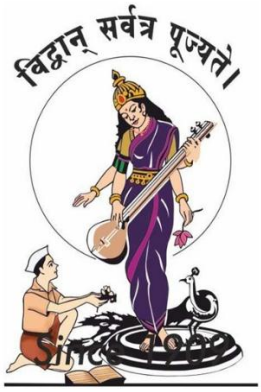


PUNE VIDYARTHI GRIHA'S

COLLEGE OF ENGINEERING AND TECHNOLOGY, PUNE-9

(AFFILIATED TO SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE)

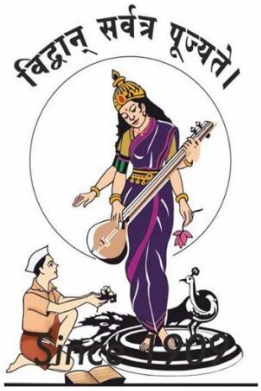
DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULUM BOOK

ACADEMIC YEAR: 2019-20

FOR THE PROGRAMME

MECHANIAL ENGINEERING (UNDER GRADUATE)



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**

Vision of the Department

"To become premier source of competent Mechanical Engineering professional for providing service to the society"

Mission of the Department

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

The Program Educational Objectives

- **PEO-I:** To demonstrate the ability to design, develop products, systems and processes in multi-disciplinary engineering environment by application of principles of Science and Engineering
- **PEO-II:** To develop experimental and computational skills necessary to formulate and solve industrial problems related to Mechanical Engineering
- **PEO-III:** To offer sustainable solutions through research, technological competency, leadership skills and team work
- **PEO-IV:** To continue professional development through higher education and lifelong learning
- **PEO-V:** To demonstrate socio-economic, ethical and environmental awareness while making professional decisions

Program Outcomes (POs)

Mechanical Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to

comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

1. **Demonstrate competency in the area of Thermal, Design, Manufacturing and to apply skills in multidisciplinary areas of engineering.**
2. **Face competitive examinations that offer challenging and rewarding careers (pursuing higher studies, general administration or entrepreneurship) in mechanical engineering or other areas.**

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SE (Mechanical)

Curriculum Book

Syllabus Structure of Savitribai Phule Pune University, Pune

S. E. (Mechanical) 2015 course Semester – I

(w.e.f. Academic year 2019-20)

Subject Code	Subject	Teaching Scheme Hours/Week			Examination Scheme					Total Marks	Credits	
		L	Tut.	PR	In-Sem (online)	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**	

S. E. (Mechanical) Semester – II

Subject Code	Subject	Teaching Scheme Hours/Week			Examination Scheme					Total Marks	Credits	
		L	Tut.	PR	In-Sem (online)	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**	

SE (Mech)

Semester I

Engineering Mathematics- III

Course Title: Engineering Mathematics -III		**Course Number:207002**	
Year: SE(Mechanical)		**Semester: I**	
Type of Course	Basic		
Teaching Scheme: 4 Hrs/Week		**Tutorials:** 1 Hr/Week	
Course Assessment Method Examples	**Direct methods**	On-line Examination: 50Marks	Theory Examination: 50Marks
		Term-work 25 Marks	Practical/Oral: ----
	Indirect Methods	Tutorials,Assignments, Presentations, MCQs	Q&A session, Group Discussion
Course Prerequisites	A student requires sufficient amount of knowledge of certain topics related to Engineering Mathematics –I & Engineering Mathematics-II, to understand the concepts of Engineering Mathematics-III.		
Course Objectives	1.Linear Differential Equation with constant coefficient & its application.		
	2.Fourier Transform ,application to FT problems on one & two dimensional heat flow problem, Laplace Transform ,its properties ,LT of some special functions ,applications of LT for solving differential equation.		
	3.Measures of central tendency,Standard deviation, Coefficient of Variation,Moments,Skewness,Kurtosis, Correlation and Regression, Probability,Probability distribution, Test of hypothesis.		
	4.Vector Differential Calculus ,physical interpretation of vector differentiation ,Gradient ,Curl ,Divergence ,Directional Derivative ,Solenoidal ,Irrotational .		
	5.Vector Integral Calculus & its application ,line surface & volume integrals ,Stokes Theorem ,Divergence Theorem.		
	6.Application to partial differential equation.		
Course Outcomes			
C207.1	Demonstrate wide knowledge in topics like Linear Differential Equations & its application.		
C207.2	Demonstrate the ability for understanding the concepts of Fourier Transform, Demonstrate the ability for understanding the concepts of laplace transform ,LT of standard functions ,Inverse LT		
C207.3	Demonstrate wide knowledge in topics Statistics and probability		
C207.4	Demonstrating the physical interpretation of vector differentiation, by understanding Gradient ,Divergence ,Solenoidal Field ,Irrotational Field.		
C207.5	Demonstrating the interpretation of vector integral calculus & its application by understanding line , surface ,volume integrals green`s lemma theorem, Gauss Divergence Theorem ,Stokes Theorem.		
C207.6	Demonstrate &evaluate the application of partial differential Equations.		
Course Contents			
Unit-I	**LINEAR DIFFERENTIAL EQUATION WITH CONSTANT COEEFICIENTS**		

	Differential equation of 1st order , 1st degree ,explanation about Order and degree of differential equation.Introduction to the concepts of complimentary function and particular integral.Various methods of finding particular integral namely General Method, Variation Parameter, Short Cut Method.Introduction to LDE with constant coefficients, Homogeneous equations,Cauchy`s & Legendre`s DE, Simultaneous & Symmetric Simultaneous DE.		
Unit-II	**FOURIER TRANSFORM & LAPLACE TRANSFORM**		
	Fourier Transform ,understanding of exponential form of Fourier series Fourier integral theorem, meaning of sine and cosine integrals and their inverses Fourier transform ,its meaning standard properties , and their inverses. Uses of fourier Transform in solving difference equations. Laplace transform of standard functions ,properties & theorems,LTof standard functions ,special functions ,periodic unit step, unit impulse,inverse Laplace transform application of Laplace transforms to solve DE, liquid level systems ,second order systems.		
Unit-III	**STATISTICS AND PROBABILITY**		
	Measures of central tendency,Standard deviation, Coefficient of Variation,Moments,Skewness,Kurtosis, Correlation and Regression, Probability,Probability distribution, Test of hypothesis		
Unit-IV	**VECTOR DIFFERENTIAL CALCULUS**		
	Physical Interpretation of vector differentiation, Radial ,transverse & Normal componentsOf velocity & acceleration, vector differential operator, Gradient, Divergence & Curl.Directional derivatives Solenoidal, Irrotational & Conservative fields Scalar Potential ,Vector Identities.		
Unit- V	**VECTOR INTEGRAL CALCULUS**		
	Line, surface ,volume integral & its application to find work done ,Green`s Lemma theorem, Gauss`s Divergence Theorem, Stoke`s Theorem Application to problem in electromagnetic fields.		
Unit-VI	**APPLICATION OF PARTIAL DIFFERENTIAL EQUATIONS**		
	Basic concepts of partial differential equations ,modeling of vibration string ,heat flow equations ,method of separation of variables Problems based on application of PDE to chemical and allied engineering.		
Text Books	Author	Title of Book	Publication & Edition
T1	Erwin Kreyszig	Advanced Engineering Mathematics	Wiley Eastern Ltd
T2	Peter V .O`Neil	Advanced Engineering Mathematics	Thompson Learning
Reference Books			
R1	P.N.Wartikar	Applied Mathematics (Volumes I& II)	Pune Vidyarthi Griha Prakashan ,Pune

R2	Thomas L.Harman James Dabney & Norman Richert	Advanced Engineering Mathematics with MATLAB	2eCole, Thomson Learning
R3	M.D.Greenberg	Advanced Engineering Mathematics	Pearson Education2e
R4	B.S.Grewal	Higher Engineering Mathematics	Khanna Publication, Delhi
Self-Learning Material (OCW, Handouts, Web Recourses, Research papers etc.)	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 (If any)	NIL		
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 12level 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.		
Assignments			
Assignment No.1& Assignment No.2	Numerical on C.F,P.I ,Shortcut cases Cauchys &Legendres Equation ,Symmteric and simultaneous Equations, Numerical on Fourier transform ,inverse fourier transform .		
Assignment No.3 &Assignment No.4	Numerical on Laplace Transform ,inverse laplace transform . Numerical on vector algebra ,gradient ,divergence ,curl & vector identities		
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 of standard Functions ,properties & general theorems
	6.Numerical on Statistics and Probability
	7.Numerical on vector algebra ,Gradient ,Divergence ,Curl.
	8 Numerical on vector identities.

Manufacturing Processes I

Course Title: Manufacturing Processes I		**Course Number: 202041**	**Course Code:**
Year: Second Year		**Semester: I**	
Designation of Course		Professional Core	
Teaching Scheme: 3Hrs/Week		**Tutorial:**	
Course Assessment Methods	**Direct methods**	Online e Examination: 50 Marks	End Semester Examination: 50 Marks
	Indirect Methods	Assignments	Class Test
Prerequisites	Basic Mechanical Engineering, mathematics		
Course Objectives			
1	To make acquaintance of foundry processes like pattern making and casting		
2	To study metal forming processes such forging, rolling, extrusion and wire drawing		
3	To make study of different plastic moulding processes		
4	To study metal joining processes		
Course Outcomes			
CO1	Student will be able to **understand** and **analyse** foundry practices like pattern making mould making, Core making and Inspection of defects		
CO2	Student will be able to **understand** and **analyse** hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes.		
CO3	Student will be able to **Understand** different plastic moulding processes, Extrusion of Plastic and Thermoforming		
CO4	Student will be able to **Understand** different Welding and joining processes and its defects		
CO5	Student will be able to **Understand, Design and Analyze** different sheet metal working processes		
CO6	Student will be able to **Understand** the constructional details and Working of Centre Lathe		
Course Contents			
Unit-I	**Casting Processes**		
	SAND CASTING – Pattern- types, material and allowances, Moulding sand- types, properties and testing, Moulding – 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**		
	, Hot and Cold Working – Concepts and comparative study, Material behaviour 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**		
	Moulding – Compression moulding, Transfer moulding, Blow moulding, Injection moulding – 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**		
	. 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**		
	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**		
	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)		
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
T3			
Reference Books			
R1	Reikher	Casting: An analytical approach	Springer

R2	M.P Grover	Fundamentals of modern manufacturing: Materials and systems	
R3	Cryil Donaldson and George H LeCain	Tool Design	Tata McGraw Hill Education Pvt. Ltd. 6
Self-Learning Facilities, Web Resources, Research papers for reference	Nil		
Contents beyond Syllabus	Nil		
Additional Experiments	Nil		
Bridging Courses	Nil		
Tutorials	Nil		
Presentations	Nil		

Computer Aided Machine Drawing

Course Title : Computer Aided Machine Drawing		**Course Number: 202042**	**Course Code:**
Year: 2019-20		**Semester: I**	
Designation of Course		**Professional Core Teaching Scheme**: 4 Hrs/Week	
Teaching Scheme: 4 Hrs/Week		**Tutorial: Nil**	
Course Assessment Methods	**Direct Methods**	Practical & Term Work	On – Line / In - Semester
	Indirect Methods	Assignments	Class Test
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. Assignment on parametric solid modeling of a machine component.
	Practical/Tutorial
	Assembly Modelling
Unit-IV	Assembly modeling - defining relationship between various parts of machine, creation of constraints, generation of exploded view.
	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.		
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			
Self-Learning Facilities, Web Resources, Research papers for reference	Manual / Course Notes		
Contents beyond Syllabus			
Additional Experiments	NIL		
Bridging Courses	NIL		
Tutorials	NIL		
Presentations	NIL		

Thermodynamics

Course Title: Thermodynamics		**Course Number: C204**	**Course Code: 202043**
Year: S.E.		**Semester: One**	
Designation of Course		Professional Core	
Teaching Scheme: 4 Hrs/Week		**Tutorial:** Nil	
Course Assessment Methods	**Direct methods**	Online Examination: 50 Marks	End Semester Examination: 50 Marks
			Oral 50 Marks
	Indirect Methods	Assignments	Class Test
Prerequisites	Engineering Mathematics, Engineering Physics Engineering Chemistry, 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			
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**
	Entropy as a property, Clausius inequality, Principle of increase of Entropy, Change of entropy for an ideal gas and pure substance. ***Ideal Gas*** **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**
	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. ***Thermodynamic Vapour Cycle*** **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 Practicals	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.		
Text Books	**Author**	**Title of Book**	**Publication**
T1	R. K. Rajput	Engineering Thermodynamics	Tata McGraw-Hill
T2	P. K. Nag	Engineering Thermodynamics	PHI EEE ISBN978-81-203-3360-4
Reference Books			
R1	Y. Cengel and Boles	Thermodynamics A Engineering approach	McGraw Hill International editions
R2	P. L. Ballany	Thermal Engineering	Khanna Publisher
R3	C. P. Arora	Engineering Thermodynamics	Tata McGraw Hill Publications
R4	S. Domkundwar, C. P. Kothandraman, And Domkundwar	Thermal Engineering	Dhanpat Rai Publication
Self-Learning Facilities, Web Resources, Research papers for reference	NPTEL Video Lectures		
Contents beyond Syllabus	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	**External methods**	On-line Examination: 50 Marks	End Semester Examination: 50 Marks
			Term Work 25 Marks
	Internal Methods	Assignments	Class Test, MCQ
Prerequisites	Engineering Chemistry		
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 On completion of the course, learner will be able to			
CO1	Identify the basic crystal structure of metals and materials.		
CO2	Detect the defects in crystal and its effect on crystal properties. And recognize effect of cold-working and hot working.		
CO3	Evaluate different Mechanical properties of material through various tests		
CO4	Identify the methods for the prevention of Metals corrosion.		
CO5	Describe and Select surface modification methods.		
CO6	Select proper metal, alloys, non-metal and powder metallurgical components for specific requirement.		
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 Behaviours 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	NPTEL lectures http://nptel.iitm.ac.in		
Contents beyond Syllabus	Introduction to Advanced material for specific application in detail.		
Additional Experiments			
Bridging Courses			
Tutorials			
Presentations	Prepared by students on corrosion and Surface Modification Methods		

Strength of Materials

Course Title : Strength of materials		**Course Number : C206**	**Course Code : 202051**
Year : Second Year Engg. (SE)		**Semester : III**	
Designation of Course		**Professional Core**	
Teaching Scheme: 4 Hrs/Week		**Tutorial : Nil**	
Course Assessment Methods	**Direct methods**	On-line Examination: 50 Marks	End Semester Examination: 50 Marks
			Practical/Oral
	Indirect Methods	Class Test	Assignments
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		
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
R2	E.P. Popov	Introduction to Mechanics of Solids	Prentice Hall
R3	Singer and Pytel	Strength of materials	Harper and row
R4	B.K. Sarkar	Strength of Material	Tata McGraw Hill New
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		