol style="list-style-type: none"> <li>1. Basics Of Communication In English : Francis Sounderaj, MacMillan India Ltd.2</li> <li>2. English for Business Communication : Simon Sweeney , Cambridge University Press</li> <li>3. An Introduction to Professional English And Soft Skills : Das , Cambridge University Press</li> </ol>

**Reference:**

1. A course in Listening and Speaking Vol I & Vol II, V.Sasikumar, P. Kiranmai, Geetha Rajeevan, Cambridge University Press
2. Cambridge English For Job Hunting : ColmDownes, Cambridge University Press
3. The Complete Letter Writer :MacMillan India Ltd
4. E Writing – 21st Century Tools for Effective Communication :Booher , MacMillan India Ltd
5. NASSCOM-Global Business Foundation Skills: Cambridge University Press

## 202048: Theory of Machines – I

Teaching Scheme:	Credits	Examination Scheme:
TH: <b>04</b> hr/week	Th: <b>04</b>	TH In-Sem: <b>50</b>
Tutorial: <b>01</b> hr/week	Tut: <b>01</b>	End-Sem: <b>50</b>
		PR: <b>--</b>
		OR: <b>25</b>
		TW: <b>25</b>

### Prerequisites: -

1. Engineering Mathematics
2. Engineering Physics
3. Engineering Mechanics

### Course Objectives:

- To make the student conversant with commonly used mechanism for industrial application.
- To develop competency in drawing velocity and acceleration diagram for simple and complex mechanism.
- To develop analytical competency in solving kinematic problems using complex algebra method.
- To develop competency in graphical and analytical method for solving problems in static and dynamic force analysis.
- To develop competency in conducting laboratory experiments for finding moment of inertia of rigid bodies.

### Course Outcomes:

On completion of the course, learner will be able to–

- Identify mechanisms in real life applications.
- Perform kinematic analysis of simple mechanisms.
- Perform static and dynamic force analysis of slider crank mechanism.
- Determine moment of inertia of rigid bodies experimentally.
- Analyze velocity and acceleration of mechanisms by vector and graphical methods.

### Course Contents



<p><b>Unit I Fundamentals of Kinematics and Mechanisms (10 Hrs)</b></p> <p>Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom (Mobility), Kutzbach criterion, Grubler's criterion. Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions. Straight line mechanisms such as: Peaucellier Mechanism, Scott Russell Mechanism, Grasshopper Mechanism, Watt mechanism. Equivalent linkage of mechanisms., Steering gear mechanisms: Condition for correct steering, Davis steering gear mechanism, Ackermann steering gear mechanism.</p>
<p><b>Unit II: Static and Dynamic Force Analysis (8Hrs)</b></p> <p>Theory and analysis of Compound Pendulum, Concept of equivalent length of simple pendulum, Bifilar suspension, Trifilar suspension.</p> <p>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, Introduction to T-<math>\theta</math> diagram.</p> <p>Friction: Friction in turning pair, friction circle, friction axis, friction in slider crank mechanism.</p>
<p><b>Unit III: Friction Clutches, Brakes and Dynamometer (8 Hrs.)</b></p> <p>Pivot and collar friction, Classification of Clutches, torque transmitting capacity of - plate clutch, cone clutch and centrifugal clutch, Classification of brakes, braking torque of - shoe brakes, internal shoe brake, disc brake, brake power of absorption and transmission type dynamometers – prony brake, rope brake, belt transmission, epicyclic train and Bevis-Gibson torsion</p>
<p><b>Unit IV: Kinematic Analysis of Mechanisms: Analytical Method (8 Hrs)</b></p> <p>Analytical method for displacement, velocity and acceleration analysis of slider crank Mechanism.</p> <p>Position analysis of links with vector and complex algebra methods, Loop closure equation, Chase solution, Velocity and acceleration analysis of four bar and slider crank mechanisms using vector and complex algebra methods.</p> <p>Hooke's joint, Double Hooke's joint.</p>
<p><b>Unit V: Velocity and Acceleration Analysis of Simple Mechanisms: Graphical Methods-I (8 Hrs)</b></p> <p>Relative velocity method: Relative velocity of a point on a link, Angular velocity of a link, Sliding velocity, Velocity polygons for simple mechanisms.</p> <p>Relative acceleration method: Relative acceleration of a point on a link, Angular acceleration of a link, Acceleration polygons for simple mechanisms. (limit to only 4 link mechanisms)</p> <p>Instantaneous center of rotation (ICR) method: Definition of ICR, Types of ICRs, Methods of locating ICRs (limit to only 6 link mechanisms), Kennedy's Theorem, Body and space centrode.</p>

**Unit VI: Velocity and Acceleration Analysis of Mechanisms: Graphical Methods-II (8 Hrs)**

Velocity and acceleration diagrams for the mechanisms involving Coriolis component of acceleration. (limit to only 4 link mechanisms) Klein's construction.

**Books:**

**Text:**

5. Thomas Bevan, "Theory of Machines" CBS Publisher and Distributors, Delhi.
6. S. S. Ratan, "Theory of Machines", Tata McGraw Hill.
7. Ashok G. Ambekar, "Mechanism and Machine Theory", Prentice Hall, India
8. Sadhu Singh, "Theory of Machines", Pearson

**Reference:**

1. Shigley J. E., and Uicker J.J., "Theory of Machines and Mechanism", McGraw Hill Inc.
2. Shigley J. E 'Mechanical Engineering Design', McGraw Hill Inc.
3. Ghosh Amitabh and Mallik A. K. "Theory of Machines and Mechanism", East- West Press.
4. Wilson C.E., Sandler J. P. Kinematics and Dynamics of Machinery", Person Education.
5. Erdman A.G. and Sandor G.N., "Mechanism Design, Analysis and Synthesis" Volume-I, Prentice –Hall of India

**Term Work based on following Tutorials to be submitted in the form of Journal:**

1. Draw (any 4) configurations of mechanisms and determine types of pairs, links, degree of freedom.
2. To determine experimentally the mass moment of inertia of a connecting rod using a compound pendulum method.
3. To determine experimentally the mass moment of inertia of a flat bar using bifilar suspension method or to determine experimentally the mass moment of inertia of a flywheel/gear/circular disc using trifilar suspension method.
4. Numerical based on Friction Clutches, Brakes and Dynamometer Or to measure torque transmitting capacity of friction clutch experimentally.
5. Numerical based on - single and double Hooke's joint.
6. One problem on velocity and acceleration analysis using: Vector algebra and Complex algebra and comparison of results.
7. **Two problems** on velocity and acceleration analysis using relative velocity and acceleration method.
8. **Two problems** on velocity analysis using ICR method.
9. **Two problems** on velocity and acceleration analysis using relative velocity and acceleration method involving Coriolis component.
10. Problems on velocity and acceleration analysis using Klein's construction for uniform and non-uniform crank velocity.

**Note: 1. Sr. No. 1,7,8,9 and 10 Problems based on Graphical methods are to be solved on half imperial drawing sheets.**

**2. Oral based on above Term work conducted in the tutorial class.**

**202048: Engineering Metallurgy**

Teaching Scheme:	Credits	Examination Scheme:
TH: <b>03</b> hr/week	Th:03	TH In-Sem: 50
Tutorial: <b>01</b> hr/week	PR/OR/TW:01	End-Sem: 50
		PR: --
		OR: 25
		TW: --

**Course Objectives:**

- To acquaint students with the basic concepts of Metal Structure
- To impart a fundamental knowledge of Ferrous & Non Ferrous Metal Processing
- Selection and application of different Metals & Alloys
- To Know Fundamentals of Metallography
- To develop futuristic insight into Metals

**Course Outcomes:**

On completion of the course, learner will be able to–

- describe how metals and alloys formed and how the properties change due to microstructure
- apply core concepts in Engineering Metallurgy to solve engineering problems.
- conduct experiments, as well as to analyze and interpret data
- select materials for design and construction.
- possess the skills and techniques necessary for modern materials engineering practice
- recognize how metals can be strengthened by alloying, cold-working, and heat treatment

**Course Contents****Unit I Overview of Metallurgy (6 Hrs)**

Methods of metal extraction (Principle only of pyro , hydro & electro metallurgy), cast v/s wrought products, Related terms and their definitions : System, Phase, Variable, Component, Alloy, Solid solution, Hume Ruther's rule of solid solubility, Allotropy and polymorphism, Concept of solidification of pure metals & alloys, Nucleation : homogeneous and heterogeneous,

Dendritic growth, super cooling, equiaxed and columnar grains, grain & grain boundary effect.

Cooling curves, Plotting of Equilibrium diagrams, Lever rule, Coring, Eutectic system, Partial eutectic and isomorphous system.

<p><b>Unit II: Micro &amp; macroscopic study of Metals</b> <span style="float: right;"><b>(6 Hrs)</b></span></p> <p>Classification of metal observations: their definition, difference &amp; importance.</p> <p>Microscopy: Various sampling techniques, specimen preparation, specimen mounting (hot &amp; cold mounting) electrolytic polishing, etching procedure and reagents, electrolytic etching.</p> <p>Microscopic techniques : optical microscopy, electron microscopy, transmission electron microscopy (TEM), scanning electron microscopy ( SEM), scanning probe microscopy (SPM ), AFM etc. ( principal &amp; application only )</p> <p>Study of Metallurgical microscope .Measurement of grain size by different methods &amp; effect of grain size on various mechanical properties.</p> <p>Macroscopy: Sulphur printing, flow line observations, spark test.</p>
<p><b>Unit III: Iron-Carbon alloy system &amp; Cast Iron</b> <span style="float: right;"><b>(8 Hrs.)</b></span></p> <p>Iron-iron carbide equilibrium diagram, critical temperatures, solidification and microstructure of slowly cooled steels, structure &amp; property relationship, classification and application of steels.</p> <p>Cast Irons: Classification, Manufacturing, Composition , Properties &amp; applications of white C.I., Grey cast iron, malleable C.I., S.G. cast iron, chilled and alloy cast iron, effect of various parameters on structure and properties of cast irons. Specific applications such as machine tools, automobiles, pumps, valves etc.</p> <p>Introduction to non-equilibrium cooling of steels, widmanstatten structure</p>
<p><b>Unit IV: Heat- treatment Of Steels</b> <span style="float: right;"><b>(6 Hrs)</b></span></p> <p>Transformation products of Austenite, Time Temperature Transformation diagrams, critical cooling rate, continuous cooling transformation diagrams. Heat treatment of steels: Annealing, Normalising, Hardening &amp; Tempering, quenching media, other treatments such as Martempering, Austempering, Patenting, Ausforming. Retention of austenite, effects of retained austenite. Elimination of retained austenite (Subzero treatment). Secondary hardening, temper embrittlement, quench cracks, Hardenability &amp; hardenability testing, Defects due to heat treatment and remedial measures.</p> <p>Classification of surface hardening treatments, Carburising, heat treatment after Carburizing, Nitriding, Carbo-nitriding, Flame hardening, and Induction hardening.</p>
<p><b>Unit V: Engineering Alloy Steels &amp; designation</b> <span style="float: right;"><b>(4 Hrs)</b></span></p> <p>Classification of alloy steels &amp; Effect of alloying elements, examples of alloy steels, stainless steels, sensitization &amp; weld decay of stainless steel, tool steels, heat treatment of high speed steel, special purpose steels with applications, super alloys. Heat affected zone. Designation (for plane &amp; alloy steels) : IS, AISI, SAE, DIN etc.</p>

<b>Unit VI: Non Ferrous Metals</b>	<b>(6 Hrs)</b>
<p>Classification of nonferrous metals. Importance of nonferrous metals in engineering applications &amp; compositions, study of different mechanical properties: Cu &amp; Cu based alloys, Al and Al based alloys, Ni and Ni based alloys, Co and Co based alloys, Titanium &amp; its alloys, Tin &amp; Lead base alloys, Bearing materials: important properties &amp; applications.</p>	
<b>Books:</b>	
<b>Text:</b>	
<ol style="list-style-type: none"> <li>1. “Material Science &amp; Metallurgy For Engineers”, Dr. V.D. Kodgire &amp; S. V. Kodgire , Everest Publication.</li> <li>2. “Mechanical Behaviour &amp; Testing Of Materials ”, A . K. Bhargava, C.P. Sharma P H I Learning Private Ltd.</li> </ol>	
<b>Reference:</b>	
<ol style="list-style-type: none"> <li>1. “Engineering Metallurgy”, Higgins R. A., Viva books Pvt. Ltd., 2004.</li> <li>2. “Material Science &amp; Engg.” Raghvan V., Prentice Hall of India , New Delhi. 2003</li> <li>3. Introduction to Physical Metallurgy, Avner, S.H., Tata McGraw-Hill, 1997.</li> <li>4. Engineering Metallurgy Dr. O.P. Khanna</li> </ol>	
<b>Term Work based on following</b>	
<ol style="list-style-type: none"> <li>1 Study &amp; Demonstration of Specimen Preparation for microscopic examination.</li> <li>2 Study of Optical Metallurgical microscope.</li> <li>3 Study and Drawing of Microstructure of Steels of various compositions.</li> <li>4 Study and Drawing of Microstructure of Cast Irons.</li> <li>5 Study and Drawing of Microstructure of Non Ferrous Metals.</li> <li>6 Heat treatment of Plain Carbon Steel and determination of relative hardness.</li> <li>7 Study and Drawing of Microstructure of Heat Affected Zone in Welding.</li> <li>8 Jominy End Quench Test for hardenability.</li> <li>9 Spark Test.</li> <li>10 Sulfur Printing Test.</li> <li>11 Flow Line Observation Test.</li> <li>12 Characterization techniques like SEM, TEM.</li> </ol>	
<b>Note : Out of above Twelve practical , any Eight practical should be conducted .</b>	

## 202050: Applied Thermodynamics

Teaching Scheme:	Credits	Examination Scheme:
TH: <b>04</b> hr/week	Th:04	TH In-Sem: 50
PR: <b>02</b> hrs/week	PR/OR/TW:01	End-Sem: 50
		PR: 50
		OR: --
		TW: --

**Prerequisites:** - 1. Engineering Thermodynamics.  
2. Engineering Mathematics

### Course Objectives:

- To get familiar with fundamentals of I. C. Engines, Construction and working Principle of an Engine and Compare Actual, Fuel-Air and Air standard cycle Performance.
- To study Combustion in SI and CI engines and its controlling factor in order to extract maximum power.
- To study emission from IC Engines and its controlling method, Various emission norms.
- Perform Testing of I. C. Engines and methods to estimate Indicated, Brake and Frictional Power and efficiencies
- To understand theory and performance Calculation of Positive displacement compressor.

### Course Outcomes:

On completion of the course, learner will be able to–

- Classify various types of Engines, Compare Air standard, Fuel Air and Actual cycles and make out various losses in real cycles.
- Understand Theory of Carburetion, Modern Carburetor, Stages of Combustion in S. I. Engines and Theory of Detonation, Pre-ignition and factors affecting detonation.
- Understand Fuel Supply system, Types of Injectors and Injection Pumps, Stages of Combustion in CI Engines, Theory of Detonation in CI Engines and Comparison of SI and CI Combustion and Knocking and Factors affecting, Criteria for good combustion chamber and types.
- Carry out Testing of I. C. Engines and analyze its performance.
- Describe construction and working of various I. C. Engine systems (Cooling, Lubrication, Ignition, Governing, and Starting) also various harmful gases emitted from exhaust and different devices to control pollution and emission norms for pollution control.
- Describe construction, working of various types of reciprocating and rotary compressors with performance calculations of positive displacement compressors.

<b>Course Contents</b>	
<p><b>Unit I Basics of IC Engines</b></p> <p>Heat Engine, IC and EC engines, I.C. Engine construction - components and materials, Engine nomenclature, Valve timing diagram, Intake and exhaust system, Engine classification, Applications.</p> <p><b>Fuel Air Cycle and Actual Cycle</b></p> <p>Fuel air cycle, Assumptions, Comparison with air standard cycle, Effect of variables on performance, Actual cycle and various losses, Comparison of Air standard Vs Fuel Vs Actual cycle.</p>	<p><b>(5 Hrs)</b></p> <p><b>(5 Hrs)</b></p>
<p><b>Unit II SI Engines</b></p> <p>Theory of Carburetion, Types of carburetors, Electronic fuel injection system, Combustion in spark Ignition engines, stages of combustion, flame propagation, rate of pressure rise, abnormal combustion, Phenomenon of Detonation in SI engines, effect of engine variables on Detonation. Combustion chambers, Rating of fuels in SI engines, Additives.</p>	<p><b>(5 Hrs)</b></p>
<p><b>Unit III CI Engines</b></p> <p>Fuel supply system, types of fuel pump, injector and distribution system, Combustion in compression ignition engines, stages of combustion, factors affecting combustion, Phenomenon of knocking in CI engine. Effect of knocking, Methods of knock control, Types of combustion chambers, rating of fuels in CI engines. Dopes &amp; Additives, Comparison of knocking in SI &amp; CI engines.</p>	<p><b>(5 Hrs)</b></p>
<p><b>Unit IV Testing of IC Engines</b></p> <p>Objective of testing, Various performance parameters for I.C. Engine - Indicated power, brake power, friction power, SFC, AF ratio etc. Methods to determine various performance parameters, characteristic curves, heat balance sheet.</p> <p><b>Supercharging</b></p> <p>Supercharging and turbo-charging methods and their limitations</p>	<p><b>(6 Hrs)</b></p> <p><b>(2 Hrs)</b></p>
<p><b>Unit V I.C. Engine Systems</b></p> <p>Cooling System, Lubrication System, Ignition System, Governing system, Starting System</p> <p><b>I.C. Engine Emissions and Control</b></p> <p>Air pollution due to IC engine and its effect, Emissions from petrol/gas and diesel engines, Sources of emissions, Euro norms, Bharat stage norms, Emission control methods for SI and CI engines</p>	<p><b>(6 Hrs)</b></p> <p><b>(4 Hrs)</b></p>

<p><b>Unit VI Positive Displacement Compressors (Reciprocating and Rotary) (10 Hrs)</b></p> <p><b>Reciprocating Compressor</b> - Single stage compressor – computation of work done, isothermal efficiency, effect of clearance volume, volumetric efficiency, Free air delivery, Theoretical and actual indicator diagram, Multistaging of compressor, Computation of work done, Volumetric efficiency, Condition for maximum efficiency, Inter-cooling and after cooling, Capacity control of compressors</p> <p><b>Rotary Compressor</b> – Introduction, vane compressors, roots blower, screw compressor. <b>(Numerical treatment on Reciprocating compressor single stage and multistage only)</b></p>
<p><b>Books:</b></p>
<p><b>Text:</b></p> <ol style="list-style-type: none"> <li>1) V. Ganesan: Internal Combustion Engines, Tata McGraw-Hill</li> <li>2) M.L. Mathur and R.P. Sharma: A course in Internal combustion engines, Dhanpat Rai</li> <li>3) H.N. Gupta, Fundamentals of Internal Combustion Engines, PHI Learning Pvt. Ltd.</li> </ol>
<p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Heywood: Internal Combustion Engine Fundamentals, Tata McGraw-Hill</li> <li>2. Domkundwar &amp; Domkundwar: Internal Combustion Engine, Dhanpat Rai</li> <li>3. R. Yadav: Internal Combustion Engine, Central Book Depot, Ahmedabad.</li> <li>3. S. Domkundwar, C. P. Kothandaraman, A. Domkundwar, Thermal Engineering, Dhanpat Rai &amp; Co.</li> </ol>
<p><b>List of Practical's:</b></p> <ol style="list-style-type: none"> <li>1. Study of Carburetor</li> <li>2. Study of Fuel pump and injector</li> <li>3. Study of Ignition System</li> <li>4. Demonstration &amp; study of commercial exhaust gas analyzers.</li> <li>5. Morse Test on Multi cylinder Petrol/ Diesel engine for determination of Friction power.</li> <li>6. Variable load test on diesel engine to determine various efficiencies, SFC and Heat balance sheet.</li> <li>7. Test on variable compression ratio engine.</li> <li>8. Visit to Automobile service station</li> <li>9. Test on Positive Displacement Air Compressor</li> <li>10. Assignment on any one advanced technology related to I.C. Engine such as VVT, VGT, HCCI</li> <li>11. Assignment on alternative fuels used in I.C. Engines.</li> </ol> <p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>1. Minimum 8 experiments should be performed.</li> <li>2. Perform any 3 from 1 to 4.</li> <li>3. Perform any 2 from 5, 6, and 7.</li> <li>4. Experiment 8 and 9 are compulsory.</li> </ol>



## 203152: Electrical and Electronics Engineering

Teaching Scheme:	Credits	Examination Scheme:
TH: 03 hr/week	Th:03	TH In-Sem [Online]: 50 End-Sem: 50
PR: 02 hrs/week	PR/OR/TW:01	PR: -- OR: -- TW: 25

**Prerequisites:** - 1. Basic Electrical Engineering 2. Basic Electronics Engineering

### Course Objectives:

#### To understand

1. Principle of operation and speed control of DC machines
2. Induction motor principle and its applications
3. Working principle of special purpose motors
4. Microcontrollers
5. Embedded systems terminologies and sensors
6. Data acquisition system for mechanical applications

### Course Outcomes:

#### Student should be able to

1. Develop the capability to identify and select suitable DC motor / induction motor / special purpose motor and its speed control method for given industrial application.
2. Program Arduino IDE using conditional statements
3. Interfacing sensors with Arduino IDE

### Course Contents

#### Electrical Engineering

#### Unit I D. C. Machines

**(6Hrs)**

Construction, working principle of D.C. generator, emf equation of D. C. generator (derivation not expected), 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 and shunt only), three-point starter for D.C shunt motor, methods for speed control of D.C. shunt and series motors, industrial applications.

#### Unit II Three Phase Induction Motors

**(6Hrs)**

Constructional feature, working principle of three phase induction motors, types; torque equation, torque slip characteristics; power stages; efficiency, starters (auto transformer starter, star delta starter); methods of speed control and industrial applications.

<b>Unit III Special Purpose Motors</b>	<b>(6 Hrs)</b>
Construction, working principle, characteristic and applications of stepper motors, A.C. and D.C servomotors, universal motors, industrial applications, brushless DC motors, linear induction motors, single phase induction motors,(types, construction, working principle of split phase and shaded pole type induction motors), descriptive treatment for AC series motor (difference between AC series and DC series motor, construction and working).	
<b>Electronics Engineering</b>	
<b>Unit IV Introduction to Microcontrollers</b>	<b>(6 Hrs)</b>
Introduction to microcontroller and microprocessors, role of embedded systems, open source embedded platforms, Atmega 328P- features, architecture, portstructure, sensors and actuators, data acquisition systems, introduction to Arduino IDE- features, IDE overview, programming concepts: variables, functions, conditional statements.	
<b>Unit V Peripheral Interface-1</b>	<b>(6 Hrs)</b>
Concept of GPIO in Atmega 328P based Arduino board, digital input and output, UART concept, timers, interfacing with LED, LCD and keypad, serial communication using Arduino IDE	
<b>Unit VI Peripheral Interface-2</b>	<b>(6Hrs)</b>
Concept of ADC in Atmega 328P based Arduino board, interfacing with temperature sensor (LM35), LVDT, strain gauge, accelerometer, concept of PWM, DC motor interface using PWM	
<b>Books:</b>	
<b>Text:</b>	
[T1] Edward Hughes “Electrical Technology”, ELBS, Pearson Education.	
[T2] Ashfaq Husain, “Electrical Machines”, Dhanpat Rai & Sons.	
[T3] S. K. Bhattacharya, “Electrical Machine”, Tata Mc Graw Hill publishing Co. Ltd, 2nd Edition.	
[T4] Nagrath & Kothari, “Electrical Machines”, Tata Mc Graw	
[T5]Electrical Machines, R. K. Rajput, Laxmi Publications, 2002	
[T6] Ajay Deshmukh, ‘Microcontrollers Theory and Applications’, TATA McGraw Hill	
[T7]Arduino microcontroller processing for everyone-Steven F Barret,Morgan and Claypool Publisher.	
[T8] C programming with ardino-Warwick Smith Elektor Publication.	

**Reference:**

[R1] Electrical Machines, Lowe, Nelson Publications.

[R2] A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, “Electrical Machines”, Tata McGraw Hill Publication Ltd. Fifth Edition.

[R3] Permanent Magnet Synchronous and Brushless DC Motor Drives, R. Krishnan, CRC press.

[R4] Smarajit Ghosh, “Electrical Machines”, Pearson Education, New Delhi.

[R5] Kenneth J. Ayala, ‘The 8051 Microcontroller’, Cengage Learning.

[R6] Started with Arduino by Massimo Banzi and Michael Shiloh Published by Maker Media, Inc.

[R7] Getting Started With Arduino: A Beginner's Guide by Brad Kendall (Author), Justin Pot (Editor), Angela Alcorn (Editor)

[R8] Arduino Cookbook, 2nd Edition by Michael Margolis published by O'Reilly Media.

[R9] Application notes from “ATMEL micro controller data book.”

[R10]

**Web References**

- 1) [www.alldatasheet.com](http://www.alldatasheet.com)
- 2) [www.atmel.com/products](http://www.atmel.com/products)

Unit	Textbooks	Reference books
1	T1,T2,T3,T4	R1,R2,R4
2	T1,T2,T3,T4,T5	R1,R2,R4
3	T1,T2,T3,T4	R1,R2,R3,R4
4	T6,T7,T8	R5,R6,R7,R10
5	T7,T8	R6,R7,R8,R9,R10
6	T7,T8	R6,R7,R8,R9,R10

**List of Practicals:****(Any 4 out of 1 to 6 and any 4 out of 7 to 12)****Electrical Engineering**

- 01) Speed control of DC shunt motor.
- 02) Brake test on DC shunt motor.
- 03) No load and blocked rotor test on 3 phase Induction Motor.
- 04) Load test on 3 phase Induction Motor.
- 05) Load test on single phase Induction Motor.
- 06) Study of starters for AC and DC motors.

**Electronics Engineering**

- 07) Interfacing of LED to blink after every 1 sec.
- 08) Display data using serial communication.
- 09) Interfacing of LCD to display the message and interface with keypad to display the key pressed.
- 10) Interfacing of temperature sensor (LM35) and show output on LCD/serial terminal.
- 11) Interfacing of strain gauge sensor and LVDT to measure the parameters.
- 12) Study of interfacing accelerometer to change the speed of DC Motor.

**Guidelines for Instructor's Manual****Practical Sessions -**

The Instructor's Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Connection diagram /circuit diagram
- Observation table
- Sample calculations for one reading
- Result table
- Graph and Conclusions.
- Data sheets of the ICs used( if any)

**Guidelines for Student's Lab Journal****For Electrical Practical**

1. Lab journal should be hand written
2. All the diagrams should be drawn on graph paper
3. Specifications of the instrument used for conduction of practical should be mentioned in respective write up.

**For Electronics Practical:**

1. Title of the program.
2. The program has to be written in the following format.  
Address- Instruction- Comment
3. Input data has to be specified.
4. Result of the program.
5. Flow Chart for each program has to be drawn on separate page.

**Guidelines for Lab /TW Assessment**

1. There is **Term Work** for the subject, so continuous assessment should be carried out such as checking of previous experiment.
2. While assessment, teacher should put the remark by writing word "Complete" and not simply "C". Put the signature along with date at the end of experiment and in the index.
3. Assign 10 marks for each experiment as per following format.

Timely completion = 03 marks

Neat and clean writing = 02 marks

Depth of understanding = 03 marks

Regular attendance = 02 marks

Maintain continuous assessment sheet. At the end of semester, convert these marks out of as prescribed in syllabus structure.

**Guidelines for Laboratory Conduction****Electrical Engineering Practicals**

1. Check whether the MCB / ELCB / main switch is off.
2. Make connections as per circuit diagram. Use flexible wire for connection of voltmeter and pressure coil connection of wattmeter. For rest of the connections, use thick wire. Do not keep loose connection. Get it checked from teacher / Lab Assistant.
3. Perform the experiment only in presence of teacher or Lab Assistant.
4. Do the calculations and get it checked from the teacher.
5. After completion of experiment, switch off the MCB / ELCB / main switch.
6. Write the experiment in the journal and get it checked within the week.

**Electronics Engineering Practicals**

1. The instructor is expected to shortlist necessary experiments from the suggested list of experiments.
2. During the practical session the instructor may divide the total students in groups of 4 to 5 students and assign them with different experiments to be performed.
3. Each student within the group has to enter and execute the program turn wise.
4. Staff member has to check the result of all the groups after the execution of the program.

**203153 : Machine Shop - I**

Teaching Scheme:		Credits	Examination Scheme:	
TH:	-- hr/week	Th/Tut:--	TH	In-Sem
				[Online]: --
				End-Sem: --
PR:	02 hrs/week	PR/OR/TW:01	PR:	--
			OR:	--
			TW:	25

**List of Practical's:**

1. Manufacture of spur gear on milling machine using indexing head.
2. Surface grinding using table grinder.
3. Manufacturing any one sheet metal component involving minimum three different operation (use dies and press).
4. Any two plastic component like bottle, bottle caps, machine handles, etc.