Sanjivani Rural Education Society's

Sanjivani College of Engineering, Kopargaon

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

B. Tech. Mechanical Engineering

2021 Pattern

Curriculum

(B. Tech. with effect from Academic Year 2021-2022)

(S. Y. B. Tech. Sem-III & IV with effect from Academic Year 2022-2023)

At. Sahajanandnagar, Post. Shingnapur Tal. Kopargaon Dist. Ahmednagar,

Maharashtra State, India PIN 423603

Vision of Department

Our vision is to develop world class, multidimensional, competent, disciplined and ethicalMechanical engineers for the society.

Mission of Department

Our mission is,

- To impart the quality education to the students through class-room teaching, innovative projects, and industry-institution interaction.
- To provide a better environment to encourage and support participation in co-curricular and extra-curricular activities.
- To use technology of Mechanical Engineering as a prime tool for the multifaceted developmentof our students in the emerging fields of Engineering.

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 andreceive 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 Educational Objectives (PEOs)

PEO1: To develop graduates with a sound technical knowledge for a successful career inindustries, higher studies and as an entrepreneur.

PEO2: To prepare graduates with expertise in use of modeling, analysis and programmingsoftware.

PEO3: To inculcate interpersonal skills with ethical approach and contribute towards social,personal, economic and environmental issues.

Program Specific Outcomes (PSOs)

At the end of the program graduates will demonstrate ability to

PSO1. Design and manufacture mechanical components and systems

PSO2. Model and analyze machine components using modeling and analysis software's.

PSO3. Specify, analyze and determine the performance of thermal systems including IC engines, refrigeration and air conditioning systems, air compressors, hydraulic turbines and pumps.

LIST OF ABBREVIATIONS			
Abbreviation	**Full Form**	**Abbreviation**	**Full Form**
ES	Engineering Science	HSMC	Humanity Science
PC	Professional Core	CA	Continuous Assessment
PE	Professional Elective	OR	End Semester Oral Examination
OE	Open Elective	PR	End Semester Practical Examination
ISE	In-Semester Evaluation	TW	Continuous Term work Evaluation
ESE	End-Semester Evaluation	BSC	Basic Science Course
PRJ	Project	MC	Mandatory Course

COURSE STRUCTURE- 2021 PATTERN

SECOND YEAR B. TECH: MECHANICAL ENGINEERING

SEMESTER-III

Cat.	Code	Course Title	Teaching Scheme			Credits	Evaluation Scheme-Marks					
			L (hrs)	T (hrs)	P (hrs)		Theory		TW	OR	PR	Total
							CIA	ESE				
PCC	ME201	Basic Thermodynamics	3	-	-	3	40	60	-	-	-	100
BSC	BS202	Engineering Mathematics-III	3	1	-	4	40	60	-	-	-	100
PCC	ME203	Strength of Materials	3	-	-	3	40	60	-	-	-	100
PCC	ME204	Manufacturing Process	3	-	-	3	40	60	-	-	-	100
HSMC	HS205	Universal Human Values & Ethics (UHV)	3	-	-	3	40	60	-	-	-	100
PCC	ME206	Lab-I (Machine Drawing & GM)	1	-	4	3	-	-	-	-	50	50
PCC	ME207	Lab-II (Open Source)	-	-	2	1	-	-	50	-	-	50
PCC	ME208	Lab-III (Strength of Materials)	-	-	2	1	-	-	-	50	-	50
PCC	ME209	Lab-IV (MP)	-	-	2	1	-	-	-	-	50	50
MLC	MC210	Mandatory Course-III	1	-	-	No	-	-	-	-	-	-
		Total	17	1	10	**22**	**200**	**300**	**50**	**50**	**100**	**700**

SEMESTER-IV

Cat.	Code	Course Title	Teaching Scheme			Credits	Evaluation Scheme-Marks					
			L (hrs)	T (hrs)	P (hrs)		Theory		TW	OR	PR	Total
							CIA	ESE				
PCC	ME211	Applied Thermodynamics	3	-	-	3	40	60	-	-	-	100
PCC	ME212	Theory of Machines	4	-	-	4	40	60	-	-	-	100
PCC	ME213	Fluid Mechanics	3	-	-	3	40	60	-	-	-	100
PCC	ME214	Numerical Methods	3	-	-	3	40	60	-	-	-	100
PCC	ME215	Materials Science & Metallurgy	3	-	-	3	40	60	-	-	-	100
HSMC	HS216	Corporate Readiness - I	-	-	2	1	-	-	50	-	-	50
PCC	ME217	Lab-I (ATD+BT+FM)	-	-	2	1	-	-		-	50	50
PCC	ME218	Lab-II (NM)	-	-	2	1	-	-	-	-	25	25
PCC	ME219	Lab-III (MSM)	-	-	2	1	-	-	-	25	-	25
PCC	ME220	Lab-IV (TOM)	-	-	2	1			-	25	-	25
PRJ	ME221	Mini project/Project Based Learning	-	-	2	1	-	-	-	25	-	25
MLC	MC222	Mandatory Course-IV	1	-	-	No	-	-	-	-	-	-
		Total	18	-	10	**22**	**200**	**300**	**50**	**75**	**75**	**700**

MC210	**Mandatory Course-III**	**Constitution of India**
MC222	**Mandatory Course-IV**	**Foundations of IoT**

Note: *For evaluation of Oral/Practical/TW, students should submit the journal regularly. Non submission of journal will be treated as absentees in concern head.*

Basic Thermodynamics (ME 201) (2021 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week		
Practical:	- Hrs./ Week	**End Sem Exam:**	60 Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA:**	40 Marks
Credits:	**3**	**Total:**	100 Marks

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Prerequisite Course: Applied Physics, Basic mechanical Engineering, Mathematics.

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Course Objectives:

1. To understand of the fundamental concepts and Laws of thermodynamics
2. To be able to use of seam tables/ Mollier chart for reading properties of steam.
3. To be able to apply the first Law of thermodynamics
4. To be able to apply Second Law of Thermodynamics to different systems
5. To understand the equations and processes governing the ideal gas behavior
6. To learn types and properties of fuels and combustion equations to find stoichiometric air fuel ratio

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	**Determine** work and heat interaction for thermodynamic processes.	3	Apply
CO2	**Determine** the properties of steam and their effect on performance of vapour power cycle	3	Apply
CO3	**Apply** first law of thermodynamics to non-flow and steady flow processes/devices.	3	Apply
CO4	**Apply** the Second Law of Thermodynamics to different systems and **Determine** the change in entropy for reversible and irreversible processes.	3	Apply
CO5	**Evaluate** heat transfer, work transfer & other important thermodynamic entities for the processes undergone by ideal gas	4	Analyze
CO6	**Determine** stoichiometric mass & volume of air for complete combustion of a given fuel	3	Apply

Course Contents

Unit	**Contents**	No.of Hours	COs
1	**Thermodynamic Concepts and Basic Definitions**		
	Role of thermodynamics in mechanical Engineering, Thermodynamic System, Boundary, Types of system, State of system, Properties of system, Classification of properties ,Thermodynamic equilibrium, Zeroth law of thermodynamics. Definition of work & heat, Comparison of heat & work, types of work and their evaluation for thermodynamic processes.	6 Hrs.	CO1
2	**Properties of Pure Substance**		
	Formation of steam, phase-change phenomenon of a pure substance, Properties of steam, Use of Steam Tables, Study of P-v, T-s diagram. Mollier diagram for steam, Dryness fraction of steam and its determination, Study of steam calorimeters (Seperating and throttling calorimeter only) **Vapour Power Cycles:-** Rankine cycle.(Simple Numerical Treatment considering superheated steam) Efficiency of cycle .	6 Hrs	CO2
3	**First Law of Thermodynamics**		
	First law of thermodynamics, Joules experiment, Applications of first law to flow and non flow processes and cycles.(Numerical Treatment) Perpetual motion machine of the first kind (PMM I). Steady Flow Energy Equation (SFEE), Application of SFEE for devices such as nozzle and diffuser, throttling Device , turbine and compressor, heat exchanger.(Simple numerical on SFEE)	6 Hrs	C03
4	**Second Law of Thermodynamics**		
	Limitations of first law of thermodynamics, Thermal reservoir, Heat Engine, Refrigerator and Heat pump: Schematic representation, Efficiency and Coefficient of Performance (COP), (Numerical Treatment), Kelvin-Planck & Clausius Statement of the Second law of Thermodynamics , Perpetual motion machine of second kind (PMM – II), Concept of Reversibility and Irreversibility.	6 Hrs	C04

	Entropy as a property , Clausius' theorem, Clausius inequality, (Numerical Treatment) Change in entropy in reversible and irreversible processes, Principle of increase of entropy, Introduction to third law of thermodynamics **Availability**: Available and Unavailable Energy		
5	**Ideal Gas Properties and Processes:**		
	Ideal Gas Laws, Equation of State, Ideal Gas constant and Universal Gas constant, Various processes (Constant P/T/V/H and Polytropic), p-v and T-s diagrams Calculations of heat transfer, work done, internal energy, Change in entropy, enthalpy. (Numerical Treatment)	6 Hrs	CO5
6	**Introduction to Fuels and Combustion**		
	Fuels: Definition & classification of fuels, Proximate and ultimate analysis of fuel, Combustion theory, Combustion Equations, Theoretical and Excess air requirements, Equivalence ratio, **Calorific value** - HCV & LCV. Bomb and Junkers gas calorimeters, (Numerical on Bomb Calorimeter)	6 Hrs.	C06

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2					2	2					2
CO2	2	2	1	2					2	2					2
CO3	3	2	1	2					2	2					2
CO4	2	2	1	2					2	2					2
CO5	3	2	1	1					2	2					2
CO6	3	2	1	1					2	2					2

Text Books

1.	P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill Publications, 4th Edition.
2.	Yonus A Cengel and Michale A Boles, "Thermodynamics: An Engineering Approach", McGraw Hill Education, 8th Edition.
3.	R.K. Rajput, "Engineering Thermodynamics", Laxmi Publications Pvt Ltd, 3rd Edition
4.	Onkar Singh, "Applied Thermodynamics", New Age International Publishers, 3rd Edition.
5.	P. L Ballaney, "Thermal Engineering", Khanna Publishers, 7th Edition 2012
6.	Domkundwar, Kothandaraman and Domkundwar,"Thermal Engineering",Dhanpat Rai Publishers , 6th Edition 2008

Reference Books

1	Moran & Shapiro, "Fundamentals of Engineering Thermodynamics", John Wiley & Sons Inc., 7th edition, 2012
2	Sonntag, Borgnakke& Van Wylen, "Fundamentals of Thermodynamics", John Wiley & Sons Inc., 7th edition, 2012
3	Sadhu Singh, "Thermal Engineering", Pearson India Education Services Pvt. Ltd
4	Y. V. C. Rao, "Theory and Problems in Thermodynamics", 2nd edition, 2012

CIA Activities:

Sr No	Title of Activity	PO Attained
1	**CIA – I (20 Mark) .**Two Test will be conducted base on unit 1 to 4	PO1 , PO2, PO3
2	**CIA – II (20 Marks)** consist of any two of the following.(Assignment, Presentation, Problem based learning, Self-Learning and Tutorial)	PO4, PO5, PO9, PO10, PO11, PO12

Mathematics III [BS 202]

SEM-3 (Civil, Mechanical, Structural, Electrical)

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Teaching Scheme
Lectures: 03 Hrs./ Week
Tutorials: 01 Hrs./ Week

Examination Scheme
End Sem Exam: 60 Marks
Teacher Assessment: 40 Marks
Total: 100 Marks
Credits: 04

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COURSE OBJECTIVES

1 To make students familiarize with concepts and techniques of vector calculus, probability and differential calculus.

2 The intent is to furnish them with the techniques to understand engineering mathematics and its applications that would develop logical thinking power, useful in their disciplines.

COURSE OUTCOMES

The Students are able to

1. **describe** the basics of vector algebra, **apply** it to calculate directional derivative, divergence and curlof vector function.
2. **understand** the concept, vector integration, **apply** it to solve engineering problems using Green'stheorem, Stoke's theorem, Gauss's theorem.
3 **analyze** solution of ordinary differential equations **using** iterative, interpolation methods.
4 **apply** integral transform technique to **solve** equations involved in engineering applications**.**
5 **analyze** data, **find** mean, correlation, regression of a statistical data, calculate probability usingdifferent distributions.
6 **apply** partial differential equation and **solve** practical problems in engineering.

CO's	Course Outcomes The Students are able to	Bloom's Taxonomy	
		Level	**Descriptor**
CO1	**describe** the basics of vector algebra, **apply** it to calculatedirectional derivative, divergence and curl of vector function	**3**	**Apply**
CO2	**understand** the concept, vector integration, **apply** it to solve engineering problems using Green's theorem, Stoke's theorem, Gauss's theorem	**3**	**Apply**
CO3	**analyze** solution of ordinary differential equations **using** iterative, interpolation methods	**4**	**Analyze**
CO4	**apply** integral transform technique to **solve** equations involved in engineering applications**.**	**3**	**Apply**
CO5	**analyze** data, **find** mean, correlation, regression of a statisticaldata, calculate probability using different distributions.	**4**	**Analyze**
CO6	**apply** partial differential equation and **solve** practical problemsin engineering	**3**	**Apply**

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	1	1	1	-	-
CO2	3	2	-	-	-	-	-	1	1	1	-	-
CO3	2	3	-	-	1	-	-	1	1	1	-	-
CO4	3	2	-	-	-	-	-	1	1	1	-	-
CO5	2	2	-	-	1	-	-	1	1	1	-	-
CO6	3	3	-	-	-	-	-	1	1	1	-	-

COURSE CONTENTS

Unit-I	**VECTOR DIFFERENTIATION**	**No.of Hours**	**COs**
	Scalar and vector point function, Derivative of a vector point function, Gradient of scalar function ∅, Directional derivative, Divergence and Curl of vector point function, Solenoidal and irrotational vector field and scalar potential, vector identities.	06	1
Unit-II	**VECTOR INTEGRATION**	**No.of Hours**	**COs**
	Line integral, Green's theorem, Work done, Conservative field, surface integral, Stokes theorem, volume integral, Gauss Divergence theorem, Equation of Stream line.	06	2
Unit-III	**NUMERICAL METHODS**	**No. of Hours**	**COs**
	Interpolation with unequal intervals: Lagrange's formulae, Interpolation using Newton's forward and backward difference formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rdand 3/8 rules. Numerical Differentiation: Euler and modified Euler's methods, Runge-Kutta method of fourth order for solving first order equations.	06	3
Unit-IV	**FOURIER TRANSFORM**	**No. of Hours**	**Cos**
	Dirichlet's Condition, Definition of Fourier transform, Properties of Fourier transform, Fourier Cosine transform, Fourier sine transform, Inverse Fourier transform.	6	4
Unit-V	**BASIC STATISTICS AND PROBABILITY**	**No. of Hours**	**Cos**
	Measures of Central tendency, Moments, Skewness and Kurtosis, Correlation and regression, Definitions of probability,Bay's theorem, Distribution function, Binomial, Poisson and normal distributions	6	5

Unit-VI	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	No. of Hours	COs
	Separation of variables; solutions of one dimensional diffusion equation; first and second order one-dimensional wave equationand two dimensional Laplace equations.	06	6

Text Book(s)

1. B. S. Grewal, Higher Engineering Mathematics, 42/e, Khanna Publishers, 2012, **ISBN-13:978-8174091154.**
2. Scott Miller, Donald Childers, Probability and Random Processes, 2 Ed, Elsevier, 2012.
3. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa PublishingHouse, 2014. **ISBN-13: 978-1842653418.**

References

1. K.A. Stroud & D. S. Booth, Advanced Engineering Mathematics, Industrial Press, 5/e,2011, **ISBN-9780831134495**
2. P. C. Matthews, Vector Calculus, Springer, 2/e, 2012, **ISBN-9783540761808**
3. T. Veerarajan, Probability Statistics and random processes, Tata McGraw Hill, 3/e, 2008. **ISBN 13: 9780070669253.**
4. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley, 9/e, 2013, **ISBN-13: 978-0471488859.**

STRENGTH OF MATERIALS [ME203] (2021 Pattern)
S.Y. Tech. Mechanical

Teaching Scheme
Lectures: 3 Hrs. / Week
Practical: -----
Credits: 3

Examination Scheme
Continuous Assessment: 40 Marks
End Sem Exam: 60 Marks
Total: 100 Marks

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Pre-requisite Course: Applied Mechanics, Mathematics
Post-requisite Course: Machine Design -I & II, Mechanical System Design, Finite Element Analysis, Project

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Course Overview:

The subject strength of material encompasses the fundamentals of all material properties starting from simple stresses, principle stresses to buckling and torsion, material behaviour under different loading conditions like shear, temperature and bending, and also the knowledge of material failures. The concepts of stress, strain, stress-strain diagram is very much useful in selection of material in machine design process. It also includes concepts like principal stresses and strains which is important tool for understanding material failure. The concepts of shear force and bending moment diagrams are helpful in designing machine elements like shafts, frames. Whenever any component is subjected to different types of loading then its behaviour can be understood from the concepts like deflection, bending, torsion and buckling.

Course Objectives :

To study the concepts of stress, strain, principal stresses and principal planes.
To study the concept of shearing force and bending moment due to external loads in determinate beams.
To compute slopes and deflections in determinate beams
To determine stresses and deformation in circular shafts due to torsion.
To determine safe load for columns for different end conditions

Course Outcomes (COs): Students will be able **to**

Course Outcome	Statements	Blooms Taxonomy	
		Level	Descriptor
CO1	solve problems based on stresses and strains for engineering materials	3	Apply
CO2	compute shear force and bending moment diagrams for determinate beams due to external loads	3	Apply
CO3	differentiate between the bending stresses, shear stresses and their distribution diagrams	4	Analyze
CO4	determine slope and deflection due to external loads in determinate beams.	3	Apply
CO5	differentiate between the torque transmitting capacity of the shaft on the basis of strength and rigidity.	4	Analyze
CO6	calculate the principal stresses and strains developed in mechanical structures based on theories of failures	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2		2			2	2	2		2	2		
CO2	2	2	2		3			2	2	2		2	2		
CO3	3	3	3		3			2	2	2		2	2		
CO4	2	3	2		3			2	2	2		2	2		
CO5	3	2	2		3			2	2	2		2	2		
CO6	3	3	2		3			2	2	2		2	2		

Course Contents

Unit	Contents	No. of Hours	COs
1	**Stresses and strains**		
	Stress, strain, types of stresses, Stress-strain diagram for ductile and brittle materials, Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants, factor of safety. Temperature stresses in simple beams	6 Hrs.	CO1
2	**Shear force and bending moment diagrams**		
	Shear force and bending moment diagrams for statically determinate beams 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 point of contra flexure.	6 Hrs.	C02
3	**Bending and Shear Stresses**		
	Bending stresses: Theory of simple bending, assumptions, derivation of flexural formula, second moment of area for (circular, Hollow, rectangular, I,T) sections with respect to centroidal and parallel axes, bending stress distribution diagrams, **Shear stresses:** Derivation of shear stress distribution formula, shear stress distribution diagrams for (circular, Hollow, rectangular, I,T) sections.	6 Hrs.	C03
4	**Slope and deflection of beams**		
	Slope and deflection of beams: Slope and deflection of determinate beams, double integration method, Macaulay's method, Castigliano's theorem derivation of formula for slope and deflection for standard cases.	6 Hrs.	C04
5	**Buckling and Torsion**		
	Buckling of columns: Derivation of Euler's formula for buckling load for column with hinged ends, concept of equivalent length for end conditions-both ends hinged, both ends fixed, one end hinged and one end is fixed, limitations of Euler's formula, Rankine's formula, safe load on columns. **Torsion:** Stresses, strain and deformations in determinate shafts of solid and hollow, homogeneous and subjected to twisting moment, derivation of torsion equation, stresses due to combined torsion, bending and axial loads.	6 Hrs.	C05
6	**Principal stresses and strains**		
	Principal stresses and strains: Normal and shear stresses on any oblique plane. Derivation of expression for principal stresses and maximum shear stress. Graphical solution using Mohr's circle of stresses. **Theories of elastic failure:** Maximum principal stress theory, maximum shear stress theory, maximum distortion energy theory.	6 Hrs.	CO6

Reference Books

Text Books:

1) R K Bansal, “A Textbook of Strength of Materials”, 6th Edition, Laxmi Publications, 2010
2) S.S. Rattan “ Strength of Materials” Tata McGraw Hill Education (India) Pvt. Ltd., 2nd Edition, 2010
3) Ramamurtham - Strength of material - Dhanpat Rai Publication, 1970.
4) S.S. Bhavikatti, Mechanics of Solids, The New Age International Publishers, 2010
5) B.K. Sarkar - Strength of material - Tata McGraw-Hill Education Publication.(620.12)
6) R.K. Rajput, Strength of materials, S. Chand Publications,

Reference Books:

1. Ferdinand P. Beer, E. Russell Johnston and Jr.John T. DeWolf “Mechanics of Materials”, Tata McGraw-Hill, Sixth Edition, 2012
2. G. H. Ryder- Strength of Materials- 3rd Edition, Macmillan Pub, India
3. E.P. Popov - Engineering Mechanics of Solids - Prentice Hall Publication.
4. Singer and Pytel - Strength of materials - Harper and row Publication.
5. Andrew Pytel & Jaan Kiusalaas, Mechanics of Materials, Second Edition, Global Engineering, 2012
6. R. C. Hibbeler - Mechanics of Materials - Prentice Hall Publication.

Web contents – Strength of Materials: Mechanical Engineering By Dr. Satish C Sharma (IIT Roorkee)

Video content: Strength of Materials: Prof. S.K. Bhattacharyya (IIT Kharagpur)

Coursera: Course offered by Georgia Institute of Technology Mechanics of Materials I: Fundamentals of Stress, Strain and Axial Loading https://www.coursera.org/learn/mechanics-1

CIA Activities:

Sr No	Title of Activity	PO Attained
1	Home Assignments on each unit	**PO9, PO10**
2	Case study problems: Report writing, Presentation	**PO5, PO9, PO10**

Note :

1. CIA will be conducted in two sections
2. First part of CIA will carry 20 marks for Class test based on Unit-I to Unit-VI and
3. Second part of CIA will consist of Report writing, Presentation
4. The assessment rubrics for the evaluation of CIA should be decided.

Manufacturing Processes [ME204] (2021 Pattern)
S.Y. B.Tech. Mechanical

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hrs. / Week	**In-Sem Exam : 30 Marks**
End Sem Exam: 50 Marks	**Continuous Assessment: 20 Marks**
Credits: 3	**Total: 100 Marks**

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Pre-requisite Course: Basic mechanical Engineering, Mathematics, Engineering graphics

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1. Course Overview:

The subject of manufacturing processes has become increasing important to the mechanical engineer. It has been established since long that the ability to work skillfully, with hands, can be developed more readily and accurately when the work to be performed in the production shop is understood both in practical and theoretical aspects. Manufacturing processes subject deals with the study and practical work of various manufacturing processes like casting, forming, welding, plastic processing and additive manufacturing which will be helpful to the students in industry.

2. Course Objectives:

1. To understand basics of foundry processes, pattern making and sand casting, die casting and calculate solidification time of castings.
2. To understand various metal forming processes such as forging, rolling, extrusion and wire drawing and calculate forces, power and work done for these processes.
3. To study different types of plastic molding processes.
4. To study various metal joining processes, their parameters and applications.
5. To understand various sheet metal working operations, analyze and design dies.
6. To study various types of Additive manufacturing processes.

3. **Course Outcome: On completion of the course, students will be able -**

Course Outcome	Statements
CO1	To describe various types of pattern ,pattern allowances ,core, castings and to calculate solidification time of casting.[BTL-04]
CO2	To describe various types forming processes , calculate amount of forces acting and work done .[BTL-3]
CO3	To compare various types of plastic processing methods and their applications.[BTL-03]
CO4	To differentiate various types of joining processes ,their applications and parameters.[BTL-03]
CO5	To design dies for sheet metal working operations.[BTL-04]
CO6	To describe types of additive manufacturing processes and compare them. [BTL-03]

4. Mapping of Course Outcomes and Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1		02		1		2			2	3	
CO2	2	2	2	1										3	
CO3	1					1	2	2					2	3	
CO4	2					02	2	2		2	3			3	
CO5	2	3	3	2										3	
CO6	2				2					2			2	3	

5. **Contents of the Syllabus -**

Unit I	Casting Processes	No. of Hours	COs
	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), Defects and remedies, Inspection techniques. **Die casting**, Investment casting, Centrifugal Casting, Continuous Casting. Safety measures and professional ethics.	08 Hrs.	C01

Unit-II	**Metal Forming Processes**	No. of Hours	COs
	Hot and Cold Working – Concepts and comparative study, Material behavior in metal forming, friction and lubrication in metal forming **Rolling** – Types of rolling mills, flat rolling analysis, power required (Simple Numerical) . **Forging** – Types, process parameter, Analysis of open die forging (Numerical) .Safety measures. **Extrusion** – Types, process parameter, Extrusion dies, Shape factor (Numerical), **Drawing** – Wire drawing and its analysis (Numerical), tube drawing	08 Hrs.	CO2

Unit-III	**Plastic Processing**	No.of Hours	COs
	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. Safety measures and case study on impact of plastic processing on environment. Professional ethics.	04 Hrs.	C03

Unit-IV	**Joining Processes**	No.of Hours	COs
	Surface preparation , types of joints. Welding Classification, Defects ,Applications , safety measures and case study on impact of welding on environment. Professional ethics. 1. **Gas welding** - Oxy acetylene gas welding, Hydrogen gas welding. 2. **Arc welding** - Metal arc welding(SMAW), Gas metal arc welding, (MIG, MAG) Tungsten inert gas welding, (TIG) Submerged arc welding,(SAW) Flux cored arc welding(FCAW), Electrode slag metal arc welding, etc 3. **Resistance welding** - Resistance but welding, seam welding, spot welding, percussion welding. 4. **Solid state welding** - Forge welding, Friction welding, Pressure welding etc	08 Hrs.	C04

Unit-V	**Sheet Metal Working**	No.of Hours	COs
	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), methods of reducing cutting forces.	08 Hrs.	C05

Unit-VI	**Additive manufacturing Processes**	No.of Hours	COs
	Definition, need, raw materials, types of processes: Photopolymerization , Binder jetting, Material extrusion, Powder Bed Fusion, Sheet Lamination and Direct Energy Deposition. Limitations, strengths Programming methods.	06 Hrs.	C06

9. Reference Books

Text Books:
1. Hajara Choudhari, Bose S.K. – Elements of workshop Technology Vol. I &II , Asian Publishing House. 2. D. K. Singh – Fundamentals of Manufacturing Engineering – Ane's Books. Pvt. Ltd**.** 3. P.N.Rao – Manufacturing technology – The Mc Graw hill companies.
Reference Books:
1. B. Ravi – Metal Casting – Computer Aided design and analysis- Prentice Hall of India 2. Reikher – Casting: An analytical approach – Springer 3. Wang – Rapid tooling guidelines for sand casting – Springer 4 J. T. Black – Degormos Materials and process in manufacturing – John Willey and sons 5 M.P Grover – Fundamentals of modern manufacturing: Materials and systems 6 Material and Processes in Manufacturing by DeGarmo E P and J T Kohser R A 7 Injection Mold Design by David O Kazmer. 8 Serope Kalpakjian Stevn- Maufactucring processes for Engineering materials. 9 John O. Milewski, Additive manufacturing Processes,Springer publications.

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS (HS 205) (2021 Pattern)

Teaching Scheme	Examination Scheme	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
	In-Sem Exam:	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Course Objectives

1. To help the students appreciate the essential complementarity between values and skills to ensure mutualhappiness and prosperity.
2. To elaborate on 'Self exploration' as the process for Value Education
3. To facilitate the understanding of harmony at various levels starting from self and going towards family andsociety.
4. To elaborate on the salient aspects of harmony in nature and the entire existence
5. To explain how the Right understanding forms the basis of Universal human values and definitiveness ofEthical human conduct.
6. To provide the vision for a holistic way of living and facilitate transition from chaotic life to an orderly life

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
HS 205.1	Recognize the concept of self-exploration as the process of valueeducation.	1	Remember
HS 205.2	Interpret the human being as the coexistence of Self and Body.	2	Understand
HS 205.3	Explain relationship between one Self and the other Self as the essential part of relationship and harmony in the family	2	Understand
HS 205.4	Explain the goal of human being living in the society, the system required to achieve the human goal and the scope of this system.	2	Understand
HS 205.5	Interpret the interconnectedness, harmony and mutual fulfilmentinherent in the nature and the entire existence.	2	Understand
HS 205.6	Draw ethical conclusions in the light of Right understanding facilitating the development of holistic technologies, production systems and management models.	3	Apply

Course Contents			
UNIT-I	**INTRODUCTION TO VALUE EDUCATION**	**No. of Hours**	**COs**
	Value education and Skill education; Priority of values over skills; Implications of Value education; Self-exploration as the process for Value education; Basic human aspirations and their fulfillment; Understanding Happiness and Prosperity-Their continuity and programme for fulfilment	06	HS 205.1
UNIT-II	**HARMONY IN THE HUMAN BEING**	**No. of Hours**	**COs**
	Understanding Human being as the coexistence of self and the body; Discrimination between the needs of the self and the body; The body as an instrument; Harmony in the self; Harmony of the self with the body	06	HS 205.2
UNIT-III	**HARMONY IN THE FAMILY**	**No. of Hours**	**COs**
	Family as the basic unit of human interaction; Understanding relationship; Feelings in relationship; Right feeling; Role of physical facility in fulfilmentof relationship; Response and reaction in behavior; Understanding Justice	06	HS 205.3
UNIT-IV	**HARMONY IN THE SOCIETY**	**No. of Hours**	**COs**
	Understanding Human Goal; Human Order; Dimensions of Human Order; Professions in a human society; World Family Order; Harmony from Family Order to World Family Order	06	HS 205.4
UNIT-V	**HARMONY IN THE NATURE AND EXISTENCE**	**No. of Hours**	**COs**
	Nature as a collection of units; Classification of units into four orders; Interconnectedness and mutual fulfillment among the four orders;Significance of Education – Sanskar for human order; Existence as units inspace; Understanding submergence; Material and consciousness units; Expression of coexistence at different levels; Role of human being in existence	06	HS 205.5
UNIT-VI	**RIGHT UNDERSTANDING IN LIFE AND PROFESSION**	**No. of Hours**	**COs**
	Universal Human Values and Ethical Human Conduct; Professional Ethicsin the light of right understanding; Holistic development towards UniversalHuman Order; Vision for Holistic technologies, Production systems and Management models; Journey towards Universal Human Order	06	HS 205.6
Text Books:			

1. R. R. Gaur, R. Sangal, G. P. Bagaria, “A Foundation Course in Human Values and Professional Ethics”,Excel Books Pvt. Ltd.
2. R. S. Naagarazan, “A Textbook on Professional Ethics and Human Values”, New Age International(P)Ltd. Publishers.
3. M. Govindrajan, S. Natarajan, V. S. Senthil Kumar, “Engineering Ethics (including Human Values)”, EasternEconomy Edition, Prentice Hall of India, 2001

Reference Books:

1. B. P. Banerjee, “Foundations of Ethics and Management”, Excel Books Pvt. Ltd.
2. P. L. Dhar, R. R. Gaur, “Science and Humanism”, Commonwealth Publishers
3. M. K. Gandhi, “The Story of my Experiments with Truth”, Discovery Publisher
4. http://uhv.org.in/

Considering the specific nature of this course, the methodology is explorational and thus universally adaptable. In order to connect the content of this course with practice, minimum 6 group activities should be conducted with activeinvolvement of the students. The continuous assessment should be strictly based on the participation of the studentsin these activities.

Sanjivani College of Engineering, Kopargaon Department of Mechanical Engineering			
Semester	III	**Subject Code**	ME206
Subject	**Lab-I** Machine Drawing & Geometrical Modeling	**No. of Lectures /Week**	1 Hr
Faculty Incharge	Dr P M Patare	**No. of Practical /Week**	4 Hrs
Examination Scheme	--	**TW**	50
Assignment (One Each Unit)	06	**Class Test** (One on two units)	03

1. Course Objectives:

1. To develop the ability to apply Limit, Fits and Dimensional Tolerances, as well as Geometric Tolerances to components and assemblies on Engineering Drawings.
2. To develop an ability to create standard components using any Drafting Tool.
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 and Production Drawings of simple machine parts.
5. To develop an ability to analyze the simple mechanisms by the simulation tools.
6. To develop an ability to create the sheet metal models using modeling software tools.

2. Course Outcomes (COs) :

After learning the course the students will be able to-

CO's	Course Outcomes	Bloom's Taxonomy	
		Level	Descriptor
CO1	**Understand** the standards used in Machine Drawing	2	Understand
CO2	**Demonstrate** Geometrical Dimensions and Tolerances for machine parts	2	Understand
CO3	**Apply** modelling commands to develop 3D models of any machine parts	3	Apply
CO4	**Apply** Assembly command to machine parts and its production drawing	3	Apply
CO5	**Construct** sheet metal models in Modeling Software	3	Apply
CO6	**Analyse** the mechanisms with the help of Simulation Tool	4	Analyze

COURSE CONTENTS

Unit	Contents	No. of Hours	COs
1	**Conventions in Machine Drawing**		
	Introduction to machine drawing, Dimensioning technique for machine components, Conventional representation of machine components as per IS code: SP-46 such as screw threads, springs, gears, bearing, tapped holes, knurling, splined shafts, tapers, chamfers, countersunk and counter bores, keys, & welded joints, Surface Roughness Introduction, terminology, machining symbol with all parameters, roughness values (Ra) indicating surface roughness on drawing.	2 Hrs.	CO1
2	**Limit, Fits and Tolerances**		
	Definitions applied to tolerances, types of tolerance, types of fits, fit system. Geometrical tolerances – Nomenclature, tolerance frame, types of geometrical tolerances & their symbols, indicating geometric tolerances on drawing.	2 Hrs.	C02
3	**Sketching and Solid Modeling**		
	Introduction to Graphic User Interface of modeling software, Sketching of simple machine parts in 2D,Parametric solid modeling (3D) using any modeling software.	2 Hrs.	C03
4	**Assembly of M/C Parts and Production Drawing**		
	Dimensional and Geometrical Constraints, Assembly of Machine Components, examples- Wheel support assembly, Bench-vice, Universal coupling, Butterfly valve etc. Production drawing techniques in any modeling software.	2 Hrs.	C04
5	**Sheet metal modeling**		
	Introduction to Sheet Metal design process, Sheet Metal model fundamentals, Creating primary and secondary Sheet metal, Wall features, Modifying Sheet Metal models, Sheet Metal Bends, Setting the Sheet metal environment.	2 Hrs.	C05
6	**Simulation of Mechanisms**		
	Kinematic simulation to study displacement, velocity and acceleration of links in the mechanism like four bar mechanism, slider crank mechanism, cam and follower etc.	2 Hrs.	CO6

List of Practical's:

Sr No	Name of Practical	No of Hours	CO
1	One A2 size sheet based on various IS conventions mentioned in the above syllabus.	04	1
2	Two A2 size sheets: one on Assembly & other on Details of simple mechanical system such as vice, tool post, tailstock and valve. Sheet on Details must include dimensional as well as geometrical tolerances and surface finish requirements	06	2
3	Sketching of Machine Parts using Modeling Software. (Any 05 Models)	04	3
4	Solid Modeling of Machine Components using Modeling Software. (Any 15 Models)	06	3
5	Assembly and Production Drawing of Machine Parts using Modeling Software. (Any 05 Assemblies)	08	4
6	Sheet Metal Modeling using Modeling Software. (Any 05 Models)	06	5
7	Position, Velocity and Acceleration analysis of Mechanisms. (Any 03 Mechanisms)	04	6
8	3D modeling of any one real life engineering component and obtaining 2D Production Drawing for the same.	06	3
9	Creating 3D Model from an existing Industrial Machine Drawing of a component	04	3
10	Study of Generative Design using Artificial Intelligence.	02	4

Text Books:

1. Gill P. S., "A Text book of Machine Drawing", Revised Edition K. Kataria and Sons, New Delhi, 2008, ISBN: 81-85749-79-5.
2. FarazdakHaideri, "Machine Drawing and Computer Graphics", Nirali Prakashan, Pune, 1998.ISBN: 9380725272
3. Roger Toogood, "Creo Parametric 6.0 Tutorial", DC Publications,2019. ISBN 978-1630572853.

Reference Books:

1. Narayana K. L., Kannaiah P., Venkatata Readdy K., "Machine Drawing", 2nd Edition, New age international Publishers, Delhi, 2008, ISBN 81-224-1917-8.
2. Bhat N. D., Panchal, "Machine Drawing", Charotar Pub. House, 2000.ISBN: 9380358466.
3. Michael J Rider, "Designing with CREO PARAMETRIC 6.0", SDC Publication, USA, ISBN: 987-1-63057-300-3.

Lab-II(Open Source) [ME207]
S.Y. Tech. Mechanical

Teaching Scheme
Practical: 2 Hrs./Week
Credit: 1

Examination Scheme
Term Work: 50 Marks
Total: 50 Marks

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Pre-requisite Course: Computer Operating
Post-requisite Course: Seminar, Project

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Course Overview:

This course will be enabling students to learn about word, Excel, PowerPoint, Email Etiquettes and Gmail suit. Learners will be able determine the suitable office tools foe specific tasks. Learners will create attractive documents, publications and presentations. Learners will be able to manage efficiently email and Gmail suit. Learners will be able to analyse the data with Excel.

Course Objectives :

To acquire a proficient skill of word.
To acquire a proficient skills of Excel
To acquire a proficient skills of PowerPoint
To communicate effectively with Email

Course Outcomes (COs): Students will be able

Course Outcome	Statements	Blooms Taxonomy Level
CO1	Create word document with basic knowledge of Word	2
CO2	Format, Edit and finalise word document	3
CO3	Create Excel document with basic knowledge of Excel	2
CO4	Analyse data with Excel tools	3
CO5	Create presentation with PowerPoint	3
CO6	Create documents by using LaTex	2

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1					2				1	2	2	2	2	2	2
CO2					3				1	2	2	2	2	2	2
CO3		1			2				1	2	2	2	2	2	2
CO4		1			3				1	2	2	2	2	2	2
CO5					3				1	2	2	2	2	2	2
CO6					2				1	2	2	2	2	2	2

Course Contents

Unit	Contents	No. of Hours	COs
1	**Basics of Word**		
	An overview of the different features of Microsoft Word, Features included are typing, formatting, editing, document spacing, Page Layout, page numbering and saving a document.	4 Hrs.	CO1
2	**Advanced tools of Word**		
	Edit and format text, Change the page layout, background and borders, Insert headers and footers, Insert and edit tables, controlling page appearance, Insert clip art and pictures to documents, Managing lists, Page design and print document	4 Hrs.	C02
3	**Basic of Excel**		
	Create, open and view a workbook, Save and print workbooks, Enter and edit data, modify a worksheet and workbook, Work with cell references, Learn to use functions and formulas, Create and edit charts and graphics, Filter and sort table data, Work with pivot tables and charts, Import and export data.	4 Hrs.	C03
4	**Analyse data with Excel**		
	Work with Cells and Worksheets, Formula, Format Workbook, Advanced Charts and Graphics, Analyze Data, Work with Macros.	4 Hrs.	C04
5	**Advanced tools of PowerPoint**		
	Create a new presentation, modify presentation themes, Add and edit text to slides, add new slides to a presentation, insert clipart images and shapes to slides, Insert and modify tables and charts, Add sound and video to a slide presentation, Insert and edit animations and slide transitions, Display a speaker-lead and self-running presentation.	4 Hrs.	C05
6	**Basics of LaTex**		
	Understanding Latex compilation Basic Syntax, Writing equations, Matrix, Tables, Page Layout – Titles, Abstract Chapters, Sections, References, Equation references, citation. List making environments Table of contents, Generating new commands, Figure handling numbering, List of figures, List of tables, Generating index.	4 Hrs.	CO6

References:

- Andrea Philo,Mike Angstadt, (2020), Microsoft Word 2016 Step-By-Step Guide, Montgomery County-Norristown Public Library
- Andrea Philo,Mike Angstadt, (2020), Microsoft Excel 2016 Step-By-Step Guide, Montgomery County-Norristown Public Library
- Joan Lambert, (2015) Microsoft PowerPoint 2016 Step by Step, Microsoft Press

Assignment # 1. Write a curriculum vitae in word (Make changes as given in () brackets)

curriculum vitae (Capital, Bold, Centre aligned, Times New Roman, 12 font)

Name: Postal Address: Mobile Number: Email ID: (Left aligned, Times New Roman, 12 font)	(Paste photo here) (Select "No" border for the table)

Academic Qualification: (Capital, Bold, Left aligned, Times New Roman, 12 font)

Examination	**Name of the College**	**Passing Year**	**Marks in % / CGPA**

(add more rows below this table and fill up the information)

Career Objectives: (Capital, Bold, Left aligned, Times New Roman, 12 font)

(Write some objectives here)

Awards received in the last 3 years: (Capital, Bold, Left aligned, Times New Roman, 12 font)

(Write your answer here)

Personal Details: (Capital, Bold, Left aligned, Times New Roman, 12 font)

Father's Name:

Mother' Name:

Date of Birth:

Place of Birth:

Date: (Left aligned, Times New Roman, 12 font)

Place: (Left aligned, Times New Roman, 12 font)

Name: (Right aligned, Times New Roman, 12 font)

Sign: (Right aligned, Times New Roman, 12 font)

Assignment#2. Create a certificate in word

Certificate

Assignment # 3. Create a database and prepare charts

- Generate 10 values each of x and y
- Plot the chart of x vs. y
- Select chart type as bar chart, line chart
- Give the name to both the axis

Assignment #4. Create a marksheet of students with grade points

- Generate 10 random numbers for 10 random subjects
- Find the grade by using formulas
- Find the CGPA and SGPA

Assignment #5. Create a power point presentation

- Prepare 5 power point slides on any topic
- Add formatting to each slide
- Use different transitions to slides
- Prepare animations to each slide

Assignment #6. Prepare a paper by using LaTex template

Rubrics for assignments - 10 Marks

V	Weightage	Needs improvement (Level 1) 0-1	Meets expectation With improvement (Level 2) 2-3	Meets expectation (Level 3) 4-5
A Contents and quality : as per expected requirements	**50%**	Poor performance than requirements	Moderate performance	Good performance
B Timely submission of written presentation	**50%**	Contents are less than requirements	Enough contents as per requirement	Contents are more than requirement

List of practical

1) Write a curriculum vitae in word
2) Create a certificate in word
3) Prepare a report with the help of tables
4) Create a database and prepare charts
5) Create a marksheet of students with grade points
6) Prepare a report with the help of pivot tables
7) Create a power point presentation
8) Prepare a paper by using template

Lab-III STRENGTH OF MATERIALS Lab. [ME208] (2021 Pattern)

S.Y. Tech. Mechanical

Teaching Scheme
Practical: 2 Hrs./ Week
Credits: 1

Examination Scheme
Oral: 50 Marks
Total Marks: 50 Marks

Pre-requisite Course: Applied Mechanics, Mathematics
Post-requisite Course: Machine Design -I & II, Material Science, Project

Course Overview:

The subject strength of material encompasses the fundamentals of all material properties starting from simple stresses, principle stresses to buckling and torsion, material behaviour under different loading conditions like shear, temperature and bending, and also the knowledge of material failures. The concepts of stress, strain, stress-strain diagram is very much useful in selection of material in machine design process. It also includes concepts like principal stresses and strains which is important tool for understanding material failure. The concepts of shear force and bending moment diagrams are helpful in designing machine elements like shafts, frames.

Course Objectives :

- To conduct tension test on the given mild steel rod for determining mechanical properties
- To determine the ultimate stress to which the specimen can withstand
- To conduct shear test on given specimen under single and double shear.
- To determine the Young's modulus of the given specimen by conducting bending test.
- To use software to verify theoretical values

Course Outcomes (COs): Students will be able **to**

Course Outcome	Statements	Blooms Taxonomy	
		Level	
CO1	conduct various tests to determine mechanical properties of the given specimen	4	
CO2	plot graphs for SFD, BMD and principal stresses	4	
CO3	Comparison of numerical and analytical analysis	3	

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			3	3	2		2	3	3		3	2		
CO2	3			3	3	2		2	3	3		3	2		
CO3	3			3	3	2		2	3	3		3	2		

List of Practical:(All practical should be conducted)

Sr. No.	Title	CO	PO	PSO
1	Tension test on a ductile material to determine its mechanical properties. http://sm-nitk.vlabs.ac.in/exp13/index.html	1	1, 4,5, 6,9, 10,12	1
2	Tension test on a brittle material to draw stress-strain diagram and to evaluate its ultimate stress http://sm-nitk.vlabs.ac.in/exp14/index.html	1		1
3	To determine Compressive strength of materials (Virtual Lab) http://sm-nitk.vlabs.ac.in/exp16/index.html	1		1
4	To determine Shear strength of mild steel material under single and double shear http://sm-nitk.vlabs.ac.in/exp7/index.html	1		1
5	To find the values of bending stresses and young's modulus of the material of a simply supported beam http://sm-nitk.vlabs.ac.in/exp2/index.html	1		1
6	Plotting of shear force and bending moment diagrams for different boundary conditions and loading conditions of beam (using software)	2		1
7	Comparison of numerical and analytical analysis on Slope and deflection (by using software)	2		1
8	Determination of Principal stresses by graphical method and verification through analytical method	2		1

References:

- William Smith, Javad Hashemi, ***Foundations of materials science and engineering***, 2019, 6th edition, McGraw-Hill, ISBN 007-125690-3.
- Dieter, G.E., ***Mechanical metallurgy***, 1988, SI metric edition, McGraw-Hill, ISBN 0-07-100406-8.
- Norman E. Dowling, ***Mechanical Behavior of Materials***, Prentice-Hall International, 4th edition, 2013.
- W.D. Callister, ***Fundamental of materials science and engineering/an interactive e. text***,2001, John Willey & Sons, Inc., New York, ISBN 0-471-39551-x

Rubrics for Evaluation of write up:

Evaluation of TW of Performance based Practical is based on the performance of student in completing the task with safety.

Rubrics

Criteria	Criteria	Weightage (%)	Needs Improvement (Level 1)	Meets Expectation (Level 2)	Meets Expectation (Level 3)
A	Gather information related to practical	20	Student has not collected any information that relates to the performing the experiment	Student has collected basic information related the practical	Student has collected a great deal of information which goes beyond the basics
B	Successfully Performs experiment without supervision	30	Cannot complete the task and standard procedures	Successfully completes the task and standard procedures under moderate supervision	Successfully completes task and standard procedures independently
C	Analysis and Interpretation of Experiment Results	30	Fails to analyse and interpret the results	Minor flaws in analyzing and interpreting the results	Flaw less performance in analyzing and interpreting the results
D	Completion of task	20	Completes below 50%	Completes 51-75 %	Completes above 76%

Lab-IV Manufacturing Process [ME 209] (2021 Pattern)
S.Y.B.Tech

Teaching Scheme

Practical: 2 Hrs./ Week
Credit : 1

Examination Scheme
PR : 50 Marks

Total: 50 Marks

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Pre-requisite Course: Basic mechanical Engineering, Mathematics, Engineering graphics, Manufacturing Processes

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Course overview – Mechanical Engineering students must develop in psycho motor skills which are required in industries. The subject machine shop-I deals with practical performance of students on lathe machine,welding,casting and additive manufacturing.

Course Objectives : -

1. To operate lathe machine and perform operations turning, facing, taper turning and threading.

2. To learn arc welding.

3. To study sand casting, gating system, types of cores, patterns.

4. To study additive manufacturing (3D printing).

Course outcomes - After completion of lab assignments, students will be able -

Course Outcome	Statements
CO1	**To create a job by performing machining operations taper turning, threading.[BTL3]**
CO2	**To create a job by using arc welding. [BTL3]**
CO3	**To complete a job using sand moulding. [BTL3]**
CO4	**To make a job using additive manufacturing. [BTL3]**

Lab assignments –

Sr. No.	Title
1	Manufacturing of any one job consisting of all the lathe operations.
2	Job on TIG/ MIG welding.
3	Demonstration of Sand Moulding Process.
4	Create a mechanical component using Additive manufacturing (3D printing)

Note- Safety measures, environment sustainability and professional ethics of above assignments should be taught.

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

Sr. No.	Lab assignments	CO	PO	PSO
1	Manufacturing of any one job consisting of all the lathe operations.	CO1	1,6,7,8,9,10,11,12	02
2	Job on TIG/ MIG welding.	CO2	1,,6,7,9,10,11,12	02,03
3	Demonstration of Sand Moulding Process.	CO3	1,6,7,8,9,10,11,12	02,03
4	Create a mechanical component using Additive manufacturing (3D printing)	CO4	1,5,6,7,8,9,10,11,12	02,03

Guidelines for Term Work assessment-(25 marks)

Each student must complete and submit following Term Work .

i) Assignment -1(lathe machine job) and assignment-3(arc welding job) w.r.t. above mentioned laboratory assignments

ii) Journal consisting of following write-ups:

a) Study of centre lathe

b) Study of welding processes

c) Study of sand moulding process

e) Study of additive manufacturing.

Guidelines for oral assessment-(25 marks)

- Questions should be asked in oral examination to individual student based on -

i) Sand moulding. ii) Arc welding iii) Lathe machine and iv) Additive manufacturing.

Reference Books

Text Books:
1. Hajara Choudhari, Bose S.K. – Elements of workshop Technology Vol. I &II , Asian Publishing House. 2. D. K. Singh – Fundamentals of Manufacturing Engineering – Ane's Books. Pvt. Ltd**.** 3. P.N.Rao – Manufacturing technology – The Mc Graw hill companies.
Reference Books:
1.B. Ravi – Metal Casting – Computer Aided design and analysis- Prentice Hall of India 2.Reikher – Casting: An analytical approach – Springer 3.Wang – Rapid tooling guidelines for sand casting – Springer 4.J. T. Black – Degormos Materials and process in manufacturing – John Willey and sons 5.Serope Kalpakjian Stevn- Maufactucring processes for Engineering materials. 6.John O. Milewski, Additive manufacturing Processes,Springer publications.

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3			1			2						
CO2	2	3	3		3	1			2						
CO3	2	3	3			1			2						

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Elements of Workshop Technology	S. K. Hajra Choudhary, A. K. Hajra Choudhary	Media promoters	
2.	A Course in Workshop Technology Vol. II	B. S. Raghuwanshi	Dhanpat Rai & CO	
3.	Workshop Technology Part 1, 2 and 3	W. A. J. Chapman	Taylor & Francis	
4.	Manufacturing Process – 2,	Anul Goel	Technical Publication	
5.	Production Technology (Manufacturing Processes)	P C Sharma,	S Chand Publication	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	HMT Handbook for Production Technology		Tata McGraw-Hill,	
2.	Materials and processes in Manufacturing	Degarmo, Black and Kohser	Prentice Hall of India. 2nd Edition	
3.	Workshop Technology	B.S. Raghuwanshi	Dhanpatrai Publication, 9th Edition, 1999.	
4.	"Production Technology", Vol. I,II,	O.P. Khanna and M. Lal,	Dhanpatrai Publication, 5th Edition, 1999.	
5.	"Workshop Technology", Volume I, II, III,	Chapman W.A.J,	CBS Publishers and distributors, 5th Edition,2002.	

Mandatory Course-III CONSTITUTION OF INDIA (MC210)

Teaching Scheme		Examination Scheme	
Lectures:	2 Hrs. / Week	**In-Sem Exam :**	-- Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	-- Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA :**	-- Marks
Credits:	**3**	**Total:**	-- Marks

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Course Objectives

1. To study the historical background, salient features and preamble of Indian constitution
2. To study the provision of fundamental right in the Indian constitution.
3. To study the directive principle of state policy and fundamental duties.
4. To study the system of government through parliamentary and federal system,
5. To understand the formation, structure and legislative framework of central government.
6. To understand the formation, structure and legislative framework of state government.

Course Outcomes

CO	Course Outcome	Bloom's Taxonomy	
		Descriptor	**Level**
CO1	The students can describe background, salient features of constitution of India	Remembering	1
CO2	The students can explain the system of government, it's structure and legislative framework also can interpret the fundamental rights and duties	Understanding	2
CO3	The student can use the fundamental rights and duties in their life	Applying	3

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	-	3	-	1	-	2	-	-
CO2	-	-	-	-	-	1	-	3	-	1	-	2	-	-
CO3	-	-	-	-	-	1	-	3	-	1	-	2	-	-

COURSE CONTENTS

Unit-I	**Introduction to Constitution of India**	No. of Hours	COs
	Historical background, Salient features, Preamble of constitution	04	CO1
Unit-II	**Fundamental rights**	No. of Hours	COs
	Features of fundamental rights, Basic rights, Right to equality, Right to freedom, Right against exploitation, Right to freedom of religion,. Cultural and educational rights, Right to property, Right to constitutional remedies	04	CO1
Unit-III	**Directive principle of state policy:**	No. of Hours	COs
	Features of directive principle, Classification of directive principle, Criticism of directive principle, Utility of directive principle, Conflict between Fundamental rights and directive principle **(B) Fundamental duties** List of fundamental duties, Features of fundamental duties, Criticism of fundamental duties, Significance of fundamental duties, Swaran Singh Committee Recommendations	04	CO2
Unit-IV	**System of Government**	No. of Hours	Cos
	Parliamentary system: Features of parliamentary government, Features of presidential government, merits and demerit of Parliamentary system. Federal system: Federal features of constitution, unitary features of constitution. Centre and state relation: Legislative relation, administrative relations and financial relation. Emergency provision: National emergency, Financial emergency and criticism of emergency provision	04	CO2
Unit-V	**Central government**	No. of Hours	Cos
	President: Election of president, powers and functions of president, and Veto power of president. Vice-president: Election of vice-president, powers and functions of vice-president Prime minister: Appointment of PM, powers and functions of PM,	04	CO3

	relationship with president, Central council of ministers: Appointment of ministers, responsibility of ministers, features of cabinet committees, functions of cabinet committees Parliament: Organization of parliament, composition of the two houses , duration two houses, membership of parliament, session of parliament, joint sitting of two houses, budget in parliament. Supreme court (SC): Organization of supreme court, independence of supreme court, jurisdiction and powers of supreme court		
Unit-VI	**State government**	No. of Hours	COs
	Governor: Appointment of governor, powers and functions of governor, constitutional position Chief minister: Appointment of CM, powers and functions of CM, relationship with governor State council of ministers: Appointment of ministers, responsibility of ministers, cabinet. High court (HC): Organization of HC, independence of HC, jurisdiction and powers of HC Sub-ordinate court: Structure and jurisdiction, Lok Adalats, Family court, Gram Nyayalayas	04	CO3

Reference Book:

1. Indian Polity for Civil Service Examination, M Laxmikanth, Mc GrawHill Education, Fifth Edition.
2. Introduction to the Constitution of India, Durga Das Basu, LexisNexis, 22 nd Edition

Applied Thermodynamics (ME 211)

Teaching Scheme		**Examination Scheme**	
Lectures	**3 Hrs. /Week**	**CIA**	**40 Marks**
Credits	**3**	**End SEM Exam**	**60Marks**
		Total	**100Marks**

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Prerequisite Course: Basic Thermodynamics

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Course Objectives :

1. To study working of engine, Actual, Fuel-Air and Air standard cycle and itsPerformance
2. To understand Combustion in SI and CI engines and factors affecting performance parameters
3. To estimate performance parameters by conducting a test on I. C. Engines and study emissions with its controllingmethods.
4. To learn about steam generator and analyze itsperformance.
5. To understand about reciprocating air compressor and evaluate theperformance

Course Outcomes (COs): On completion of the course of Applied Thermodynamics, learner will be able to

CO's	**Course Outcomes**	**Blooms Taxonomy**	
		Level	**Descriptor**
CO1	Explain basic engine terminology, air standard, fuel air and actual cycles.	2	Understand
CO2	Identify factors affecting the combustion performance of SI and CI engines.	2	Understand
CO3	Determine performance parameters of IC Engines	3	Apply
CO4	Understand emission formation mechanism of IC engines, its effects and the legislation standards.	2	Understand
CO5	Calculate performance parameters of Boilers.	3	Apply
CO6	Compute performance parameters of single stage reciprocating air compressor	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	1	-	-	1	3	3	-	3	-	-	2
CO2	2	-	-	-	1	-	-	1	3	3	-	3	-	-	2
CO3	3	3	2	3	1	-	-	3	3	3	-	1	-	-	2
CO4	2	-	2	1	1	3	2	3	3	3	-	3	1	-	2
CO5	2	3	2	3	1	3	2	3	3	3	-	3	1	-	2
CO6	2	3	2	3	-	-	-	1	3	3	-	3	-	-	2

Course Contents

Unit no.	Unit Title and contents	No. of Hours	COs
1	**Introduction to Internal Combustion Engine**		
	IC Engine: Terminology of I.C. engines, Classification, parts and materials of I.C Engine. Air standard cycles, Introduction to fuel air and actual cycle .Working of four stroke/two stroke - petrol/diesel engine, Comparison between Petrol and Diesel Engines, Applications, Intake and exhaust system, Valves actuating mechanisms, Valve timing diagram.	6	CO1
2	**SI and CI Engines**		
	SI Engines:- Spark ignition Engine mixture requirements, Fuel-Air ratio, Carburation, Introduction to Carburetor, Electronic Fuel Injection System -Multi Point Fuel Injection System and Gasoline Direct Injection, Combustion stages in SI engines, Abnormal Combustion, Theory of Detonation and Parameters affecting detonations, Rating of fuels in SI engines. **CI Engines**: Working of Fuel Injection system, Construction and Working of Fuel Pump, Fuel Injector and Various types of Nozzle, Electronically controlled unit fuel injection system, CRDI, Combustion stages in CI engines, Theory of knocking and Parameters affecting knocking, Combustion Chambers used in CI Engines, Rating of fuels in CI engines.	6	C02
3	**IC Engine Testing and Emission**		

	Engine Testing: Basic Performance Parameters of I.C. Engine, Methods and Tests to determine power and efficiencies, Brake Thermal Efficiency, Indicated Thermal Efficiency, Mechanical Efficiency, Volumetric Efficiency, brake specific fuel consumption, indicated specific fuel consumption of I.C. Engine, characteristic curves, Morse Test, Willan's line Method, Determination of IP, BP, FP, Mean effective pressure, Fuel consumption, Air Consumption, Engine performance parameters, heat balance sheet.	8	C03
4	**Engine Emission and their control**		
	Emission & Control: Emission in SI, CI Engines and factors affecting emissions. Methods to measure emission such as Non Dispersive Infrared Red, Bharat stage norms. Emission control methods and systems for SI and CI engines – Selective Catalytic Reduction, Exhaust Gas Recirculation, Diesel Particulate Filter, catalytic convertors.	6	C04
5	**Steam Generators**		
	Steam Generators: Classification, Constructional details of low pressure boilers, Primary Features of high pressure boilers, Construction and working principle of boiler, Boiler mountings and accessories, Introduction to IBR Act, Boiler performance, Specific Steam Consumption, Calculations-Equivalent Evaporation, Boiler efficiency, Heat balance Sheet.	6	C05
6	**Air Compressor**		
	Reciprocating Air Compressor: Applications of compressed air, single stage compressor without clearance and with clearance volume, volumetric efficiency, isothermal efficiency, adiabatic efficiency, effect of clearance volume, free air delivery, actual indicator diagram for air compressor, Multi staging of compressor, optimum intermediate pressure, intercooler, after cooler, Capacity control of compressors. Introduction to pre filters, after filters, Air dryers, Reservoir and Instrumentation for Air Compressor	6	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	Internal Combustion Engines	V. Ganesan. V	McGraw Hill Education, India.
2.	Fundamentals of Internal CombustionEngines	H.N.Gupta,	PHILearningPvt.Ltd.
3.	A course in Internal combustion Engines	M. L. Mathur and R.P. Sharma	Dhanpat Rai & Co
4.	Applied Thermodynamics	O. Singh	New Age InternationalPublishers, New Delhi.
5.	Thermal Engineering – I	M. M. Rathore	McGraw Hill Education (India) Private Limited
6.	Thermal Engineering	S. Singh S &S.Pati	Pearson India Education Services Pvt. Ltd, Chennai.

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Internal Combustion Engine Fundamentals	J.B. Heywood	McGraw Hill Education India
2.	A Course in Internal Combustion Engine	V.M. Domkundwar& A.V Domkundwar	Dhanpat Rai & Co, New Delhi.
3.	A Course in Thermal Engineering	S. Domkundwar ,C.P Kothandaraman and A. Domkundwar	Dhanpat Rai & Co, New Delhi

Theory of Machines (ME-212)

Teaching Scheme		Examination Scheme	
Lectures:	4 Hrs. / Week	**CIA:**	40 Marks
Credits:	**4**	**End Sem Exam:**	60 Marks
		Total:	100 Marks

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Prerequisite Course: Basic Mechanical Engineering, Engineering Mathematics, Engineering Physics, Engineering Mechanics, Computer aided drawing & drafting.

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Course Objectives:

1. To make the students conversant with kinematic analysis of mechanisms applied to real life and industrial applications.
2. To develop the competency to analyse the velocity and acceleration in mechanisms using analytical
3. To develop the competency to analyse the velocity and acceleration in mechanisms using graphical approach.
4. To develop the skill to propose and synthesize the mechanisms using analytical technique.
5. To develop the competency to understand & apply the principles of gear theory to design various applications.
6. To develop the competency to design a cam profile for various follower motions.

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Identify mechanisms in real life applications.	2	Identify
CO2	Apply kinematic analysis to simple mechanisms.	3	Determine
CO3	Determine velocity and acceleration in mechanisms by graphical method.	3	Determine
CO4	Synthesize a four-bar mechanism with analytical methods.	3	Determine
CO5	Design cam profile for given follower motions.	6	Design
CO6	Apply fundamentals of gear theory as a prerequisite for gear design.	3	Determine

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	-	3	-	-	3	3	-	1	-	-	2
CO2	2	2	1	3	-	2	-	-	3	3	-	1	-	-	2
CO3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3	1	-	2
CO5	3	3	3	3	3	3	3	3	3	3	3	3	1	-	2
CO6	2	2	2	2	2	2	2	2	2	2	2	2	-	-	2

Course Contents

Unit	**Contents**	No. of Hours	COs
1	**Fundamentals of Mechanism**		
	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, Kutzbach criterion, Grubler's criterion. Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions.	8 Hrs.	CO1
2	**Kinematic Analysis of Mechanisms: Analytical Method**		
	Analytical method for displacement, velocity and acceleration analysis of slider crank Mechanism. Introduction to different analytical method for kinematic analysis of mechanism. Analysis of Single and Double Hooke's joint.	8 Hrs.	CO2
3	**Kinematic Analysis of Mechanisms: Graphical Method**		
	Displacement, velocity and acceleration analysis of mechanisms by relative velocity method (Mechanisms upto 6 Links), Coriolis component of acceleration, Kleins construction**.** **ICR:** Analysis of mechanism by ICR method (Mechanisms up to 6 Links), Kennedy's Theorem, Angular velocity ratio theorem	8 Hrs.	CO3
4	**Synthesis of Mechanisms**		
	Steps in Synthesis: Type synthesis, Number Synthesis, Dimensional synthesis, Tasks of Kinematic synthesis: Path, function and motion generation (Body guidance). Precision Positions, Chebychev spacing, Mechanical and structural errors. **Analytical Synthesis:** Three position synthesis of four bar mechanism using Freudenstein's equation.	8 Hrs.	CO4

5	**Cams and Follower**		
	Cam and Follower: Introduction, Classification of followers and cams, Terminology of cam Displacement diagram for the Motion of follower as Uniform velocity, Simple Harmonic Motion (SHM), Uniform Acceleration and Retardation Motion (UARM), Cycloid motion, Cam profile construction for Knife edge follower and Roller follower, Cam jump phenomenon.	8 Hrs.	CO5
6	**Kinematics of Gears**		
	Gear: classification, Spur Gear: terminology, law of gearing, Involute and cycloidal tooth profile, path of contact, arc of contact, sliding velocity, Interference and under cutting, Minimum number of teeth to avoid interference, force analysis. **Gear train:** types - simple, compound and epicyclic gear trains, Analysis of epicyclic gear trains	8 Hrs.	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	Theory of Machines,	S.S.Ratan,	McGraw Hill Education
2.	Theory of Machines, Third Edition,	Beven T	Longman Publication.
3.	Theory Mechanism and Machine	A.G. Ambekar,	PHI.
4.	Machine Tool Design,	N.K. Meheta,	Tata McGraw Hill Publication
5.	Theory of Machines	R.S.Khurmi & J.K.Gupta	S.Chand & Company Ltd

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Theory of Mechanism and Machines	Ghosh Malik,	East-West Pvt. Ltd.
2.	Kinematics and Dynamics of Machinery	R L Norton,	McGraw Hill Education
3.	Theory of Machines	Sadhu Singh,	Pearson
4.	Theory of Machine	Dr.V.P.Singh,	Dhanpatrai and sons.

Fluid Mechanics (ME 213)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA:**	40 Marks
Credits:	3	**End Sem Exam:**	60 Marks
		Total:	100 Marks

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Prerequisite Course: Engineering Mathematics,

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Course Objectives:

1. To study the basic properties of fluids
2. To study fluid statics and fluid dynamics
3. To study basics of flow visualization
4. To study & apply the Bernoulli's theorem to solve various fluid flow problems
5. To compute the major & minor losses in pipe flow
6. To analyze& establish relation between flow parameters

Course Outcomes (COs): **At the end of the course, learner will be able to** –

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Determine various fluid properties encountered in fluid mechanics engineering applications	3	Apply
CO2	Calculate total pressure force, center of pressure on submerged surfaces and metacentric height of floating body	3	Apply
CO3	Calculate the velocity,acceleration fields at any point in fluid flow	3	Apply
CO 4	Apply Bernoulli's, equation in solving fluid flow problems	3	Apply
CO 5	Determine major & minor losses in pipe flows	3	Apply
CO 6	Compute boundary layer thickness, forces of drag and lift for external flows , formulate the relationship among the fluid flow parameters	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	1	1	-	-	1	-	3	-	2	-	-	-
CO2	2	2	-	-	1	-	-	1	-	3	-	2	-	-	-
CO3	2	2	-	-	1	-	-	1	2	3	-	2	-	-	-
CO4	3	3	-	-	1	-	-	1	2	3	-	2	-	-	-
CO5	2	3	-	-	1	2	-	1	2	3	-	2	-	-	-
CO6	3	3	-	1	1	-	-	1	2	3	-	1	-	1	-

Course Contents

Unit	Contents	No. of Hours	COs
1	**Fundamental Concepts**		
	Fundamental Concepts: Introduction – fluids and its applications , Concept of continuum, properties of fluids, Types of fluid, Rheological Diagram, viscosity, viscosity relation with temperature and pressure, Flow Characteristics - surface tension, capillarity, compressibility, vapor pressure.	6 Hrs.	CO1
2	**Pressure and Fluid Statics**		
	Forces acting on fluid element, Pascal's law, hydrostatics law. **Pressure Measuring Devices:** barometer, manometer. **Hydrostatic forces on submerged surfaces**: Total pressure and center of pressure on vertical, inclined surface submerged in liquid.**Buoyancy and stability**: Metacenter, metacentric height, flotation, stability of submerged & floating bodies.	6 Hrs.	CO2
3	**Fluid Kinematics**		
	Lagrangian and Eulerian descriptions of flow, classification of fluid flows, velocity and acceleration fields, continuity equation, visualization of flow angularity, vorticity, stream function and velocity potential function.	6 Hrs.	CO3
4	**Fluid Dynamics**		
	Equation of motion of incompressible fluid - Euler's and Navier Stokes Equation. Bernoulli's theorem and its applications- venturimeter , orifice meter, pitot tubes, notches & weirs. Introduction to coriolis flow meter. Stagnation pressure. Electromagnetic Flow Meters, Hot Wire Anemometer, Laser Doppler Anemometer.	6 Hrs	CO4

5	**Flow in Pipes**		
	Laminar Flow in a Pipe. **Turbulent flow:** Characteristics, Shear Stresses, Pressure drop, Hydro dynamically Smooth and Rough Boundaries. **Major and Minor losses**: Darcy Weisbach equation, Moody chart, Hydraulic and energy gradient, Concept of Equivalent Pipe, power transmission in pipes.	6 Hrs	CO5
6	**Dimensional Analysis and Boundary layer theory**		
	Dimensional Analysis The Principal of Dimensional Homogeneity, The Buckingham π Theorem, Significant Non-dimensional number for fluid flow, Flow Similarity and Model Studies. Introduction to Boundary layer theory, Boundary Layer thickness, Boundary layer Separation. **Flow Past Immersed Bodies**: Friction and Pressure Drag, Lift, Flow over Sphere and Cylinder, Streamlining, Introduction to Computational Fluid Dynamics.	6 Hrs.	CO6

Text Books:

Sr. No.	Title of Book	Authors	Publication House
1	Fluid Mechanics & Hydraulic Machines	R. K. Bansal	Laxmi Publications
2	Introduction to Fluid Mechanics and Fluid Machines	S. Chakraborty	Tata McGraw Hill
3	Fluid Mechanics: Fundamentals and Applications	Y. A. Cengel, J. M. Cimbala	McGraw Hill
4	Fluid Mechanics	F. M. White	Tata McGraw Hill

References Books:

Sr. No.	Title of Book	Authors	Publication House
1	Introduction to Fluid Mechanics	R. W. Fox, P. J. Pritchard and A. T. McDonald	Wiley India
2	Fundamentals of Fluid Mechanics	B. R. Munson, D. F. Young, T. H. Okiishi and W. W. Huebsch	Wiley India
3	Mechanics of Fluids	M. C. Potter, D. C. Wiggert	Cengage Learning (Indian Edition)
4	Fluid Mechanics	V. L. Streeter, E. B. Wylie and K. W. Bedford	Tata McGraw Hill

Numerical Methods (ME 214)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA :**	40 Marks
Credits:	**3**	**End Sem Exam:**	60 Marks
		Total:	100 Marks

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Prerequisite Course: (Engineering Mathematics)

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1. Course Objectives:

1. To understand the difference between analytical and Numerical Methods.
2. To apply Numerical Techniques for solving complex Mechanical engineering Problems.
3. To prepare base for understanding engineering analysis software.
4. Develop logical sequencing for solution procedure and skills in soft computing.
5. To analyze and interpret the data for real life problems.
6. Develop the foundation for engineering research

2. Course Outcomes (COs) :

COs	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	Understand different analytical and numerical methods to find the roots of the equations	2	Understand
CO2	Apply different numerical and analytical techniques to solve various types of simultaneous equations.	3	Apply
CO3	Use the curve fitting tools for interpretation of data	3	Apply
CO4	Solve the differential equations using numerical techniques.	3	Apply
CO5	Interpret the data using interpolation techniques.	3	Apply
CO6	Use the integration techniques for solving engineering problems.	3	Apply

COURSE CONTENTS

Unit	Topics	No. of Hours	COs
1	**Roots of Equation and Error Approximations**		
	Roots of Equation : Bisection Method, Newton Raphson method **Error Approximations:** Types of Errors: Absolute, Relative, Algorithmic, Truncation, and Round off Error, and Concept of convergence-relevance to numerical methods.	06	CO1
2	**Simultaneous Equations**		
	Gauss Elimination Method with Partial pivoting, Gauss-Seidal method and Thomas algorithm for Tri-diagonal Matrix	06	CO2
3	**Curve Fitting**		
	Curve Fitting Least square technique- Straight line, Power equation, Exponential equation and Quadratic equation. Regression Analysis	06	CO3
4	**Numerical Solutions of Differential Equation**		
	Ordinary Differential Equations [ODE] Taylor series method, Euler Method, Runge-Kutta fourth order, Simultaneous equations using Runge Kutta 2^{nd} order method. **Partial Differential Equations [PDE]:** Introduction to finite difference method, Simple Laplace method	06	CO4
5	**Interpolation**		
	Introduction to interpolation Lagrange's Interpolation, Newton's Forward interpolation, Inverse interpolation (Lagrange's method only)	06	CO5
6	**Numerical Integration**		
	Numerical Integration (1D only). Trapezoidal rule, Simpson's 1/3rdRule, Simpson's 3/8thRule. Double Integration, Trapezoidal rule.	06	CO6

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	3	3	-	-	2	1	-	1	2	3	-
CO2	2	3	-	-	3	-	-	-	1	3	-	1	3	3	-
CO3	3	-	2	2	2	-	-	-	1	1	-	2	2	3	-
CO4	3	2	-	-	3	-	-	-	2	2	-	1	3	3	-
CO5	2	2	-	-	3	-	-	-	2	1	-	2	2	3	-
CO6	3	-	-	-	3	-	-	-	2	2	-	-	2	3	-

Text Books

Sr. No.	Title of Book	Authors	Publication House
1	Numerical Methods for Engineers	Steven C. Chapra, Raymond P. Canale	Tata McGraw Hill
2	Numerical Methods in Engineering and Science	Dr. B. S. Garewal	Khanna Publishers
3	Applied Numerical Methods with MATLAB for Engineers and Scientist	Steven C. Chapra	Tata McGraw Hill
4	Applied Numerical Methods using Matlab	Rao V. Dukkipati	New Age International Publishers

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1	Applied Numerical Analysis	Gerald and Wheatley	Pearson Education
2	Numerical Methods	E. Balagurusamy	Tata McGraw Hill
3	Computer Oriented Numerical Methods	P. Thangaraj	PHI
4	Introductory Methods of Numerical Analysis	S. S. Sastry	PHI

Materials Science and Metallurgy (ME215)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA:**	40 Marks
Credits:	**3**	**End Sem Exam:**	60 Marks
		Total:	100 Marks

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Prerequisite Course: Engineering Physics, Engineering Chemistry

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Course Objectives:

1. To study the basic structure and mechanical behaviour of materials.
2. To study the basic materials and metallography
3. To understand theory of alloys & alloys diagrams
4. To know the basic heat-treatment processes of metals especially steels
5. To make aware of destructive & non-destructive testing of materials
6. To develop futuristic insight into new advancements in engineering materials

Course Outcomes (Theory): On completion of the course, learner will be able to–

COs	Statements	Blooms Taxonomy	
		Level	Descriptor
CO1	Describe the basic structure and mechanical behaviour of materials, defects in crystal, its effect on crystal properties.	2	Understand
CO2	Use the basic types of materials and their characterization techniques such as Macroscopy and Microscopy.	3	Apply
CO3	Express how metals and alloys especially steels are formed by using phase diagrams and how the properties change due to microstructure.	3	Apply
CO4	Recommend the different heat treatment processes for modifying the properties of metals especially steels.	3	Apply
CO5	Suggest suitable tests such as destructive and/or non-destructive tests for a stated application.	3	Apply
CO6	Understand the technological advancements in emerging engineering materials.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	2	2	-	1	2	-	-
CO2	2	1	1	-	2	2	-	-	2	2	-	1	2	-	-
CO3	2	1	1	-	2	-	-	-	2	2	-	1	2	-	-
CO4	2	1	1	-	2	-	-	-	2	2	-	1	2	-	-
CO5	3	1	1	-	2	-	-	-	2	2	-	1	2	-	-
CO6	2	1	1	-	-	-	-	-	2	2	-	1	2	-	-

Contents of the Course/Syllabus

Unit	Contents	No.of Hours	COs
1	**Structure and mechanical behaviour of materials**		
	Crystal structures (BCC, FCC and HCP systems), indexing of lattice planes & directions, Lattice parameters (coordination number, no. of atoms per unit cell, atomic packing factor, density), Crystal imperfections; point defects, line defects- edge and screw dislocations, surface defects, volume defects Mechanism of Elastic & plastic deformation (slip and twinning),deformation of single crystal by slip, plastic deformation of polycrystalline materials, work hardening theory, Changes in properties due to cold working & hot working.	6 Hrs.	CO1
2	**Basic materials and metallography**		
	Basic Materials: Metallic materials, Polymeric Materials, Elastomers, Ceramics and Composites: Definition, general properties, applications **Metallography:** Classification of metal observations: their definition, difference & importance, Microscopy techniques : Optical microscopy- Study of Metallurgical microscope, Electron microscopy techniques such as SEM, TEM (Principles only), sample/specimen preparation, specimen mounting (hot & cold mounting) electrolytic polishing, etching procedure and etching	6 Hrs.	C02

	reagents, electrolytic etching, Macroscopy: Sulphur printing, flow line observations.		
3	**Iron-iron carbide equilibrium diagram**		
	Solid solutions, its types, Hume Rothery rule for solid solutions, Solidification of pure metal, Different types of phase diagrams (Isomorphous, Eutectic, Peritectic, Eutectoid, Peritectoid), Gibbs phase rule, Iron-Iron carbide equilibrium diagram and its analysis, Basic classification and application of steels, Introduction to Cast Iron, its types and applications, Introduction to designation of steels.	8 Hrs.	C03
4	**Heat treatment of metals**		
	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. Introduction to heat treatment of nonferrous metals and alloys.	8 Hrs.	C04
5	**Destructive and non destructive testing**		
	Destructive Testing (DT): Tensile test, Compression test, Hardness tests-Vickers, Rockwell, Brinell, Poldi, Micro Hardness Test, Durometers, Impact test, fatigue test, creep test, Erichson Cupping Test. **Non Destructive Testing (NDT):** Principles & procedure, advantages, disadvantages and Industrial applications of NDT, such as Visual Inspection Liquid or dye penetrate test, Magnaflux test, Eddy current test, Sonic &	6 Hrs.	C05

	Ultrasonic testing and Radiography testing.		
6	**Introduction to advanced materials**		
	Composites: Basic concepts of composites, Processing of composites, advantages over metallic materials, various types of composites and their applications **Nano Materials:** Introduction, Concepts, synthesis of nanomaterials, examples, applications and Nano composites **Smart Materials:** An overview to Smart materials (e.g.: Rheological fluids) **Functionally graded materials (FGM):** Introduction, examples, processing and applications.	4 Hrs.	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	Material Science and Metallurgy	Kodgire V. D.	Everest Publishing House
2.	Material Science & Engg	Raghvan V	Prentice Hall of India, New Delhi

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Materials Science and Engineering	William D. Callister, R.Balasubramanium	Wiley India (P) Ltd.
2.	Introduction to Physical Metallurgy	Sydney Avner	McGraw Hill
3.	Materials Science & Engineering	Donald Askeland and Pradeep Fulay	Cengage Learning
4.	Introduction of Engineering Materials	B.K. Agrawal	McGraw Hill Pub. Co. ltd
5.	Mechanical Metallurgy	G.E. Dieter	McGraw Hill International New Delhi

Corporate Readiness (HS216)

Teaching Scheme		Examination Scheme	
Lectures:	2 Hrs. / Week	**Term Work:**	50 Marks
Credits:	**2**	**Total:**	50 Marks

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Prerequisite Course: Verbal and Non-verbal communication, Writing & Reading Skills

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Course Objectives:

1. To develop clarity in the exploration process of student career and to match his skills and interests with a chosen career path.
2. To improve interpersonal and communication skills.
3. To develop reading and writing skills.
4. To demonstrate the importance of team work & leadership quality.
5. To prepare students for the various professional interviews.
6. To develop different soft skills necessary to get success in their profession.

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Understand the concepts of grammar through various topics	2	Understand
CO2	Understand reading skills which can improve the phonetics	2	Understand
CO3	Apply the knowledge of Verbal Ability to apply it in written form	3	Apply
CO4	Analyse and apply the critical thinking ability as required to showcase leadership skills.	4	Analyse
CO5	Examine based on communication skills	4	Analyse
CO6	Judge an ideal personality that fits Industry requirement.	5	Evaluate

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	2	-	1	-	3	-
CO2	-	-	-	-	-	-	-	-	-	3	-	1	-	3	-
CO3	-	-	-	-	-	-	-	-	-	2	-	2	-	1	-
CO4	-	1	-	-	-	1	-	1	3	2	-	2	1	-	-
CO5	-	2	-	-	-	-	-	1	2	2	-	1	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-

UNIT	Course Contents	Hrs	CO
1	**Verbal English**		
	Para Jumbles, Idioms and phrases, Parts of speech, Brief overview of Tense	06	CO 1
2	**Reading Skills**		**CO**
	Reading Skills-why and how, Reading Newspaper, Reading Comprehension, Passage Reading	04	CO 2
3	**Writing skills**		**CO**
	Story Writing, Email Writing, Content Writing, Article and Passage Writing	04	CO 3
4	**Leadership and Teaming Up**		**CO**
	Team work, Good team member qualities, Leadership qualities, Team work activities	06	CO 4
5	**Communication Skills**		**CO**
	Spoken English, Phonetics, Accent and Intonation, Interpersonal Activities	06	C05
6	**Body Language**		**CO**
	Reveals your Inner Self and Personality, Grooming, Personal Interviews	04	CO 6

Text Books:

1. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Agarwal.
2. Reasoning verbal and Non-Verbal by B. S. Sijwali.
3. Master the Group Discussion & Personal Interview - Complete Discussion on the topics asked by reputed B-schools & IIMs by Sheetal Desarda.

References:

1. Shortcuts in Reasoning (Verbal, Non-Verbal, Analytical).
2. Analytical Reasoning by M. K. Panday
3. Logical and analytical reasoning by K. Gupta.
4. Multi-dimensional reasoning by Mishra & Kumar Dr. Lal.

Lab-I (BT+ATD+ FM) (ME217)

Teaching Scheme		Examination Scheme	
Practical:	2 Hrs./ Week	**PR Exam:**	50 Marks
Credits:	**1**	**Total:**	50 Marks

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Prerequisite Course: Applied Physics, Mathematics, Engg. Mechanics, Basic Thermodynamics

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Course Objectives:

1. To learn to make use of steam tables and measurements of calorific values of fuels
2. To estimate performance parameters by conducting tests on I. C. Engines & steam generator
3. To learn the skill of finding experimentally the properties of fluid, and calibrating the flow-meters

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Conduct experiment to Determine the calorific value of gaseous fuels and properties of steam.	3	Apply
CO2	Conduct experiment on SI/CI engines, boiler and determine the performance parameters	4	Analyze
CO3	Conduct experiment to determine fluid properties, coefficient of discharge for flow measuring devices and verify Bernoulli's theorem using experimental apparatus.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	1	-	-	3	3	3	-	1	-	-	2
CO2	3	2	2	3	1	3	2	3	3	3	-	1	-	-	2
CO3	3	2	-	3	1	-	-	3	3	3	-	1	-	-	2

List of Practicals

Sr. No	Title	No.of hours	COs
1.	Determination of calorific value of gaseous fuel using Junkers gas calorimeter	2	1
2.	Morse Test on Multi cylinder Petrol engine for determination of Friction power and mechanical Efficiency.	2	2
3.	Variable load test on diesel engine to determine various efficiencies, SFC & Heat Balance	2	2
4.	Variable load test on petrol engine to determine various efficiencies, SFC	2	2
5.	Determination of Kinematic Viscosity of given fluid using Redwood viscometer.	2	3
6.	Verification of Bernoulli's theorem using Bernoulli's apparatus.	2	3
7.	Determination of coefficient of discharge for given Venturimeter and V-notch.	2	3
8.	Determination of Major/Minor losses in pipe flow, by developing Computer code. (by using software)	2	3
9.	Trial on boiler to determine boiler efficiency, equivalent evaporation and Energy Balance.	2	2
	Demonstration Experiment		
10.	Demonstration & study of commercial exhaust gas analyzers.	2	2

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	Engineering Thermodynamics	P. K. Nag	Tata McGraw Hill Publications, 4th Edition.
2.	Thermodynamics: An Engineering Approach	Yonus A Cengel and Michale A Boles	McGraw Hill Education 8th Edition.
3.	Applied Termodynamics	Onkar Singh	New Age International Publishers, 3rd Edition.
4.	Fluid Mechanics: Fundamentals and Applications	Y. A. Cengel,J. M. Cimbala	McGraw Hill
5.	Internal Combustion Engines	V. Ganesan	Tata McGraw-Hill

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Basic Engineering Thermodynamics	Reyner Joel	Pearson Publication, 5th Edition
2.	Fundamentals of Thermodynamics	Sonntag, Borgnakke& Van Wylen	John Wiley & Sons Inc., 7thedition, 2012
3.	Internal Combustion Engine Fundamentals	Heywood J. B	Tata McGraw-Hill
4.	Introduction to Fluid Mechanics	R. W. Fox, P. J., Pritchard and A. T., McDonald	Wiley India.

Lab-II Numerical Methods (ME218)

Teaching Scheme		Examination Scheme	
Practical:	2 Hrs./ Week	**PR Exam:**	25 Marks
Credits:	**1**	**Total:**	**25 Marks**

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Prerequisite Course: (Engineering Mathematics)

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Course Objectives:

1. To understand the difference between analytical and Numerical Methods.
2. To apply Numerical Techniques for solving complex Mechanical engineering Problems.
3. To prepare base for understanding engineering analysis software.
4. Develop logical sequencing for solution procedure and skills in soft computing.
5. To analyze and interpret the data for real life problems.
6. Develop the foundation for engineering research

Course Outcomes (COs) :

After learning the course the students will be able to-

COs	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	Understand different analytical and numerical methods to find the roots of the equations	2	Understand
CO2	Apply different numerical and analytical techniques to solve various types of simultaneous equations.	3	Apply
CO3	Use the curve fitting tools for interpretation of data	3	Apply
CO4	Solve the differential equations using numerical techniques.	3	Apply
CO5	Interpret the data using interpolation techniques.	3	Apply
CO6	Use the integration techniques for solving engineering problems.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	3	3	-	-	2	1	-	1	2	3	-
CO2	2	3	-	-	3	-	-	-	1	3	-	1	3	3	-
CO3	3	-	2	2	2	-	-	-	1	1	-	2	2	3	-
CO4	3	2	-	-	3	-	-	-	2	2	-	1	3	3	-
CO5	2	2	-	-	3	-	-	-	2	1	-	2	2	3	-
CO6	3	-	-	-	3	-	-	-	2	2	-	-	2	3	-

List of Practicals

Sl. No.	Title of Term Work	CO
1.	Program on Roots of Equation a) Bisection Method b) Newton Raphson method	CO1
2.	Program on Simultaneous Equations a) Gauss Elimination Method b) Thomas algorithm c) Gauss-Seidal method.	CO2
3.	Program on Curve Fitting using Least square technique a) Straight line b) Power equation c) Exponential equation d) Quadratic equation	CO3
4.	Program on ODE a) Euler Method b) Runge-Kutta Methods- fourth order	CO4
5.	Program on PDE: Laplace equation	CO4
6.	Program on Interpolation a) Lagrange's Interpolation b) Newton's Forward interpolation	CO5
7.	Program on Numerical Integration a) Trapezoidal rule b) Simpson's 1/3rd Rule c) Simpson's 3/8th Rule d) Double integration: Trapezoidal rule	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House
1	Numerical Methods for Engineers	Steven C. Chapra, Raymond P. Canale	Tata McGraw Hill
2	Numerical Methods in Engineering and Science	Dr. B. S. Garewal	Khanna Publishers
3	Applied Numerical Methods with MATLAB for Engineers and Scientist	Steven C. Chapra	Tata McGraw Hill
4	Applied Numerical Methods using Matlab	Rao V. Dukkipati	New Age International Publishers

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1	Applied Numerical Analysis	Gerald and Wheatley	Pearson Education
2	Numerical Methods	E. Balagurusamy	Tata McGraw Hill
3	Computer Oriented Numerical Methods	P. Thangaraj	PHI
4	Introductory Methods of Numerical Analysis	S. S. Sastry	PHI

Lab-III Material Science and Metallurgy (ME219)

Teaching Scheme		Examination Scheme	
Practical:	2 Hrs./ Week	**Oral:**	25 Marks
Credits:	**1**	**Total:**	25 Marks

Course Outcomes (COs): On completion of the course, learner will be able to –

COs	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	Apply the characterization technique such as Microscopy (possibly along with suitable image analysis software) for examining contents of microstructures of various metals and alloys.	3	Apply
CO2	Experiment different heat treatment processes for modifying the properties of steels.	3	Apply
CO3	Demonstrate different tests such as destructive and/or non-destructive tests for a stated application.	3	Apply

B) Preferably an Industrial Visit to the industry/laboratory dealing with Materials and Metallurgical operations should be arranged.

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	2	2	-	-	2	3	-	1	2	-	-
CO2	2	2	1	3	2	2	-	-	2	3	-	1	2	-	-
CO3	2	2	1	3	2	2	-	-	2	3	-	1	2	-	-

LIST OF EXPERIMENTS/PRACTICALS

A) Any Eight Experiments/Practicals to be performed (Compulsory)

Sr. No.	Title	CO
1	Demonstration of Optical Metallurgical Microscopy and Basics of Scanning Electron Microscopy using Virtual Labs (IIT Kanpur).	1
2	Demonstration of Specimen/Sample Preparation (including Etchant preparation) for microscopic examination and Sample preparation for TEM analysis using Virtual Labs (IIT Kanpur).	1
3	Study, Drawing and analysis of Microstructure of Steels of various compositions preferably using Optical Metallurgical Microscope equipped with suitable image analysis software.	1
4	Conduction of Annealing, Normalizing and Quenching Heat treatment of Plain carbon steels and determination of relative hardness.	2
5	Determination of Hardenability of Steel using Jominy End Quench Test. [Use of computational/office productivity software tools such as MS Excel, Libre Office etc is recommended]	2
6	Determination of Hardness of a given sample using Rockwell Hardness Test and Hardness conversion table	3
7	Calculation of Hardness of a given sample using Brinell Hardness Test OR Poldi Hardness Test	3
8	Demonstration of Magnetic Particle Test for Finding flaws, cracks or discontinuities in a given sample.	3
9	Discovering flaws, cracks or discontinuities in a given sample by using Dye Penetrant Test.	3
10	Determination of impact strength of a given material using Impact Tests (Both Physically as well as Virtually using Strength of Materials Virtual lab-NITK Surathkal)	3

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	Material Science and Metallurgy	Kodgire V. D.	Everest Publishing House
2.	Material Science & Engg	Raghvan V	Prentice Hall of India, New Delhi

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Materials Science and Engineering	William D. Callister, R.Balasubramanium	Wiley India (P) Ltd.
2.	Introduction to Physical Metallurgy	Sydney Avner	McGraw Hill
3.	Materials Science & Engineering	Donald Askeland and Pradeep Fulay	Cengage Learning
4.	Introduction of Engineering Materials	B.K. Agrawal	McGraw Hill Pub. Co. ltd
5.	Mechanical Metallurgy	G.E. Dieter	McGraw Hill International New Delhi

Lab-IV Theory of Machines (ME220)

Teaching Scheme		Examination Scheme	
Practical:	2 Hrs./ Week	**Oral:**	25 Marks
Credits:	**1**	**Total:**	25 Marks

Course Objectives:

1 Study procedure to perform an experiment / procedure to find velocity and acceleration.
2 Study conditions to find unknown forces / velocity and acceleration for given condition.
3 Understand result of an experiment /Drawing through report / Sheet.

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes
CO1	Perform an experiment / Perform an analytical or graphical method to find unknown forces and reactions in members for static condition as per given specification.
CO2	Calculate unknown forces and reactions / / Calculate Velocity and acceleration in member for static condition as per given specifications.
CO3	Produce a result and conclusion through analytical, graphical and experimental in a report form.

Mapping of COs with POs/PSOs

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	2	-	-	-	1	3	3	-	3	1	-	-
CO2	2	3	1	2	1	-	-	2	1	-	-	2	1	-	-
CO3	1	1	1	2	-	-	-	1	2	2	-	1	1	-	-

List of Experiments

Exp. No.	Topic	CO
1.	To solve two problems on velocity and acceleration analysis using relative velocity and acceleration method.	1,2,3
2.	To solve two problems on velocity analysis using ICR method.	1,2,3
3.	To draw a cam profile any two problems with combination of various follower motion with radial and off-set cam.	1,2,3
4.	Speed and torque analysis of epicyclic gear train to determine holding torque.	1,2,3
5.	To verify CAM jump phenomenon	1,2,3
6.	To do computer programming on kinematic analysis of slider crank mechanism using Analytical Method. (Any Software)	1,2,3
7.	Virtual Lab CAM Follower Mechanism	-

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	Theory of Machines,	S.S.Ratan,	McGraw Hill Education
2.	Theory of Machines, Third Edition,	Beven T	Longman Publication.
3.	Theory Mechanism and Machine	A.G. Ambekar,	PHI.
4.	Machine Tool Design,	N.K. Meheta,	Tata McGraw Hill Publication
5.	Theory of Machines	R.S.Khurmi & J.K.Gupta	S.Chand & Company Ltd

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Theory of Mechanism and Machines	Ghosh Malik,	East-West Pvt. Ltd.
2.	Kinematics and Dynamics of Machinery	R L Norton,	McGraw Hill Education
3.	Theory of Machines	Sadhu Singh,	Pearson

Mini Project/ Project based Learning (ME221)

Teaching Scheme		Examination Scheme	
Practical:	2 Hrs./ Week	**OR:**	25 Marks
Credits:	1	**Total:**	25 Marks

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Prerequisite Course: A sound knowledge of the courses learnt and eagerness to identify and solve problems related to laboratories, department, industry and society.

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Course Objectives:

1. Acquire practical knowledge within the chosen area of technology for project development.
2. Identify, analyze, formulate and solve problem with a comprehensive and systematic approach.
3. Contribute as an individual or in a team in development of technical projects.
4. Develop effective communication skills for presentation of project related activities.
5. To support independent learning and innovative attitude.

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Apply technical and engineering knowledge gained from previous courses to identify a suitable problem and propose technically and economically feasible solution	3	Apply
CO2	Demonstrate adaptable & reusable solution of minimal complexity by using modern tools & advanced programming techniques to execute/implement project.	3	Apply
CO3	Demonstrate skills to disseminate technical and general information by means of oral as well as written presentation skills.	3	Apply
CO4	Create model using the concepts learnt in the theory with a good look and feel effects.	6	Create

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	2	-	2	-	3	3	2	-	2	-	-
CO2	3	-	2	-	2	-	2	-	3	3	2	-	2	-	-
CO3	3	-	2	-	2	-	2	-	3	3	2	-	2	-	-
CO4	3	-	2	-	2	-	2	-	3	3	2	-	2	-	-

Guidelines for Team Formation, Guide Allotment and Evaluation:

- A group of 3 to maximum 4 students shall work on a topic approved by the Guide and Head of the Department.
- Head of the Department shall appoint Mini Project Guides.
- Group formation, discussion with faculty advisor/guide, formation of the Semester Mini Project statement, resource requirement, if any should be carried out in the earlier part of the Semester.
- Students shall carry work jointly in constant consultation with internal guide, co-guide and external guide, if applicable.
- The students are expected to utilize the laboratory resources before or after their contact hours
- The review committee may be constituted by the Head of the Department and the progress of the project shall be evaluated based on a minimum of two reviews.
- The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners appointed by the Head of the Department.
- Students shall submit comprehensive mini project report after completing the work to the satisfaction.
- 1 credits shall be awarded to the candidate after the viva voce and project demonstration at the End of Semester.

Guidelines for Topic selection:

The outcome of the mini project shall be any one of the following, but not limited to

- A working model
- A product useful to the society
- Modernisation of existing laboratory set up
- Computerisation of existing setup
- Development of mobile app
- Applying IoT technique to the existing lab setup
- Troubleshooting in existing system

Guidelines for Continuous Internal Evaluation:

Review-I

Attendance till review: **5 marks**
Problem identification, problem statement and project work: **10 marks**
Project report and presentation: **10 marks**

Review-II and Final Oral Examination:

It shall be conducted based on implementation, testing, results, poster presentation, demonstration, whichever is applicable.
Attendance till Review: **5 marks**
Demonstration of Project Work: **10 marks**
Final Project Report and presentation: **10 marks**

Mandatory Learning Course-IV Foundations of IoT (MC 222)

Teaching Scheme **Examination Scheme**

Lectures: 1 Hr. / Week
Credits: **NIL** **Total:** -NA-

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Prerequisite Course: Fundamentals of Digital Electronics

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Course Objectives:

1. Understand the fundamentals of Microprocessor and Microcontrollers
2. Fundamentals of Embedded System and Arduino
3. Understand the basic principles of Interfacing
4. Understand the basic principles of Internet of Things
5. Understand the fundamentals of Communications and Output
6. Understand the fundamentals of Applications and Raspberry

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Understand the fundamentals of Microprocessor and Microcontrollers	1	Understand
CO2	Understand the fundamentals of Embedded System and Arduino	1	Understand
CO3	Understand the basic principles of Interfacing	1	Understand
CO4	Understand the basic principles of Internet of Things	1	Understand
CO5	Understand the fundamentals of Communications and Output	1	Understand
CO6	Understand the fundamentals of Applications and Raspberry	1	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	3	-	-	-	-	2	1	1	2	-	-
CO2	3	1	-	-	3	-	-	-	-	2	1	1	2	-	-
CO3	3	1	-	-	3	-	-	-	-	2	1	1	2	-	-
CO4	3	-	-	-	3	-	-	-	-	-	-	-	2	-	-
CO5	3	-	-	-	3	-	-	-	-	-	-	-	2	-	-
CO6	-	2	2	2	3	-	-	-	-	2	1	1	2	-	-

Course Contents

Unit	Contents	No.of Hours	COs
1	**Microprocessor and Microcontrollers**		
	a. Concept of Microprocessor(μp) and Microcontrollers(μc) b. Analog and Digital signals, Analog to digital converter, a. c. Need of representing a signal or information in digital form.	1 Hrs.	CO1
2	**Embedded System and Arduino**		
	a. Introduction to embedded system, Introduction to Arduino Boards. b. Selection criteria of Arduino based on various available variants.	1 Hrs.	C02
3	**Interfacing**		
	a. Concept of digital and analog ports in Arduino Uno. b. Interfacing of simple peripherals like LED, Buzzer with Arduino.	1 Hrs.	CO3
4	**Internet of Things**		
	a. Introduction to IoT and role of controllers in IoT. b. Arduino IDE PinMode(), DigitalWrite, AnalogRead() function, Arduino Interrupts	1 Hrs.	C04
5	**Communications and Output**		
	a. Selection of COM ports for serial communication. b. Interfacing of LM35 with Arduino and observing the output on serial monitor.	1 Hrs.	C05

	c. Interfacing of LM35 with Arduino and observing the output on IoT platform (ThingSpeak).		
6	**Applications and Raspberry**		
	a. IoT based web-controlled application by ESP 8266 Node MCU with LM 35 Temperature sensor. b. Introduction to Raspberry-Pi	1 Hrs.	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	The Internet 'of Things: Enabling Technologies, Platforms, and Use Cases	Pethuru Raj and Anupama C. Raman	CRC Press
2.	Make sensors	Terokarvinen, kemo, karvinen and villey valtokari	Maker Media
3.	Internet of Things: A Hands-on Approach	Arshdeep Bahga and Vijay Madisetti	CRC Press

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	"Internet of Things: A Hands-On Approach	Vijay Madisetti, Arshdeep Bahga	Mc Graw Hill
2.	Fundamentals of Wireless Sensor Networks: Theory and Practice	Waltenegus Dargie,Christian Poellabauer	CRC Press
3.	Beginning Sensor networks with Arduino and Raspberry Pi –	Charles Bell	Apress