PUNE VIDYARTHI GRIHA'S

COLLEGE OF ENGINEERING AND TECHNOLOGY, PUNE-9

(AFFILIATED TO SAVITRIBAI PHULE PUNE UNIVERSIT, PUNE)

DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULUM BOOK

ACADEMIC YEAR: 2016-17

FOR THE PROGRAMME

S.E.(MECHANICAL ENGINEERING)

PUNE VIDYARTHI GRIHA'S

COLLEGE OF ENGINEERING AND TECHNOLOGY

VISION

TO ACHIEVE EXCELLENCE IN ENGINEERING EDUCATION

MISSION

- **To satisfy all stakeholders**
- **To develop ethical, highly motivated engineering professionals with good human values, requisite skills and competencies**
- **To adopt innovative teaching mechanisms**
- **To promote research culture**
- **To contribute to country's economic development**
- **To be responsive to changes in technology, socio-economic and environmental conditions**

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To become premier source of competent Mechanical Engineering professionals for providing service to the society.

MISSION

1. To provide state of the art facility and to offer opportunities for multifaceted development and enriching learning experience for students, faculty and staff.
2. To enhance the status as a recognized academic and research centre in collaboration with other institutions and industry.
3. To provide interactive and innovative teaching to transform students into competent engineering professionals having good ethical, social and human values.
4. To deliver ready to employ engineering graduates who are adaptable and practicing lifelong learning to meet the ever changing requirements of the employers.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1: To demonstrate the ability to design, develop products, systems and processes in multi-disciplinary engineering environment by application of principles of Science and Engineering.

PEO2: To develop experimental and computational skills necessary to formulate and solve industrial problems related to Mechanical Engineering.

PEO3: To offer sustainable solutions through research, technological competency, leadership skills and team work.

PEO4: To continue professional development through higher education and lifelong learning.

PEO5: To demonstrate socio-economic, ethical and environmental awareness while making professional decisions.

PROGRAMME OUTCOMES

The Programme Outcomes of the Department of Mechanical Engineering are:

Graduates of the mechanical engineering program will be able to -

PO1: Use basic knowledge in mathematics, science and engineering to solve problems specificto Mechanical engineering.

PO2: Investigate complex problems, gather data and then interpret and analyze the sameleading to a meaningful solution.

PO3:Identify, formulate and design a mechanical system that meets desired specifications.

PO4: Function as a coherent member in multidisciplinary design teams, and deliver resultsthrough collaborative research.

PO5: Identify, formulate and solve mechanical engineering problems of complex nature.

PO6: Understand their professional and ethical responsibilities, and use technology for thebenefit of mankind.

PO7: Communicate effectively in both verbal and written forms within and outside theengineering community, give and receive instructions.

PO8: Apply and understand impact of engineering solutions in societal and environmentalcontexts.

PO9: Self-educate and clearly understand the importance of lifelong learning.

PO10: Understand and apply the basic principles of project management and finance.

PO11: Apply modern computational tools to analyze mechanical engineering problems.

PO12: Design a mechanical system or, component to meet the desired needs within realisticconstraints such as economic, environmental, social, health and safety.

PROGRAMME SPECIFIC OUTCOMES

PSO1. Demonstrate competency in the areas of Thermal, Design and Manufacturing.

PSO2. Ability to use skills and tools to work in interdisciplinary areas of engineering

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Second Year

Curriculum Book

Syllabus Structure of SavitribaiPhule Pune University, Pune

Subject Code	Subject	Teaching Hours/Week			Examination Scheme					Total Marks	Credits	
		L	Tut.	P.	In-Sem	End-Sem	TW	Pr.	Oral		Lect/Tut	Pr/Or
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											
					--	--						
	Total	**19**	**02**	**08**	**250**	**250**	100	50	100	**750**	**20**	**05**
	Total of Part-I	**29 Hrs**				**750**					**25**	

Note: Material ScienceandEngineering Mathematics-IIIpracticalmaybe carried outfortnightly fortwohours, sothat the tutorial hours may be used as practical.

Subject Code	Subject	Teaching Hours/Week			Examination Scheme					Total Marks	Credits	
		L	Tut.	P.	In-Sem	End-Sem	TW	Pr.	Oral		Lect/Tut	Pr/Or
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
	Total	**18**	**02**	**10**	**250**	**250**	**100**	**100**	**50**	**750**	**18**	**07**
	Total of Part-II	**30 Hrs**				**750**					**25**	

Note: Theory of Machine-I and Engineering Metallurgypractical maybe carriedout fortnightly for twohours, so that the tutorial hours may be used as practical.

SE (Mechanical)

Semester I / II

Engineering Mathematics -III

Course Title: Engineering Mathematics -III		**Course Number: 207002**	
Year: SE		**Semester: I**	
Designation of Course		PROFESSIONAL	
Teaching Scheme: 4 Hrs/Week		**Tutorial:** 1 Hrs/Week	
Course Assessment Methods	**Direct methods**	On-line/In-semester Examination: 50 Marks	End Semester Examination: 50/70 Marks
			Practical/Oral/Term Work
	Indirect Methods	Tutorials, Assignments, Presentations, MCQ`S	Q&A session, Group Discussion
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:			
CO1	Solve higher order linear differential equations and apply to modeling and analyzing mass spring systems.		
CO2	Apply Laplace transform and Fourier transform techniques to solve differentia equations involved in the vibration theory .Heat Transfer & related engineering applications.		
CO3	Apply statistical methods like correlation, regression analysis in analyzing, interpreting experimental data and probability theory in testing and quality control.		
CO4	Perform vector differentiation and integration, analyze the vector fields and apply to fluid flow problems.		
CO5	Solve various partial differential equations such as wave equation, one and two dimensional heat flow equations.		
Course Contents			
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-springsystems, 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, 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,Scalalr potential ,vector fields.		
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	**Author**	**Title of Book**	**Publication**
T1	Erwin Kreyszig	Advanced Engineering Mathematics	Wiley Eastern Ltd
T2	Peter V .O`Neil	Advanced Engineering Mathematics	Cengage Learning
Reference Books			
R1	P.N.Wartikar	Applied Mathematics (Volumes I& II)	Pune Vidyarthi Griha Prakashan ,Pune
R2	ThomasL.Harman James Dabney	Advanced Engineering Mathematics with MATLAB	2eCole,Thomson Learning
R3	M.D.Greenberg	Advanced Engineering Mathematics	Pearson Education2e
R4	B.S.Grewal	Higher Engineering	Khanna Publication,

		Mathematics	Delhi
R5	B.V.Ramana	Higher Engineering Mathematics	Tata McGraw-Hill
Self-Learning Facilities, Web Resources, Research papers for reference	Handouts related to important formulas based on algebra ,trigonometric functions ,identities are provided into the initial lectures.		
Contents beyond Syllabus	Lagrange method(Method of variation of parameter) : To understand the particular integral if short cut method fails ,then use of general method involves laborious integration ,in such cases method of variation of parameter helps to determine complete solution . Lagrange Method is also studied for 3rd order linear differential Equation. This method may also be extented to higher order linear differential equations.		
Additional Experiments	NA		
Bridging Courses	Before the commencement of regular classes ,respective teachers conducts 20 minutes session on everyday basis for the first 15 days which focuses on class 12 level basic maths,also revision of certain important topics related to Engineering Mathematics- I and Engineering Mathematics-II are covered to understand the concepts of Engineering Mathematics-III.		
Tutorials	1. Numerical on complimentary function ,particular integral ,short cut methods .		
	2.Numerical on cauchys legendres differential equation , symmetric and simultaneous equations.		
	3.Numerical on fourier transform ,fourier cosine transform ,fourier sine transform		
	4.Numerical on inverse fourier transform ,inverse fourier cosine and inverse fourier sine transform .		
	5.Numerical on Laplace -Transform & Inverse Laplace-Transform		
	6.Numerical on. Statistical Methods & Probability & Probability Distribution		
	7.Numerical on vector algebra ,Gradient ,Divergence ,Curl.		
	8 Numerical on vector identities.		

Manufacturing Process - I

Course Title: Manufacturing Process - I		**Course Number:**	**Course Code:** 202041
Year: 2016		**Semester: 1**	
Designation of Course		Professional Core	
Teaching Scheme: 3 Hrs/Week		**Tutorial:**	
Course Assessment Methods	**Direct methods**	On-line Examination: 50 Marks	End Semester Examination: 50Marks
			Term Work
	Indirect Methods	Assignments, Presentations	
Prerequisites	Basic Mechanical Engineering , Engineering Mathamatics		
1	To make acquaintance of foundry processes pattern making and casting		
2	To study metal forming processes such forging, rolling, extrusion and wire drawing.		
3	To make study of different plastic molding processes		
4	To study metal joining processes		
5	To design and development of product with Sheet metal working process		
6	Introduction to center lathe		
Course Outcomes			
CO1	Understand and analyze foundry practices like pattern making, mold making, Core making and Inspection of defects.		
CO2	Understand and analyze Hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes.		
CO3	Understand different plastic molding processes, Extrusion of Plastic and Thermoforming		
CO4	Understand different Welding and joining processes and its defects		
CO5	Understand, Design and Analyze different sheet metal working processes		
CO6	Understand the constructional details and Working of Centre Lathe		
Course Contents			
Unit-I			
	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		
	Practical/Tutorial		

Unit-II			
	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		
	Practical/Tutorial		
Unit-III			
	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		
	Practical/Tutorial		
Unit-IV			
	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.		
	Practical/Tutorial		
Unit- V			
	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 .		
	Practical/Tutorial		
Unit-VI			
	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)		
	Practical/Tutorial		
Text Books	**Author**	**Title of Book**	**Publication**

T1	Hajara Choudhari, Bose S.K	Elements of workshop Technology Vol. I &II	Asian Publishing House
T2	D. K. Singh	Fundamentals of Manufacturing Engineering	Ane's Books. Pvt. Ltd
Reference Books			
R1	B. Ravi	Metal Casting – Computer Aided design and analysis	Prentice Hall of India
R2	Reikher	Casting: An analytical approach	Springer
R3	M.P Grover	Fundamentals of modern manufacturing: Materials and systems	
R4	A.S Athalye	Processing of plastic	Colour Publication (Pvt.)Ltd. U.K
R5	Cryil Donaldson and George H LeCain	Tool Design	Tata McGraw Hill Education Pvt. Ltd
Self-Learning Facilities, Web Resources, Research papers for reference	Nil		
Contents beyond Syllabus			
Additional Experiments			
Bridging Courses			
Tutorials			
Presentations			

Computer Aided Machine Drawing

Course Title : Computer Aided Machine Drawing		**Course Number :**	**Course Code : 202042**
Year : 2016-17		**Semester : I**	
Designation of Course		Professional Core	
Teaching Scheme: 4 Hrs/Week		**Tutorial :** Nil	
Course Assessment Methods	**Direct methods**	On-line/In-semester Examination: --	End Semester Examination: --
			Practical & Term Work
	Indirect Methods	Assignments, Presentations	Seminars, Quiz, Q&A session, Group Discussion
Prerequisites	1. Fundamentals Engineering Drawing 2. Projection of Solids 3. Basic knowledge of 2-D drafting using graphics software		
Course Objectives			
1	To understand Parametric Modeling Fundamentals, Procedure, and "Shape before Size" Approach.		
2	To develop an ability to Create Parametric 2-D Sketches, and Create and Edit Parametric Dimensions.		
3	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.		
4	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.		
5	To develop the ability to apply Limits, Fits, and Dimensional Tolerances, as well as Geometric Tolerances to components and assemblies on Engineering Drawings.		
6	To develop an ability to create 2D drawings from 3D models.		
Course Outcomes			
CO1	Understand the importance of CAD in the light of allied technologies such as CAM, CAE, FEA, CFD, PLM.		
CO2	Understand the significance of parametric technology and its application in 2D sketching.		
CO3	Understand the significance of parametric feature-based modeling and its application in 3D machine components modeling.		
CO4	Ability to create 3D assemblies that represent static or dynamic Mechanical Systems.		
CO5	Ability to ensure manufacturability and proper assembly of components and assemblies.		
CO6	Ability to communicate between Design and Manufacturing using 2D		

	drawings.		
Course Contents			
Unit-I	**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.		
	Practical/Tutorial		
	No separate Practical on the above topic.		
Unit-II	**Parametric Sketching**		
	Parametric sketching - draw and modify 2D entities, apply/modify constraints and dimensions.		
	Practical/Tutorial		
	Assignment on 2-D sketching with geometrical and dimensional constraints.		
Unit-III	**Parametric Solid Modelling**		
	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.		
	Practical/Tutorial		
	Assignment on parametric solid modeling of a machine component.		
Unit-IV	**Assembly Modelling**		
	Assembly modeling - defining relationship between various parts of machine, creation of constraints, generation of exploded view.		
	Practical/Tutorial		
	Assignment on solid modeling of the parts of a machine.		
Unit- V	**Geometric Dimensioning and Tolerancing**		
	Geometric dimensioning and tolerancing - Limits, Fits, Dimensional Tolerances, Geometric Tolerances, Introduction to ASME Y14.5 – 2009.		
	Practical/Tutorial		
	Assignment on assembly modeling of the parts modeled in assignment 3 using proper mating conditions and generation of exploded view.		
Unit-VI	**Production Drawing**		
	Production drawing – generation of 2-D sketches from parts and assembly 3-D model, appropriate dimensioning and tolerancing.		
	Practical/Tutorial		
	Generation of production drawings of the parts and assembly with appropriate tolerancing.		
Text Books	**Author**	**Title of Book**	**Publication**
T1	Bhat N. D.	Machine Drawing	Charotar Publications
T2	Ajeet Siingh	Machine Drawing	Mc Graw Hill Publications
Reference Books			
R1	-----	-----	-----
R2	-----	-----	-----
R3	-----	-----	-----
R4	-----	-----	-----

R5	-----	-----	-----
Self-Learning Facilities, Web Resources, Research papers for reference	Manual / Course Notes		
Contents beyond Syllabus	Nil		
Additional Experiments	Nil		
Bridging Courses	Nil		
Tutorials	Nil		
Presentations	Nil		

Thermodynamics

Course Title: Thermodynamics		**Course Number:**	**Course Code: 202043**
Year: S.E.		**Semester: I**	
Designation of Course		Professional Core	
Teaching Scheme: 4 Hrs/Week		**Practical : 2 Hrs/week**	
Course Assessment Methods	**Direct methods**	On-line/In-semester Examination: 50 Marks	End Semester Examination: 50 Marks
		Oral 50 Marks	Term Work: 25 Marks
	Indirect Methods	Assignments	Class Test
Prerequisites	1. Engg. Mathematics 2. Engg. Physics/Chemistry 3. Fundamental Concepts and laws of Thermodynamics		
Course Objectives			
1	Identify and use units and notations in Thermodynamics		
2	State and illustrate first and second laws of Thermodynamics		
3	Explain the concepts of entropy, enthalpy, reversibility and irreversibility		
4	Apply the first and second laws of Thermodynamics to various gas processes and cycles		
5	To get conversant with properties of steam, dryness fraction measurement, vapor processes and Thermodynamic vapor cycles, performance estimation		
6	To get conversant with Psychrometric Charts, Psychrometric processes, human comfort conditions		
Course Outcomes: On completion of the course, learner will be able to			
CO1	Apply various laws of thermodynamics to various processes and real systems		
CO2	Apply the concept of Entropy, Calculate heat, work and other important thermodynamic properties for various ideal gas processes		
CO3	Estimate performance of various Thermodynamic gas power cycles and gas refrigeration cycle and availability in each case		
CO4	Estimate the condition of steam and performance of vapour power cycle and vapour compression cycle		
CO5	Estimate Stoichiometric air required for combustion, performance of steam generators and natural draught requirements in boiler plants		
CO6	Use Psychromertic charts and estimate various essential properties related to Psychrometry and processes		
Course Contents			
Unit-I	**Laws of thermodynamics**		
	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
Unit-II	**Entropy and Ideal Gas**
	Entropy as a property, Clausius inequality, Principle of increase of Entropy, Change of entropy for an ideal gas and pure substance. **Ideal Gas definition Gas Laws**: 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.
Unit-III	**Thermodynamic cycles**
	Gas Power Cycles: Air Standard Cycle, Efficiency and Mean Effective Pressure, Carnot Cycle, Otto Cycle, Diesel cycle, Dual cycle, Comparison of cycles, Brayton cycle, **Gas Refrigeration Cycle:** Reversed Carnot, Bell Coleman Cycle. **Availability:**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.
Unit-IV	**Properties of Pure substances, Thermodynamic Vapour Cycle**
	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. **Vapour Power Cycles:** 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, **Vapour Refrigeration Cycles:** 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 **(Numerical treatment using R134a only and enthalpy Cp, Cv data should be provided in tabulated form).**
Unit- V	**Steam Generators**
	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 **(No Numerical Treatment on fuels and combustion, only basic definitions and terminologies to be covered)**. 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).

Unit-VI	Psychrometry
	Psychrometry and Psychrometric Properties, Basic Terminologies, Psychrometric Relations, Psychrometric Chart, Psychrometric Processes, Thermodynamics of Human Body, Comfort Conditions **(Numerical treatment using Psychrometric chart only).**

List of Practical's:

1. Joule's experiment to validate first law of thermodynamics.
2 Determination of dryness fraction of steam (At least two Calorimeters).
3. Experiment to Calculate COP of Simple Vapor Compression Cycle (VCC).
4. Study of Boiler Mountings
5. Study of Boiler Accessories
6. Trial on boiler to determine boiler efficiency, equivalent evaporation and Energy Balance
7. Industrial visit to any process industry which uses boiler and submission of detailed report
8. Demonstration of Psychrometric processes

Text Books	Author	Title of Book	Publication
T1	R. K. Rajput	Engineering Thermodynamics	Laxmi Publications
T2	P. K. Nag	Engineering Thermodynamics	Tata McGraw Hill Publications
Reference Books			
R1	Y. Cengel & Boles	Thermodynamics – An Engineering Approach	
R2	P. L Ballany	Thermal Engineering	Khanna Publishers
R3	C.P. Arora	Engineering Thermodynamics	Tata McGraw Hill
R4	S. Domkundwar, C. P. Kothandaraman, Anand Domkundwar	Thermal Engineering	Dhanpat Rai Publishers

Self-Learning Facilities, Web Resources, Research papers for reference	NPTEL lectures on Thermodynamics
Contents beyond Syllabus	Nil
Additional Experiments	Performance estimation of VCC using any professional software (CoolPack etc.) Performance estimation of Air standard cycle using standard simulation software's (MATLAB, VC++ etc.).
Bridging Courses	N.A.
Tutorials	One on each unit
Presentations	Nil

Material Science

Course Title: Material Science		**Course Number: 202044**	**Course Code:**
Year: Second Year		**Semester:** first	
Designation of Course		Professional Core/Elective/Humanities	
Teaching Scheme: 3 Hrs/Week		**Tutorial:** 1 Hr/Week	
Course Assessment Methods	**Direct methods**	On-line Examination: 50 Marks	End Semester Examination: 50 Marks
			Practical 50 Marks Term Work 25 Marks
	Indirect Methods	Assignments, Presentations	Quiz, Q&A session
Prerequisites			
Course Objectives			
1	To introduce the students to the relationships that exists between the structure and properties of engineering materials.		
2	To introduce the students to the production, properties and application of the major groups of engineering materials.		
3	Selection and application of different Metals & Alloys.		
4	To understand the structure of Engineering Materials.		
5	To develop futuristic insight into Materials.		
Course Outcomes			
CO1	Understand the basic concepts and properties of Material.		
CO2	Understand about material fundamental and processing.		
CO3	Select proper metal, alloys, non-metal and powder metallurgical component for specific requirement.		
CO4	Detect the defects in crystal and its effect on crystal properties.		
CO5	Evaluate the different properties of material by studying different test.		
CO6	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)		
	Practical/Tutorial		
	1. Numerical based on Indexing, Atomic packing factor, Density.		
Unit-II	Mechanical Behaviors of Metal & Materials (6 Hrs)		
	Introduction to Crystal imperfections & Classification , Crystal imperfections : point defects, line defects- edge and screw dislocations, surface defects, volume defects, Mechanism of Elastic & 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 & hot working		

	Practical/Tutorial
Unit-III	Destructive & Non-destructive Testing (8 Hrs)
	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, Brinnel, Poldi, Micro Hardness Test, Durometers, Impact test, fatigue test, creep test, Erichsen Cupping Test. Non Destructive testing: Principals & procedure, advantages, disadvantages and Industrial applications of NDT, such as Visual Inspection ,Liquid /dye penetrate test, Magnaflux test, Eddy current test, Sonic & Ultrasonic testing and Radiography testing
	Practical/Tutorial
	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.
Unit-IV	Metals Corrosion & Its Prevention (4 Hrs)
	Classification of corrosion : Dry corrosion & 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, Corrosion prevention methods : classification of different methods, e,g, inhibitors, cathodic & anodic protection, internal & external coatings, Low & High temperature corrosion. Design against corrosion.
	Practical/Tutorial
Unit- V	Surface Modification Methods. (6 Hrs)
	Importance of surface modification, classification of different methods & factors affecting : electroplating , PVD , CVD ,IVD, powder coating, shot blasting, ion implantation, plasma nitriding , anodizing, Surface preparation before coating & coating defects.
	Practical/Tutorial
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.		
	Practical/Tutorial		
	12. Study of Self lubricated Bearings / Cemented carbide tips ,in Powder Metallurgy		
Text Books	**Author**	**Title of Book**	**Publication**
T1	Kodgire V.D.	Material Science and Metallurgy	Everest publications
T2	Raghvan V.	Material Science & Engg.	Prentice Hall of India , New Delhi. 2003
Reference Books			
R1	Smith	Science of Engineering Materials	Prentice Hall
R2	Callister W. D., John Wiley	Materials Science and Engineering	
R3	Higgins R. A.	Engineering Metallurgy	Viva books Pvt. Ltd., 2004.
R4	Avner S.H.	Introduction to Physical Metallurgy,	Tata McGraw-Hill, 1997.
R5	Dieter, G.E.	Mechanical Metallurgy	McGraw-Hill, 1988.
Self-Learning Facilities, Web Resources, Research papers for reference	Nil		
Contents beyond Syllabus	Introduction to Advanced material for specific application in detail.		
Additional Experiments			
Bridging Courses			
Tutorials			
Presentations			

Strength of materials

Course Title: Strength of materials		**Course Number:**	**Course Code: 202051**
Year: Second Year		**Semester: III**	
Designation of Course		**Core**	
Teaching Scheme: 4 Hrs/Week		**Tutorial: Nil**	
Course Assessment Methods	**Direct methods**	On-line Examination: 50Marks	End Semester Examination: 50 Marks
			Practical/Oral
	Indirect Methods	Assignments	Quiz, Q&A session,
Prerequisites	1.Fundamentals of engineering mechanics 2. Analysis of forces and moments 3. Laws of motion, kinetics, kinematics 4. Algebra and trigonometry		
Course Objectives			
1	To analyze various types of stresses and strains, different elastic constants and their interrelations for structural members.		
2	To develop skill to draw shear force diagram and bending moment diagram from given loading conditions		
3	To introduce the theory of simple bending with flexure formula, shear stress with its formula and distribution across sections, deflection and slope of various types of beams for standard sections		
4	To introduce stresses and strain in shafts due to torsion alone and also due to combined effect of torsion, bending and axial forces.		
5	To introduce concept of buckling of columns leading to Euler's formula for variety of end conditions of columns.		
6	To introduce the concept of principal planes and principal stresses, locating principal planes and planes of maximum shear using analytical as well as graphical method.		
Course Outcomes :			
CO1	Students will be able to determine various constants of elasticity of a material and also calculate stress and strain induced in various types of structural member when subjected to axial loading.		
CO2	Students will be able to draw shear force diagrams and bending moment diagrams for a beam and thus determine bending stress and shear stress occurring in beams of variety of cross-sections with given loading conditions.		
CO3	Students will be able to determine deflections produced in the beams of various sections due to various types of loads.		
CO4	Students will be able to calculate the stress and strain in a shaft transmitting torque and determine safe load that can be supported by a short and a long column		
CO5	Students will be able to determine and illustrate principal stresses, maximum shearing stress acting on a structural member and locate the principal plane.		

CO6	Students will be able to determine the stresses and strains in members subjected to combined loading and apply the theories of failure for static loading.
Course Contents	
Unit-I	Simple stresses and strains
	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.
	Practicals
	1. Tension test for aluminum alloy and mild steel using extensometer. 2. Tension test for brass using extensometer 3. Shear test of ductile material on Universal Testing Machine.
Unit-II	**Shear Force and Bending Moment Diagrams**
	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.
	Practical
	Graphical simulation of Shear force and bending moment diagrams with different end conditions.
Unit-III	Stresses in Machine Elements
	Bending stresses : 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. **Shear stresses**: 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.
	Practicals
	1. Experimental verification of flexural formula in bending for cantilever beam. 2. Experimental verification of flexural formula in bending for simply supported beam. 3. Measurement of stresses and strains in beams for different end conditions using strain Gauges

Unit-IV	**A:Slope and deflection of beams, B: Strain energy:**
	A:Slope and deflection of beams: 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**: Strain energy due to axial load (gradual, sudden and impact), strain energy due to bending and torsion.
	Practical
	Graphical simulation of Slope and deflection.
Unit- V	**A:Torsion, B: Buckling of columns:**
	A:Torsion: 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:** 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
	Practical
	Experimental verification of torsion formula for circular bar.
Unit-VI	**A**: **Principal stresses and strains, B: Theories of elastic failure:**
	Principal stresses and strains: 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. 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), Concept of equivalent torsional and bending moments. **Theories of elastic failure:** Maximum principal stress theory, maximum shear stress theory, maximum distortion energy theory – their applications and limitations.
	Practical
	1.Experimental verification of von Mises theory of failure. 2.Graphical simulation of Principal stresses through graphical and analytical method.

Text Books	**Author**	**Title of Book**	**Publication**
T1	G. H. Ryder	Strength of Materials	Macmillan Pub, India
T2	S.S. Rattan	Strength of Material	Tata McGraw Hill Publication Co. Ltd.
T3	Ramamurtham	Strength of material	Dhanpat Rai Publication

T4	Timoshenko and Young	Strength of Materials	CBS Publication
Reference Books			
R1	Beer and Johnston	Strength of materials	CBS Publication
R2	E.P. Popov	Introduction to Mechanics of Solids	Prentice Hall Publication
R3	Singer and Pytel	Strength of materials	Harper and row Publication
R4	B.K. Sarkar	Strength of Material	Tata McGraw Hill New Delhi
Self-Learning Facilities, Web Resources, Research papers for reference	www.nptel.ac.in		
Contents beyond Syllabus	Nil		
Additional Experiments	Nil		
Bridging Courses	Nil		
Tutorials	Nil		
Presentations	Nil		

Fluid Mechanics

Course Title: Fluid Mechanics		**Course Number:**	**Course Code: 202045**
Year: S.E.		**Semester: II**	
Designation of Course		Professional Core	
Teaching Scheme: 4 Hrs/Week		**Practical : 2 Hrs/week**	
Course Assessment Methods	**Direct External methods**	On-line/In-semester Examination: 50 Marks	End Semester Examination: 50 Marks
		Oral 50 Marks	Term Work: 25 Marks
	Direct Internal Methods	Assignments	Class Test
Prerequisites	1. Engg. Mathematics 2. Engg. Physics		
Course Objectives			
1	To understand various properties of fluids and fluid statistics		
2	To understand fluid kinematics		
3	To understand fluid dynamics		
4	To learn Laminar and Turbulent flow physics and Internal flow		
5	To learn fluid flow through pipe and dimensional analysis		
6	To understand Boundary layer, Drag, Lift and external flows		
Course Outcomes: On completion of the course, learner will be able to			
CO1	Use various properties of fluids in solving the problems in fluid statistics		
CO2	Ascertain the type of flow and apply stream function and velocity potential function for visualization of flow field.		
CO3	Apply Bernaulli's equations to fluid flow problems		
CO4	Ascertain the type of flow and Estimate the shear stress distribution for piped laminar flow		
CO5	Estimate Major and minor losses in pipes. Apply dimensional analysis for dimensional homogeneity and dimensionless numbers.		
CO6	Estimate Drag and lift forces on submerged bodies.		
Course Contents			
Unit-I	**Fundamentals of Fluid Mechanics**		
	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)		
Unit-II	**Kinematics of Fluid Motion**		
	Eulerian and langragian 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 Streakline),vorticity in two dimensional flow, stream function and velocity potential function
Unit-III	**Fluid Dynamics**
	Introduction to flow models-control volume and infinitesimally small element, Linear momentum Equation using differential Approach, Introduction to Navier –Stokes equation, Euler equation of motion, derivation of Bernoulli's equation along streamline, concept of HGL and THL or TEL, application of Bernoulli's equation to venturimeter, Pitot tube, Submerged Orifices, Orifice meter, V-notch
Unit-IV	**Internal Flow**
	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.
Unit- V	**Flow through Pipes**
	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) Dimensional Analysis: Dimensions of Physical Quantities, dimensional homogeneity, Buckingham π Theorem and important dimensionless numbers.
Unit-VI	**External flows**
	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).

List of Practical's:

(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.

Text Books	**Author**	**Title of Book**	**Publication**
T1	Munson, Young and Okiishi	Fundamentals of Fluid Mechanics	Wiley India
T2	Dr. R.K. Bansal	Fluid Mechanics	Laxmi Publication (P) Ltd. New Delhi
T3	Modi P. N. and Seth S. M	Hydraulics and Fluid Mechanics	Standard Book House
Reference Books			
R1	Kundu, Cohen, Dowling	Fluid Mechanics	Elsevier India
R2	Chaim Gutfinger David Pnueli	Fluid Mechanics	Cambridge University press
R3	Edward Shaughnessy, Ira Katz James Schaffer	Introduction to Fluid Mechanics	OXFORD University Press
Self-Learning Facilities, Web Resources, Research papers for reference	NPTEL lectures on Fluid Mechanics		
Contents beyond Syllabus	Nil		
Bridging Courses	N.A.		
Tutorials	One on each unit		
Presentations	Nil		

Theory of Machines I

Course Title: Theory of Machines I		**Course Number: C210**	**Course Code:202048**
Year: 2016-17		**Semester: II**	
Designation of Course		Professional Core/~~Elective/Humanities~~	
Teaching Scheme: 4 Hrs/Week		**Tutorial:**1 Hr/Week	
Course Assessment Methods	**Direct methods**	On-line/~~In-semester~~ Examination: 50/~~30~~Marks	End Semester Examination: 50/~~70~~Marks
			~~Practical~~/Oral/Term Work
	Indirect Methods	Assignments	
Prerequisites	1. Engineering Mathematics 2. Engineering Physics 3. Engineering Mechanics		
Course Objectives			
1	To provide the fundamentals of kinematic of machines, governing laws to predict the motion of linkages.		
2	To explain the engineering concept and working of different bearing, clutches and brakes.		
3	To develop the analytical & graphical skills to find motion parameters and procedure to carry static and dynamic force analysis of simple mechanisms.		
4	To relate the theoretical procedure with experimental methods to find moment of inertia of rigid bodies.		
Course Outcomes			
CO1	a) Apply the theoretical concepts of various kinematic links, pairs, degree of freedom and their kinematic attributes to real life mechanism/machine to predict the relative motion.		
CO2	Develop and perform the laboratory experiments on the basis of theoretical concepts to find moment of inertia of connecting rod and other rigid bodies using theories of compound pendulum, bifilar suspension, trifillar suspension.		
CO3	Analyze the torque transmission/absorption by plate clutches, centrifugal clutches, pivot bearing, collar bearings etc.		
CO4	Evaluate the motion parameters like displacement, velocity and acceleration of various links in mechanisms by analytical methods.		
CO5	Develop the instantaneous graphical solution of motion parameters of different mechanisms with the help relative method and ICR method.		
CO6	Develop the instantaneous graphical solution of motion parameters involving Coriolis acceleration.		

Course Contents	
Unit-I	**Fundamentals of Kinematics and Mechanisms**
	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),Kutzbachcrieterion, 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.
	Practical/Tutorial
	Draw (any 4) configurations of mechanisms and determine types of pairs, links, degree of freedom.
Unit-II	**Static and Dynamic Force Analysis**
	Theory and analysis of Compoundof equivalent length of pendulum, Bifilar suspension, Trifilar suspension. Dynamics of reciprocating engines: Two mass statically and dynamically equivalent system, correction couple, static and dynamic force analysis of reciprocating engine mechanism (analytical method only), Crank shaft torque, Introduction to T-θ diagram. Friction: Friction in turning pair, friction circle, friction axis, friction in slider crank mechanism.
	Practical/Tutorial
	1. To determine experimentally the mass moment of inertia of a connecting rod using a compound pendulum method 2. To determine experimentally the mass moment of inertia of a flat bar using bifilarsuspension method or to determine experimentally the mass moment of inertia of aflywheel/gear/circular disc using trifilar suspension method.
Unit-III	**Friction Clutches, Brakes and Dynamometer**
	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

	Practical/Tutorial
	Numerical based on Friction Clutches, Brakes and Dynamometer Or to measure torque transmitting capacity of friction clutch experimentally.
Unit-IV	**Kinematic Analysis of Mechanisms: Analytical Method**
	Analytical method for displacement, velocity and acceleration analysis of slider crankMechanism. 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 usingvector and complex algebra methods. Hooke's joint, Double Hooke's joint.
	Practical/Tutorial
	1. Numerical based on - single and double Hooke's joint. 2. One problem on velocity and acceleration analysis using: Vector algebra and Complexalgebra and comparison of results.
Unit- V	**Velocity and Acceleration Analysis of Simple Mechanisms: Graphical Methods-I**
	Relative velocity method: Relative velocity of a point on a link, Angular velocity of a link, Sliding velocity, Velocity polygons for simple mechanisms. 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) 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.
	Practical/Tutorial
	1. Two problemson velocity and acceleration analysis using relative velocity and acceleration method. 2. Two problemson velocity analysis using ICR method.
Unit-VI	**Velocity and Acceleration Analysis of Mechanisms: Graphical Methods-II**
	Velocity and acceleration diagrams for the mechanisms involving Coriolis component of acceleration. (limit to only 4 link mechanisms) Klein's construction.
	Practical/Tutorial
	1. Two problemson velocity and acceleration analysis using relative velocity and acceleration method involving Coriolis component. 2. Problems on velocity and acceleration analysis using Klein's construction for uniformand non-uniform crank velocity.

Text Books	Author	Title of Book	Publication
T1	S. S. Ratan	Theory of Machines	Tata McGraw Hill.
T2	Ashok G. Ambekar	Mechanism and Machine Theory	Prentice Hall, India
Reference Books			
R1	Shigley J. E., and Uicker J.J.,	Theory of Machines and Mechanism	McGraw Hill Inc
R2	Ghosh Amitabh and Mallik A. K	Theory of Machines and Mechanism	East- West Press.
R3	Wilson C.E., Sandler J. P.	Kinematics and Dynamics of Machinery	Person Education.
R4	Erdman A.G. and Sandor G.N.,	Mechanism Design, Analysis and Synthesis	Prentice –Hall of India
R5	Shigley J. E	Mechanical Engineering Design	McGraw Hill Inc.
Self-Learning Facilities, Web Resources, Research papers for reference	NPTEL Video Lectures		
Contents beyond Syllabus	Introduction to Synthesis of Mechanisms.		
Additional Experiments	---		
Bridging Courses	--		
Tutorials	--		
Presentations	--		

Engineering Metallurgy

Course Title: Engineering Metallurgy		**Course Number: 202048**	**Course Code:**
Year: Second Year		**Semester: second**	
Designation of Course		Professional Core/Elective/Humanities	
Teaching Scheme: 3 Hrs/Week		**Tutorial: 1 Hr/Week**	
Course Assessment Methods	**Direct methods**	On-line Examination: 50 Marks	End Semester Examination: 50 Marks
			Term Work 25 Marks Oral
	Indirect Methods	Assignments, Presentations	Seminars, Quiz, Q&A session
Prerequisites			
Course Objectives			
1	To acquaint students with the basic concepts of Metal Structure		
2	To impart a fundamental knowledge of Ferrous & Non Ferrous Metal		
3	Processing Selection and application of different Metals & Alloys		
4	To Know Fundamentals of Metallography		
5	To develop futuristic insight into Metals.		
Course Outcomes			
CO1	Describe how metals and alloys formed and how the properties change due to microstructure		
CO2	Apply core concepts in Engineering Metallurgy to solve engineering problems		
CO3	Conduct experiments, as well as to analyze and interpret data		
CO4	Select materials for design and construction.		
CO5	Possess the skills and techniques necessary for modern materials engineering practice		
CO6	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.		
	Practical/Tutorial		

Unit-II	Micro & macroscopic study of Metals (6 Hrs)
	Classification of metal observations: their definition, difference & importance. Microscopy: Various sampling techniques, specimen preparation, specimen mounting (hot & cold mounting) electrolytic polishing, etching procedure and reagents, electrolytic etching. Microscopic techniques : optical microscopy, electron microscopy, transmission electron microscopy (TEM),scanning electron microscopy (SEM), scanning probe microscopy (SPM), AFM etc. (principal & application only) Study of Metallurgical microscope .Measurement of grain size by different methods & effect of grain size on various mechanical properties. Macroscopy: Sulphur printing, flow line observations, spark test.
	Practical/Tutorial
	1 Study & Demonstration of Specimen Preparation for microscopic examination. 2 Study of Optical Metallurgical microscope. 9 Spark Test. 10 Sulfur Printing Test. 11 Flow Line Observation Test. 12 Characterization techniques like SEM, TEM
Unit-III	Iron-Carbon alloy system & Cast Iron (8 Hrs.)
	Iron-iron carbide equilibrium diagram, critical temperatures, solidification and microstructure of slowly cooled steels, structure & property relationship, classification and application of steels. Cast Irons: Classification, Manufacturing, Composition , Properties & 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. Introduction to non-equilibrium cooling of steels, widmanstaten structure
	Practical/Tutorial
	3 Study and Drawing of Microstructure of Steels of various compositions. 4 Study and Drawing of Microstructure of Cast Irons. 5 Study and Drawing of Microstructure of Non Ferrous Metals. 7 Study and Drawing of Microstructure of Heat Affected Zone in Welding.
Unit-IV	Heat- treatment Of Steels (6 Hrs)
	Transformation products of Austenite, Time Temperature Transformation diagrams, critical cooling rate, continuous cooling transformation diagrams. Heat treatment of steels: Annealing, Normalising, Hardening & 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 & hardenability testing, Defects due to heat treatment and remedial measures. Classification of surface hardening treatments, Carburising, heat treatment after Carburizing, Nitriding, Carbo-nitriding, Flame hardening, and Induction hardening
	Practical/Tutorial
	6 Heat treatment of Plain Carbon Steel and determination of relative hardness. 8 Jominy End Quench Test for hardenability.

Unit- V	Engineering Alloy Steels & designation (4 Hrs)
	Classification of alloy steels & Effect of alloying elements, examples of alloy steels, stainless steels, sensitization & 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 & alloy steels) : IS, AISI, SAE, DIN etc.
	Practical/Tutorial
Unit-VI	Non Ferrous Metals (6 Hrs)
	Classification of nonferrous metals. Importance of nonferrous metals in engineering applications & compositions, study of different mechanical properties: Cu & Cu based alloys, Al and Al based alloys, Ni and Ni based alloys, Co and Co based alloys, Titanium & its alloys, Tin & Lead base alloys, Bearing materials: important properties & applications.
	Practical/Tutorial

Text Books	**Author**	**Title of Book**	**Publication**
T1	Dr. V.D. Kodgire	Material Science and Metallurgy for Engineers	Everest Publication
T2	A.K. Bhargava, C.P.Sharma	Mechanical Behaviour & Testing Of Materials	P H I Learning Private Ltd
Reference Books			
R1	Higgins R. A.	Engineering Metallurgy	Viva books Pvt. Ltd., 2004.
R2	Raghvan V	Material Science and Engineering.	Prentice Hall of India , New Delhi. 2003
R3	Avner S.H.	Introduction to Physical Metallurgy,	Tata McGraw-Hill, 1997.
R4	Dr. O.P.Khanna	Engineering Metallurgy	

Self-Learning Facilities, Web Resources, Research papers for reference	Nil
Contents beyond Syllabus	
Additional Experiments	
Bridging Courses	
Tutorials	
Presentations	

Applied Thermodynamics

Course Title: Applied Thermodynamics		**Course Number:202050**	**Course Code: 202050**
Year: S.E.		**Semester: I**	
Designation of Course		Professional Core	
Teaching Scheme: 4 Hrs/Week		**Practical : 2 Hrs/week**	
Course Assessment Methods	**Direct methods**	On-line/In-semester Examination: 50 Marks	End Semester Examination: 50 Marks
		Oral 50 Marks	Term Work: 25 Marks
	Indirect Methods	Assignments	Class Test
Prerequisites	1. Engineering Thermodynamics. 2. Engineering Mathematics		
Course Objectives			
1	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.		
2	To study Combustion in SI and CI engines and its controlling factor in order to extract maximum power.		
3	To study emission from IC Engines and its controlling method, Various emission norms.		
4	Perform Testing of I. C. Engines and methods to estimate Indicated, Brake and Frictional Power and efficiencies		
5	To understand theory and performance Calculation of Positive displacement compressor		
Course Outcomes: On completion of the course, learner will be able to			
CO1	Classify various types of Engines, Compare Air standard, Fuel Air and Actual cycles and make out various losses in real cycles.		
CO2	Understand Theory of Carburetion, Modern Carburetor, Stages of Combustion in S. I. Engines and Theory of Detonation, Pre-ignition and factors affecting detonation		
CO3	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.		
CO4	Carry out Testing of I. C. Engines and analyze its performance		
CO5	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		
CO6	Describe construction, working of various types of reciprocating and rotary		

	compressors with performance calculations of positive displacement compressors.
Course Contents	
Unit-I	**Basics of IC Engines, Fuel Air Cycle and Actual Cycle**
	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. 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.
Unit-II	**S.I.Engines**
	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.
Unit-III	**C.I.Engines**
	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 & Additives, Comparison of knocking in SI & CI engines.
Unit-IV	**Testing of IC Engines , Supercharging**
	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. Supercharging and turbo-charging methods and their limitations
Unit- V	**I.C. Engine Systems, I.C. Engine Emissions and Control**
	Cooling System, Lubrication System, Ignition System, Governing system, Starting System. 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
Unit-VI	**Positive Displacement Compressors (Reciprocating and Rotary)**
	Reciprocating Compressor - 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 **Rotary Compressor –** Introduction, vane compressors, roots blower, screw compressor. **(Numerical treatment on Reciprocating compressor single stage and multistage only)**

List of Practical's:
1. Study of Carburetor
2. Study of Fuel pump and injector
3. Study of Ignition System
4. Morse Test on Multi cylinder Petrol/ Diesel engine for determination of Friction power.
5. Test on variable compression ratio engine.
6. Visit to Automobile service station
8. Test on Positive Displacement Air Compressor

Text Books	**Author**	**Title of Book**	**Publication**
T1	V. Ganesan	Internal Combustion Engines	Tata McGraw-Hill
T2	M.L. Mathur and R.P. Sharma	A course in Internal combustion engines	Dhanpat Rai
Reference Books			
R1	Heywood	Internal Combustion Engine Fundamentals	Tata McGraw-Hill
R2	Domkundwar & Domkundwar	Internal Combustion Engine	Dhanpat Rai
R3	R. Yadav	Internal Combustion Engine	Central Book Depot, Ahmedabad
R4	S. Domkundwar, C. P. Kothandaraman, Anand Domkundwar	Thermal Engineering	Dhanpat Rai Publishers
Self-Learning Facilities, Web Resources, Research papers for reference	NPTEL lectures on Thermodynamics		
Contents beyond Syllabus	Webinars on Latest Automobile Technology		
Additional Experiments	1.Assignment on any one advanced technology related to I.C. Engine such as VVT, VGT, HCCI 2. Assignment on alternative fuels used in I.C. Engines.		
Bridging Courses	N.A.		
Tutorials	One on each unit		
Presentations	one each on I.C.Engine systems		

Electrical and Electronics Engineering

Course Title:Electrical and Electronics Engineering		**Course Number: 203152**	**Course Code:203152**
Year: 2016		**Semester: II**	
Designation of Course		Professional Core/Elective	
Teaching Scheme: 3 Hrs/Week		**Practical:2hrs/week**	
Course Assessment Methods	**Direct methods**	On-line/In-semester Examination: 50Marks	End Semester Examination: 50Marks
			Practical/Oral/Term Work
	Indirect Methods	Assignments, Presentations	Seminars, Quiz, Q&A session, Group Discussion
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			
CO1	Develop the capability to identify and select suitable DC motor / induction motor / specialpurpose motor and its speed control method for given industrial application.		
CO2	Program Arduino IDE using conditional statements		
CO3	Interfacing sensors with Arduino IDE		
Course Contents			
Unit-I	**D. C. Machines (6Hrs)**		
	Construction, working principle of D.C. generator, emf equation of D. C. generator (derivationnot expected), working principle of D.C. motor, types of D.C. motor, back emf, torque equationfor D.C. motor, characteristics of D.C. motor (series and shunt only), three-point starter for D.Cshunt motor, methods for speed control of D.C. shunt and series motors, industrial applications.		
	Practical/Tutorial		
	1. Speed control of DC shunt motor. 2. Brake test on DC shunt motor.		
Unit-II	**Three Phase Induction Motors (6Hrs)**		

	Constructional feature, working principle of three phase induction motors, types; torqueequation, torque slip characteristics; power stages; efficiency, starters (auto transformer starter,star delta starter); methods of speed control and industrial applications.
	Practical/Tutorial
	1. No load and blocked rotor test on 3 phase Induction Motor. 2. Load test on 3 phase Induction Motor.
Unit-III	**Special Purpose Motors (6 Hrs)**
	Construction, working principle, characteristic and applications of stepper motors, A.C. andD.C servomotors, universal motors, industrial applications, brushless DC motors, linearinduction motors, single phase induction motors,(types, construction, working principle of splitphase and shaded pole type induction motors), descriptive treatment for AC series motor(difference between AC series and DC series motor, construction and working).
	Practical/Tutorial
	1. Load test on single phase Induction Motor. 2. Study of starters for AC and DC motors.
Unit-IV	**Introduction to Microcontrollers (6 Hrs)**
	Introduction to microcontroller and microprocessors, role of embedded systems, open sourceembedded platforms, Atmega 328P- features, architecture, portstructure, sensors and actuators,data acquisition systems, introduction to Arduino IDE- features, IDE overview, programmingconcepts: variables, functions, conditional statements.
	Practical/Tutorial
	.
Unit- V	**Peripheral Interface-1 (6 Hrs)**
	Concept of GPIO in Atmega 328P based Arduino board, digital input and output, UARTconcept, timers, interfacing with LED, LCD and keypad, serial communication using ArduinoIDE.
	Practical/Tutorial
	1.Interfacing of LED to blink after every 1 sec 2. Display data using serial communication. 3.Interfacing of LCD to display the message and interface with keypad to display the key pressed 4. Interfacing of temperature sensor (LM35) and show output on LCD/serial terminal.
Unit-VI	**Peripheral Interface-2 (6Hrs)**
	Concept of ADC in Atmega 328P based Arduino board, interfacing with temperature sensor(LM35), LVDT, strain gauge, accelerometer, concept of PWM, DC motor interface usingPWM.

	Practical/Tutorial		
	1. Interfacing of strain gauge sensor and LVDT to measure the parameters. 2. Study of interfacing accelerometer to change the speed of DC Motor.		
Text Books	**Author**	**Title of Book**	**Publication**
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
T4	Nagrath & Kothari	Electrical Machines	Tata Mc Graw
T5	R. K. Rajput	Electrical Machines	Laxmi Publications, 2002
T6	Ajay Deshmukh	Microcontrollers Theory and Applications'	TATA McGraw Hill
T7	Steven F Barret,Morgan	Arduino microcontroller processing for everyone	Claypool Publisher.
T8	Warwick Smith	C programming with ardino	Elektor Publication
Reference Books			
R1	Lowe	Electrical Machines	Nelson Publications.
R2	A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans	Electrical Machines	Tata McGraw Hill Publication Ltd. Fifth Edition
R3	R. Krishnan	Permanent Magnet Synchronous and Brushless DC Motor Drives	CRC press.
R4	Smarajit Ghosh	Electrical Machines	Pearson Education, New Delhi.
R5	Kenneth J. Ayala	The 8051 Microcontroller'	Cengage Learning
R6	Massimo Banzi and Michael	Started with Arduino	Shiloh Published by Maker Media, Inc.
R7	Brad Kendall (Author	Getting Started With Arduino: A Beginner's Guide	Justin Pot (Editor), Angela Alcorn (Editor)
R8	Michael Margolis	Arduino Cookbook-2nd Edition	O'Reilly Media
R9		ATMEL micro controller data book	
Self-Learning Facilities, Web Resources, Research papers for reference	www. alldatasheet.com www.atmel.com/products		

Contents beyond Syllabus	Working of Microcontrollers 8051 and its comparison with Arduino. Recent applications of Arduino
Additional Experiments	
Bridging Courses	Basic Electrical Engineering,Basic Electronics Engineering at FE level
Tutorials	
Presentations	1.Working of DC Motor and DC generator 2.Working of Three phase induction motors 3.working of Universal Motor 4. Single phase induction motor. 5.Atmega 328P- features, architecture, portstructure 6.UART concept, timers.