SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to SPPU Pune)

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE - 2020 PATTERN

SECOND YEAR B. TECH.

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

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KOPARGAON-423603

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DEPARTMENT OF MECHANICAL ENGINEERING

Sanjivani College of Engineering was established in the year 1983. The Mechanical Engineering Department is a part of the institute since its inception. The Department has grown over the years with qualified teaching faculty members who are passionate to impart quality education. The department laboratories are fully equipped with latest equipment's, software's and all necessary teaching aids. It is now recognized as one of the prominent departments and known for academic excellence under the Pune University. The department is having valid Accreditation by 'NBA' from 31 July 2015 to 31 June 2021. Besides high quality teaching and instruction at UG, PG and Ph. D., the department is actively involved in basic and applied research and consultancy services. The department is providing quality technical and advisory support through consultancy to various private construction agencies, State Government, Central Government projects. Apart from academic knowledge, we also, train our students to face the challenges in their profession by providing value added courses like Communication and Presentation skills, building of Team Sprit through field study, expert talk etc. The department also, provides an opportunity to learn software's like MATLAB, AUTOCAD, UGNX, ANSYS, PTC Creo etc. to make our students more digitalized.

We arrange regular interaction of our stake holders like students, parents and faculty along with a Training and Placement cell which works full time for bright future of our students. The results are consistently above 90% and considerable number of student ranks in SPPU merit list. Students from Mechanical department have made incredible mark national and international levels and we are sure will continue in times to come. The Infrastructure development in India is growing at a faster rate and there are many career paths for Mechanical engineers. Mechanical engineers are essential in government sector, public and private sector and Multinational companies, to build various mega projects like highways, Industrial structures, smart cities, and reservoirs etc. The next decade will be most demanding and rewarding for Mechanical engineers.

Vision of Department

Our vision is to develop world class, multidimensional, competent, disciplined and ethical Mechanical 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 development of 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 and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives (PEOs)

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

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

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.

COURSE STRUCTURE- 2020 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			OR	PR	TW	Total
							ISE	ESE	CA				
PRJ	ME201	General Prof. Skills	-	-	2	1	-	-	-	-	-	50	50
BSC	BS202	Engineering Mathematics-III	3	1	-	4	30	50	20	-	-	-	100
PC	ME203	Basic Thermodynamics	3	-	-	3	30	50	20	-	-	-	100
PC	ME204	Manufacturing Processes	3	-	-	3	30	50	20	-	-	-	100
PC	ME205	Strength of Materials	3	-	-	3	30	50	20	-	-	-	100
HSMC	HS206	Universal Human Values & Ethics	3	-	-	3	30	50	20	-	-	-	100
PC	ME207	Basic Thermodynamics Lab	-	-	2	1	-	-	-	50	-	-	50
PC	ME208	Machine Shop - I	-	-	2	1	-	-	-	-	50	-	50
PC	ME209	Strength of Materials Lab	-	-	2	1	-	-	-	50	-	-	50
MC	MC210	Mandatory Course-III	2	-	-	No	-	-	-	-	-	-	-
		Total	17	1	8	**20**	**150**	**250**	**100**	**100**	**50**	**50**	**700**

SEMESTER-IV

Cat.	Code	Course Title	Teaching Scheme			Credits	Evaluation Scheme-Marks						
			L (hrs)	T (hrs)	P (hrs)		Theory			OR	PR	TW	Total
							ISE	ESE	CA				
PC	ME211	Numerical Methods	3	-	-	3	30	50	20	-	-	-	100
PC	ME212	Fluid Mechanics	4	-	-	4	30	50	20	-	-	-	100
PC	ME213	Materials Science & Metallurgy	3	-	-	3	30	50	20	-	-	-	100
PC	ME214	Kinematics of Machines	4	-	-	4	30	50	20	-	-	-	100
PRJ	ME215	Seminar	-	-	2	1	-	-	-	50	-	-	50
PC	ME216	Machine Drawing & Geometrical Modeling	1	-	4	3	-	-	-	-	-	50	50
PC	ME217	Numerical Methods Lab	-	-	2	1	-	-	-	-	50		50
PC	ME218	Fluid Mechanics Lab	-	-	2	1	-	-	-	-	50	-	50
PC	ME219	Materials Science & Metallurgy Lab	-	-	2	1	-	-	-	50	-	-	50
PC	ME220	Kinematics of Machines Lab	-	-	2	1	-	-	-	50	-	-	50
MC	**MC221**	**Mandatory Course-IV**	**2**	-	-	**No**	-	-	-	-	-	-	-
		Total	17	-	14	**22**	**120**	**200**	**80**	**150**	**100**	**50**	**700**

MC210	**Mandatory Course-III**	**Constitution of India – Basic features and fundamental principles**
MC221	**Mandatory Course-IV**	**Innovation - Project based – Sc., Tech, Social, Design & Innovation**

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.*

General Proficiency Skills [ME201]
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	Learn the etiquettes of Email writing	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							2			
CO2					3							2			
CO3					2							2			
CO4					3							2			
CO5					3							2			
CO6					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 Email writing and Google-suit**		
	Manage mailing list and Google groups, E mail scheduling, Email etiquettes, Basic Mail Merging features, Hyperlinking, Basics of Google classroom, Google Forms and its Sharing settings, Upload a video on YouTube	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

Engineering Mathematics-III (BS202)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	1 Hrs./Week (if applicable)	**CIA :**	20 Marks
Credits:	**4**	**Total:**	100 Marks

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COURSE OBJECTIVES

1. To describe and recall the basics of Vector Calculus and differential equations.
2. To understand the concept for solving problems based on vector and differential calculus in the universe.
3 To apply core concepts for the solution of engineering problems based on Vector calculus and differential equations.
4 To analyze the problems of which kind and their solution methods available in Vector and differential calculus and use a particular method for finding a solution in the engineering field.

COURSE OUTCOMES

The Students are able to

1 Know and recall the basics of Vector Calculus and differential equations.
2 Understand the concept used for solving problems based on vector and differential calculus in the universe.
3 Apply core concepts for the solution of engineering problems based on Vector calculus and differential equations.
4 Analyze the problems of which kind and their solution methods available in Vector and differential calculus and use a particular method for finding a solution in the engineering field.

CO's	Course Outcomes	Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Know and recall the basics of Vector Calculus and differential equations	**1**	**Remember**
CO2	Understand the concept used for solving problems based on vector and differential calculus in the universe	**2**	**Understand**
CO3	Apply core concepts for the solution of engineering problems based on Vector calculus and differential equations	**3**	**Apply**
CO4	Analyze the problems of which kind and their solution methods available in Vector and differential calculus and use a particular method for finding a solution in the engineering field	**4**	**Analyse**

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	3	2	-	-	1	-	-	2	2	1	-	1	-	-
CO2	3	2	-	-	1	-	-	2	2	1	-	1	-	-
CO3	3	2	-	-	1	-	-	2	2	1	-	1	-	-
CO4	3	2	-	-	1	-	-	2	2	1	-	1	-	-

(Specify values as : 3: High Level, 2: Medium Level, 1: Low Level for mapping of Cos to POs)

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.	08	1,3
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.	08	3,4
Unit-III	**HIGHER ORDER DIFFERENTIAL EQUATION**	**No.of Hours**	**COs**
	Homogeneous and non-homogeneous linear differential equation of n^{th} order and its solution, Method of variation of parameter, operator method for particular integral, solution of certain types of linear differential equation:-Cauchy's and Legendre's differential equation, Applications Branch wise (Simple Electrical Circuits, Mass spring system and Bending moments).	08	1,2,3
Unit-IV	**SERIES SOLUTION OF DIFFERENTIAL EQUATION**	**No.of Hours**	**COs**
	Linear differential equations with variable coefficients, solution about ordinary point, about singular point (Frobenius method) series solution of Bessel's equation, series solution of Legendre's equation,	08	3,4
Unit-V	**PARTIAL DIFFERENTIAL EQUATION**	**No.of Hours**	**COs**
	Formation of partial differential equation, Partial differential equation of order one (linear and nonlinear), Charpit method, PDE of higher order with constant coefficient	08	2,3,4
Unit-VI	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION**	**No.of Hours**	**COs**
	One dimensional heat equation, Wave equation, Two dimensional heat equation (Laplace equation), Telephone equation, Radio equations	08	1,3,4

Books:

Text Book(s)

1. B. S. Grewal, Higher Engineering Mathematics, 42/e, Khanna Publishers, 2012, **ISBN-13: 978-8174091154.**
2. N. P. Bali and Manish Goyal, A TextBook of Engineering, Mathematics, 8/e, Lakshmi Publications, 2012. **ISBN: 9788131808320.**
3. H. K. Das, Engineering Mathematics, S Chand, 2006, **ISBN-8121905209**

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. Robert C. Wrede, Introduction to vector and tensor analysis, Dover, 2013, **ISBN-048661879X**
4. W. E. Boyce, R. C. Diprima, Elementary differential equation and boundary value problems.
5. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House, 2014. **ISBN-13: 978-1842653418.**
6. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley, 9/e, 2013, **ISBN-13: 978-0471488859.**

Basic Thermodynamics (ME203)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA :**	20 Marks
Credits:	**3**	**Total:**	100 Marks

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Prerequisite Course: Applied Physics, Mathematics, Basic Mechanical Engineering

Course Objectives:

1. To acquire knowledge about the basic terms used in classical thermodynamics and zeroth law of thermodynamics.
2. To know and apply first law of thermodynamics to various processes, cycles.
3. To understand and apply second law of thermodynamics to various processes, cycles.
4. To learn how to make use of steam tables and Mollier diagram.
5. To learn about ideal gases and vapour power cycles & gas power cycles.
6. To learn measurements of calorific values of fuels and properties of lubricants.

Course Outcomes (COs):

1. Determine work transfer for thermodynamic processes. (BTL-3)
2. Apply first law of thermodynamics to non-flow and steady flow processes/devices. (BTL-3)
3. Determine the change in entropy for reversible and irreversible processes. (BTL-3)
4. Calculate heat transfer, work done, change in internal energy, change in entropy, change in enthalpy for processes using ideal gas and analyse the performance of thermodynamic power cycles. (BTL-4)
5. Estimate the properties of pure substances using steam table and Mollier diagram (BTL-3)
6. Determine the calorific value of solid/liquid/ gaseous fuels and properties of lubricants (BTL-3)

Mapping of Course Outcome (CO) and Programme Outcome (PO)

	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
CO2	3									2		1			2
CO3	3									2		1			2
CO4	3				2		2			2		1			2
CO5	3	2		2		2		2	2	2		1			2
CO6	2			2				2	2	2		1			2

Course Contents

Unit-I	Thermodynamic Concepts and Basic Definitions	No. of Hours	CO
	Introduction to Thermodynamics: system, properties, states, processes, cycle & equilibrium, Zeroth law of thermodynamics. Definition of work & heat, types of work and their evaluation for various thermodynamics processes , Comparison of heat & work	06	CO1
Unit-II	**First Law of Thermodynamics**	**No. of Hours**	
	First law of thermodynamics, Joules experiment, Applications of first law to flow and non flow processes and cycles. 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.	06.	CO2
Unit-III	**Second Law of Thermodynamics**	**No. of Hours**	
	Second Law Statements: Kelvin–Planck and Clausius Statement, Heat engine, Heat pump & refrigerator. Perpetual motion machine (PMM – II), Concept of Reversibility and Irreversibility. Entropy as a property , Clausius' theorem, Clausius inequality, Change in entropy in reversible and irreversible processes, Principle of increase of entropy, Introduction to third law of thermodynamics	06	CO3
Unit-IV	**Ideal Gas Processes & Thermodynamic Cycles**	**No. of Hours**	
	Ideal Gas Laws, Equation of State, Ideal Gas constant and Universal Gas constant, Ideal gas processes- on P-V and T-S diagrams. Calculations of heat transfer, work done, internal energy. Change in entropy, enthalpy. Concept of availability **Thermodynamic Cycles: Gas Power Cycles:-** Introduction to Carnot Cycle, Diesel Cycle, Otto Cycle, Brayton cycle **Vapour Power Cycles:-** Introduction to Carnot Cycle, Rankine cycle.	08	CO4
Unit-V	**Properties of Pure Substance**	**No. of Hours**	
	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.	08	CO5

Unit-VI	Introduction to Fuels and Combustion	No. of Hours	
	Fuels: Definition & classification of fuels, Its composition & calorific value, Bomb and gas calorimeters, **Combustion :**Introduction, combution equations-stiochiometry, combustion analysis by mass and by volume,stiochiometric mass & volume of air for the complete combustion of a fuel, products of combution by mass & volume, conversion of volumetric to gravimetric (mass) analysis, conversion of volumetric to gravimetric analysis. Dry flue or exhaust gas, excess air.	08	CO6

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.

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., 7thedition, 2012
3. Y. V. C. Rao, "Theory and Problems in Thermodynamics", 2nd edition, 2012
4. Jones J.B. and Hawkins G.A., "Engineering Thermodynamics", John Wyley and Sons. 2nd Edition
5. Kenneth. Wark,"Thermodynamics", McGraw-Hill,5th Edition
6. J.P. Holman, "Thermodynamics", McGraw-Hill, 4th Edition.
7. A.Venkatesh, "Basic Engineering Thermodynamics", TMH, 2012
8. Reyner Joel, "Basic Engineering Thermodynamics", Pearson Publication, 5th Edition
9. Sadhu Singh, "Thermal Engineering", Pearson India Education Services Pvt. Ltd

Manufacturing Processes (ME 204)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA :**	20 Marks
Credits:	**3**	**Total:**	100 Marks

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Prerequisite Course: Nil

1. **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 and to understand lathe machine.

2. **Course Outcome: On completion of the course,**

Course Outcome	Statements
CO1	Students will be able to describe various types of pattern ,pattern allowances ,core, castings and apply knowledge to calculate solidification time of casting.[BTL-03]
CO2	Students will be able to understand and describe various types forming processes and calculate amount of forces acting and work done .[BTL-3]
CO3	Student will be able to compare various types of plastic processing methods and their applications.[BTL-04]
CO4	Students will be able to differentiate various types of joining processes ,their applications and parameters.[BTL-04]
CO5	Students will be able to design dies for sheet metal working operations.[BTL-04]
CO6	Students will be able to describe types of additive manufacturing processes and compare them. [BTL-04]
CO7	Students will be able to operate lathe machine and perform turning, facing, taper turning operations.[BTL-03]

3. Mapping of Course Outcomes and Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2		02	2	3	1	3	3	3	2	3	03
CO2	3	3	2	2				2	1	1		1		3	03
CO3	2							1		1		1	2	3	02
CO4	2					02	2	3	2	3	3	3		3	03
CO5	3	3	3	2				1		1		1		3	02
CO6	2				2	02	2	3	2	3	3	3	2	3	02

4. 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.	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) **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	04 Hrs.	C03
Unit-IV	**Joining Processes**	No.of Hours	COs
	Surface preparation and types of joints. Welding Classification, Defects and Applications. 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. Thermit welding -** 5. **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

5. 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.

STRENGTH OF MATERIALS (ME205)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA :**	20 Marks
Credits:	**3**	**Total:**	100 Marks

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Prerequisite Course: Applied Mechanics, Mathematics

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Course Objectives: (Please specify Six 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

Course Outcome	Statements
CO1	to solve problems based on stresses and strains for engineering materials [BT3]
CO2	to calculate the principal stresses and strains developed in different mechanical structures based on different theories of failures [BT3]
CO3	to calculate shear force and bending moment diagrams for determinate beams due to external loads [BT3]
CO4	to differentiate the bending stresses, shear stresses and their distribution diagrams [BT3]
CO5	to calculate slope and deflection due to external loads in determinate beams. [BT3]
CO6	to differentiate the torque developed based on strength and weight of the shaft. [BT3]

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	3		1	2	1		1	3		2
CO2	3	2	2	2	3	1		2	2	2		2	3		3
CO3	2	2	2		1	3		2	2	1	2	1	3		2
CO4	3	3	2	2	2	2		2	2	2		2	2		3
CO5	3	3	1	2	2	1		1	2	1		1	2		3
CO6	3	3	2	3	2	2		2	1	2	2	2	2		3

Course Contents

Unit	Contents	No.of Hours	COs
1	**Stresses and strains**		
	Stress, strain, 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, stresses in Fiber-Reinforced Composites	6 Hrs.	CO1
2	**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.	C02
3	**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.	C03
4	**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.	C04
5	**Slope and deflection of beams**		
	Slope and deflection of beams: Slope and deflection of determinate beams, double integration method, Macaulay's method, derivation of formula for slope and deflection for standard cases.	6 Hrs.	C05
6	**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.	CO6

Reference Books

Text Books:

1) R K Bansal, “A Textbook of Strength of Materials”, 6th Edition, Laxmi Publications, 2010 (620.112)
2) S.S. Rattan “ Strength of Materials” Tata McGraw Hill Education (India) Pvt. Ltd., 2nd Edition (Sixth reprint 2013) (620.113)
3) Ramamurtham - Strength of material - Dhanpat Rai Publication.(620.112)
4) S.S. Bhavikatti, Mechanics of Solids, The New Age International Publishers, 2010 (620.18)
5) B.K. Sarkar - Strength of material - Tata McGraw-Hill Education Publication. (620.12)

Reference Books:

- Ferdinand P. Beer, E. Russell Johnston and Jr.John T. DeWolf “Mechanics of Materials”, Tata McGraw-Hill, Sixth Edition, 2012 (620.112)
- G. H. Ryder- Strength of Materials- 3rd Edition, Macmillan Pub, India (620.119)
- E.P. Popov - Engineering Mechanics of Solids - Prentice Hall Publication. (620.104)
- Singer and Pytel - Strength of materials - Harper and row Publication. (620.113)
- Andrew Pytel & Jaan Kiusalaas, Mechanics of Materials, Second Edition, Publisher, Global Engineering, 2012 (620.113)
- 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

Georgia Institute of Technology-Online Course_https://www.coursera.org/lecture/materials-structures/module21-solve-a-combined-static-loading-problem-9bvsj

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS (HS206)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA :**	20 Marks
Credits:	**3**	**Total:**	100 Marks

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Course Objectives:

1. To make the students aware about the concept and need of value education.
2. To help the students appreciate the essential complementarity between values and skills to ensure sustained happiness and prosperity.
3. To facilitate the development of a holistic perspective among the students towards life and profession.
4. To facilitate the understanding of harmony at various levels staring from self and going towards family, society and nature.
5. To make the students aware about the correlation between engineering ethics and social experimentation in various situations.
6. To highlight the importance of professional ethics in the wake of global realities.

Course Outcomes (COs) :

After successful completion of this course, the students should be able to:

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Understand the concept of self exploration as the process of value education.	2	Understand
CO2	Understand the human being as the coexistence of self and body.	2	Understand
CO3	Apply the holistic approach for fulfilling human aspirations for the humans to live in harmony at various levels.	3	Apply
CO4	Analyze the universal human order in correlation with professional ethics.	4	Analyze
CO5	Apply ethical practices in engineering profession.	3	Apply
CO6	Evaluate the importance of various ethical practices in the wake of global realities.	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
CO1	-	-	-	-	-	2	-	3	-	1	-	2	-	-
CO2	-	-	-	-	-	2	-	3	-	1	-	2	-	-
CO3	-	-	-	-	-	3	-	3	-	1	-	2	-	-
CO4	-	-	-	-	-	3	-	3	-	1	-	2	-	-
CO5	-	-	-	-	-	3	-	3	-	1	-	2	-	-
CO6	-	-	-	-	-	3	-	3	-	1	-	2	-	-

COURSE CONTENTS

Unit-I	Introduction to Value Education	No. of Hours	COs
	Values, Morals and Ethics; Concept and need of value education; Self-exploration as the process for value education; Guidelines for value education; Basic human aspirations and their fulfillment	06	CO1
Unit-II	Harmony in Human Being	No. of Hours	COs
	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	CO2
Unit-III	Harmony in the family, society and nature	No. of Hours	COs
	Harmony in the family- The basic unit of human interaction; Values in the human to human relationship; Harmony in the society; Vision for the universal human order; Harmony in the nature; Realizing existence as coexistence at all levels	06	CO3
Unit-IV	Professional Ethics	No. of Hours	COs
	Natural acceptance of human values; Definitiveness of ethical human conduct; Humanistic education and universal human order; Competence in professional ethics; Transition towards value-based life and profession	06	CO4
Unit-V	Engineering Ethics and Social Experimentation	No. of Hours	COs
	Need of engineering ethics; Senses of engineering ethics; Variety of moral issues; Moral autonomy; Utilitarianism; Engineering as experimentation; Engineers as responsible experimenters; Codes of ethics	06	CO5
Unit-VI	Global Issues	No. of Hours	COs
	Globalization and multi-national corporations; Cross-cultural issues; Business ethics; Environmental ethics; Computer ethics; Bio-ethics; Ethics in research; Intellectual property rights and plagiarism	06	CO6

Books:

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

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 exploration and thus universally adaptable. In order to connect the content of this course with practice, minimum 6 group activities should be conducted with active involvement of the students. The teacher’s assessment should be strictly based on the participation of the students in these activities.

Basic Thermodynamics (ME207)

Teaching Scheme		Examination Scheme	
Lectures:	- Hrs. / Week	**In-Sem Exam :**	-- Marks
Practical:	2 Hrs./ Week	**End Sem Exam:**	-- Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA :**	-- Marks
		OR	50 Marks
Credits:	**1**	**Total:**	50 Marks

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Prerequisite Course: Applied Physics, Mathematics, Basic Mechanical Engineering

Course Objectives:

1. To acquire knowledge about the basic terms used in classical thermodynamics and zeroth law of thermodynamics.
2. To know and apply first law of thermodynamics to various processes, cycles.
3. To understand and apply second law of thermodynamics to various processes, cycles.
4. To learn how to make use of steam tables and Mollier diagram.
5. To learn about ideal gases and vapour power cycles & gas power cycles.
6. To learn measurements of calorific values of fuels and properties of lubricants.

Course Outcomes (COs):

1. Determine work transfer for thermodynamic processes. (BTL-3)
2. Apply first law of thermodynamics to non-flow and steady flow processes/devices. (BTL-3)
3. Determine the change in entropy for reversible and irreversible processes. (BTL-3)
4. Calculate heat transfer, work done, change in internal energy, change in entropy, change in enthalpy for processes using ideal gas and analyse the performance of thermodynamic power cycles. (BTL-4)
5. Estimate the properties of pure substances using steam table and Mollier diagram (BTL-3)
6. Determine the calorific value of solid/liquid/ gaseous fuels and properties of lubricants (BTL-3)

Mapping of Course Outcome (CO) and Programme Outcome (PO)

	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
CO2	3									2		1			2
CO3	3									2		1			2
CO4	3				2		2			2		1			2
CO5	3	2		2		2		2	2	2		1			2
CO6	2			2				2	2	2		1			2

List of Practical (Any 8)

1. Study of Joule's paddle wheel experiment
2. Performance estimation of air standard cycle using software.
3. Determination of dryness fraction of steam using calorimeter.
4. Determination of calorific value of solid/liquid fuel using Bomb calorimeter
5. Visit to any industry which uses steam for process heating/power generation
6. Determination of calorific value of gaseous fuel using gas calorimeter
7. Determination of flash and fire point of a given sample oil
8. To determine thermal efficiency of internal combustion Engine.
9. To determine coefficient of performance (COP) of ice plant.

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.

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., 7thedition, 2012
3. Y. V. C. Rao, "Theory and Problems in Thermodynamics", 2nd edition, 2012
4. Jones J.B. and Hawkins G.A., "Engineering Thermodynamics", John Wyley and Sons. 2nd Edition
5. Kenneth. Wark,"Thermodynamics", McGraw-Hill,5th Edition
6. J.P. Holman, "Thermodynamics", McGraw-Hill, 4th Edition.
7. A.Venkatesh, "Basic Engineering Thermodynamics", TMH, 2012
8. Reyner Joel, "Basic Engineering Thermodynamics", Pearson Publication, 5th Edition
9. Sadhu Singh, "Thermal Engineering", Pearson India Education Services Pvt. Ltd

Machine Shop-I (ME208)

Teaching Scheme		Examination Scheme	
Lectures:	- Hrs. / Week	**In-Sem Exam :**	-- Marks
Practical:	2 Hrs./ Week	**End Sem Exam:**	-- Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA :**	-- Marks
		PR	50 Marks
Credits:	**1**	**Total:**	50 Marks

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1. **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 and to understand lathe machine.

2. **Course Outcome: On completion of the course,**

Course Outcome	Statements
CO1	Students will be able to describe various types of pattern ,pattern allowances ,core, castings and apply knowledge to calculate solidification time of casting.[BTL-03]
CO2	Students will be able to understand and describe various types forming processes and calculate amount of forces acting and work done .[BTL-3]
CO3	Student will be able to compare various types of plastic processing methods and their applications.[BTL-04]
CO4	Students will be able to differentiate various types of joining processes ,their applications and parameters.[BTL-04]
CO5	Students will be able to design dies for sheet metal working operations.[BTL-04]
CO6	Students will be able to describe types of additive manufacturing processes and compare them. [BTL-04]
CO7	Students will be able to operate lathe machine and perform turning, facing, taper turning operations.[BTL-03]

3. Mapping of Course Outcomes and Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2		02	2	3	1	3	3	3	2	3	03
CO2	3	3	2	2				2	1	1		1		3	03
CO3	2							1		1		1	2	3	02
CO4	2					02	2	3	2	3	3	3		3	03
CO5	3	3	3	2				1		1		1		3	02
CO6	2				2	02	2	3	2	3	3	3	2	3	02

4. Contents of the Syllabus

List of Practical's:

Sr. No.	Title	CO	PO	PSO
1	Turning	CO7	1,6,7,8,9,10,11,12	02
2	Welding (Arc welding)	CO4	1,2,6,7,9,10,11,12	02,03
3	Sand moulding	CO1	1,2,6,7,8,9,10,11,12	02,03
4	3D printing	CO6	1,2,5,6,7,8,9,10,11,12	02,03

Assessment tools –

1. Practical Journal

2. Oral after every practical on job.

3. Assignments on every practical.

5. 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.

STRENGTH OF MATERIALS Lab. [ME209]

S.Y. Tech. Mechanical

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

Examination Scheme
Term Work: 25 Marks
Oral: 50 Marks
Total Marks: 75 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

Course Outcome	Statements	Blooms Taxonomy Level
CO1	To conduct a test on universal testing machine to determine mechanical properties of the given specimen	4
CO2	To demonstrate single and double shear test on the specimen	4
CO3	to verify the flexural formula for a simply supported beam	3
CO4	To plot shear force and bending moment diagrams using software	3
CO5	To compare the experimental values of deflection of a simply supported beam with theoretical values	4
CO6	To determine the Principal stresses by graphical method and verification through analytical method.	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	1			2	1	2		1	1	1		1	2		
CO2	1			1		2		1	2	2		2	2		
CO3	1			1		2		2	2	1		1	2		
CO4	1			2	2			1	1	2		2	2		
CO5	1			1	1			1	1	1		1	2		
CO6	1			2	2			1	2	2		2	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	2		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	3		1
6	Plotting of shear force and bending moment diagrams for different boundary conditions and loading conditions of beam (using software)	4		1
7	Comparison of numerical and analytical analysis on Slope and deflection (by using software)	5		1
8	Determination of Principal stresses by graphical method and verification through analytical method	6		1

References:

1. William Smith, Javad Hashemi, ***Foundations of materials science and engineering***, 2019, 6th edition, McGraw-Hill, ISBN 007-125690-3.
2. Dieter, G.E., ***Mechanical metallurgy***, 1988, SI metric edition, McGraw-Hill, ISBN 0-07-100406-8.
3. Norman E. Dowling, ***Mechanical Behavior of Materials***, Prentice-Hall International, 4th edition, 2013.
4. 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

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

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to SPPU Pune)

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE - 2020 PATTERN

SECOND YEAR B. TECH.

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

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING

KOPARGAON-423603

(An Autonomous Institute Affiliated to SPPU Pune)

DEPARTMENT OF MECHANICAL ENGINEERING

Sanjivani College of Engineering was established in the year 1983. The Mechanical Engineering Department is a part of the institute since its inception. The Department has grown over the years with qualified teaching faculty members who are passionate to impart quality education. The department laboratories are fully equipped with latest equipment's, software's and all necessary teaching aids. It is now recognized as one of the prominent departments and known for academic excellence under the Pune University. The department is having valid Accreditation by 'NBA' from 31 July 2015 to 31 June 2021. Besides high quality teaching and instruction at UG, PG and Ph. D., the department is actively involved in basic and applied research and consultancy services. The department is providing quality technical and advisory support through consultancy to various private construction agencies, State Government, Central Government projects. Apart from academic knowledge, we also, train our students to face the challenges in their profession by providing value added courses like Communication and Presentation skills, building of Team Sprit through field study, expert talk etc. The department also, provides an opportunity to learn software's like MATLAB, AUTOCAD, UGNX, ANSYS, PTC Creo etc. to make our students more digitalized.

We arrange regular interaction of our stake holders like students, parents and faculty along with a Training and Placement cell which works full time for bright future of our students. The results are consistently above 90% and considerable number of student ranks in SPPU merit list. Students from Mechanical department have made incredible mark national and international levels and we are sure will continue in times to come. The Infrastructure development in India is growing at a faster rate and there are many career paths for Mechanical engineers. Mechanical engineers are essential in government sector, public and private sector and Multinational companies, to build various mega projects like highways, Industrial structures, smart cities, and reservoirs etc. The next decade will be most demanding and rewarding for Mechanical engineers.

Vision of Department

Our vision is to develop world class, multidimensional, competent, disciplined and ethical Mechanical 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 development of 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 and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives (PEOs)

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

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

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.

COURSE STRUCTURE- 2020 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			OR	PR	TW	Total
							ISE	ESE	CA				
PRJ	ME201	General Prof. Skills	-	-	2	1	-	-	-	-	-	50	50
BSC	BS202	Engineering Mathematics-III	3	1	-	4	30	50	20	-	-	-	100
PC	ME203	Basic Thermodynamics	3	-	-	3	30	50	20	-	-	-	100
PC	ME204	Manufacturing Processes	3	-	-	3	30	50	20	-	-	-	100
PC	ME205	Strength of Materials	3	-	-	3	30	50	20	-	-	-	100
HSMC	HS206	Universal Human Values & Ethics	3	-	-	3	30	50	20	-	-	-	100
PC	ME207	Basic Thermodynamics Lab	-	-	2	1	-	-	-	50	-	-	50
PC	ME208	Machine Shop - I	-	-	2	1	-	-	-	-	50	-	50
PC	ME209	Strength of Materials Lab	-	-	2	1	-	-	-	50	-	-	50
MC	MC210	Mandatory Course-III	2	-	-	No	-	-	-	-	-	-	-
		Total	17	1	8	**20**	**150**	**250**	**100**	**100**	**50**	**50**	**700**

SEMESTER-IV

Cat.	Code	Course Title	Teaching Scheme			Credits	Evaluation Scheme-Marks						
			L (hrs)	T (hrs)	P (hrs)		Theory			OR	PR	TW	Total
							ISE	ESE	CA				
PC	ME211	Numerical Methods	3	-	-	3	30	50	20	-	-	-	100
PC	ME212	Fluid Mechanics	4	-	-	4	30	50	20	-	-	-	100
PC	ME213	Materials Science & Metallurgy	3	-	-	3	30	50	20	-	-	-	100
PC	ME214	Kinematics of Machines	4	-	-	4	30	50	20	-	-	-	100
PRJ	ME215	Seminar	-	-	2	1	-	-	-	50	-	-	50
PC	ME216	Machine Drawing & Geometrical Modeling	1	-	4	3	-	-	-	-	-	50	50
PC	ME217	Numerical Methods Lab	-	-	2	1	-	-	-	-	50		50
PC	ME218	Fluid Mechanics Lab	-	-	2	1	-	-	-	-	50	-	50
PC	ME219	Materials Science & Metallurgy Lab	-	-	2	1	-	-	-	50	-	-	50
PC	ME220	Kinematics of Machines Lab	-	-	2	1	-	-	-	50	-	-	50
MC	**MC221**	**Mandatory Course-IV**	**2**	-	-	**No**	-	-	-	-	-	-	-
		Total	17	-	14	**22**	**120**	**200**	**80**	**150**	**100**	**50**	**700**

MC210	**Mandatory Course-III**	**Constitution of India – Basic features and fundamental principles**
MC221	**Mandatory Course-IV**	**Innovation - Project based – Sc., Tech, Social, Design & Innovation**

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.*

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	NM (ME 211)
Subject	Numerical Methods	**No. of Lectures /Week**	3
Faculty Incharge	Dr P M Patare	**No. of Practical /Week**	--
Examination Scheme	In Sem (30) End Sem (50)	CA (20)	--
Assignment (One Each Unit)	06	**Class Test** (One on one units)	06

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. **Optimize** the solution for different real life problems with available constraints.
6. **Build** the foundation for engineering research

2. Course Outcomes (COs) :

After learning the course the students will be able to-

CO's	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	To **understand** different analytical and numerical methods to find the roots of the equations	2	Understand
CO2	To **apply** different numerical and analytical techniques to solve various types of simultaneous equations.	3	Apply
CO3	To **learn** various traditional and advanced optimization technique.	4	Analyze
CO4	To **recognize** and **learn** different numerical techniques to handle the differential equations.	4	Analyze
CO5	To **Evaluate and interpret** the data using curve fitting and regression analysis tools.	5	Evaluate
CO6	To **formulate** numerical techniques to solve the engineering problems using integration techniques	5	Evaluate

COURSE CONTENTS

Unit	Topics	No. of Hours	COs
Unit-I	**Roots of Equation and Error Approximations**		
	Roots of Equation : Bisection Method, Newton Raphson method **Error Approximations :** Types of Errors: Absolute, Relative, Algorithmic, Truncation, Round off Error, Error Propagation, Concept of convergence-relevance to numerical methods.	06	CO1
Unit-II	**Simultaneous Equations**		
	Gauss Elimination Method with Partial pivoting, Gauss-Seidal method and Thomas algorithm for Tri-diagonal Matrix	06	CO2
Unit-III	**Optimization**		
	Traditional Optimization Technique : GRA (Grey Relational Analysis), TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), Modern Optimization Techniques: Artificial Neural Network (ANN)	06	CO3
Unit-IV	**Numerical Solutions of Differential Equation**		
	Ordinary Differential Equations [ODE] Taylor series method, Euler Method, Runge-Kutta fourth order, Simultaneous equations using Runge Kutta 2nd order method. **Partial Differential Equations [PDE]:** Finite Difference methods Introduction to finite difference method, Simple Laplace method	06	CO4
Unit-V	**Curve Fitting and Regression Analysis**		
	Curve Fitting Least square technique- Straight line, Power equation, Exponential equation and Quadratic equation. Regression Analysis **Introduction to multi regression analysis,** Lagrange's Interpolation, Newton's Forward interpolation, Inverse interpolation (Lagrange's method only)	06	CO5
Unit-VI	**Numerical Integration**		
	Numerical Integration (1D only). Trapezoidal rule, Simpson's 1/3rdRule, Simpson's 3/8thRule. Double Integration, Trapezoidal rule.	06	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Numerical Methods for Engineers	Steven C. Chapra, Raymond P. Canale	Tata McGraw Hill	511.7 CHA-04 28520
2	Numerical Methods in Engineering and Science	Dr. B. S. Garewal	Khanna Publishers	511.7 GRE-10 70477
3	Applied Numerical Methods with MATLAB for Engineers and Scientist	Steven C. Chapra	Tata McGraw Hill	511.7 CHA-15 59147
4	Applied Numerical Methods using Matlab	Rao V. Dukkipati	New Age International Publishers	511.7 RAO-15 59301

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Applied Numerical Analysis	Gerald and Wheatley	Pearson Education	510 GER-16 59566
2	Numerical Methods	E. Balagurusamy	Tata McGraw Hill	511.7 E B-07 43889
3	Computer Oriented Numerical Methods	P. Thangaraj	PHI	001 THA-13 59256
4	Introductory Methods of Numerical Analysis	S. S. Sastry	PHI	511 SAS-91 13986

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	FM (ME 212)
Subject	Fluid Mechanics	**No. of Lectures /Week**	4
Faculty Incharge	Mr Y. H. Ahire	**No. of Practical /Week**	--
Examination Scheme	In Sem (30) End Sem (50)	CA (20)	--
Assignment (One Each Unit)	06	**Class Test** (One on each units)	06

1. 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 & forces of drag and lift
6. To analyse & establish relation between flow parameters

2. Course Outcomes (COs) :

After learning the course the students will be able to-

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	To **determine** various fluid properties encountered in fluid mechanics engineering applications	3	Apply
CO2	To **determine** total pressure force, center of pressure on submerged surfaces and metacentric height of floating body	3	Apply
CO3	To **differentiate** between the types of fluid flow and **calculate** the velocity, acceleration fields at any point in fluid flow	4	Analyze
CO4	To **apply** Bernoulli's, equation in flow measurements and **determine** the velocity, shear stress distribution for a laminar flow through pipes & parallel plates	3	Apply
CO5	To **differentiate** between major & minor losses in pipe flows and **compute** boundary layer thickness, forces of drag and lift for external flows	4	Analyze
CO6	To **formulate** the relationship among the fluid flow parameters and **predict** the performance of prototype by model studies	4	Analyze

COURSE CONTENTS

Unit	Topics	No. of Hours	COs
Unit-I	**Fundamental Concepts of Fluid and its Properties**		
	Introduction – fluids and its applications - distinction between solid and fluid-concept of continuum-properties of fluids and their measurement- rheology – no-slip condition, viscosity, viscosity relation with temperature and pressure, numerical on viscosity – Flow Characteristics - surface tension, capillarity, compressibility, vapor pressure.	06	CO1
Unit-II	**Pressure and Fluid Statics**		
	Forces acting on fluid element, pascal's law, hydrostatics law, **Manometry and barometry** - pressure scale, barometer, piezometer, manometer and its types. Numerical on manometer **Hydrostatic forces on submerged surfaces**: total pressure and center of pressure on vertical, inclined & curved surface submerged in liquid including numerical on dam gate. **Buoyancy and stability** – Metacenter, metacentric height, flotation, stability of submerged & floating bodies (No numerical).	08	CO2
Unit-III	**Fluid kinematics**		
	Lagrangian and Eulerian descriptions of flow, classification of fluid flows, velocity and acceleration fields, continuity equation (1D & 3D in cartesian system), visualization of flow (stream, path and streak line, stream tube), angularity, vorticity, stream function and velocity potential function.	06	CO3
Unit-IV	**Fluid Dynamics**		
	Equation of motion of incompressible fluid - Euler's and Navier Stokes equation. **Bernoulli's theorem and its applications** (Numerical included) - venturimeter, orifice meter, pitot tubes, introduction to orifices, notches & weirs. Introduction to coriolis flow meter. Stagnation pressure. **Laminar flow** - Entrance region theory, velocity and shear Stress distribution, fixed parallel plates and Couette flow - velocity profile of turbulent flow, hydro dynamically smooth and rough boundaries.	08	CO4
Unit-V	**Flow in pipes & External Flow**		
	Major losses - Darcy Weisbach equation, Moody chart, minor losses, Hydraulic and energy gradient, Pipes in series and parallel - concept of Equivalent Pipe, Siphons, power transmission in pipes. **External Flow:** Boundary layer concepts (flat plate) – types of boundary layer thickness, boundary layer separation and methods to control separation, drag and lift, friction and pressure drag, aerofoil, bluff body, streamline body.	08	CO5
Unit-VI	**Dimensional analysis and modelling**		
	Dimensions & units, Dimensional homogeneity, Dimensional Analysis, repeating variables, Buckingham-Pi Theorem, dimensionless parameters. Similitude & model testing: model & prototype, similarity, scaling parameters, model laws, objectives, importance and application of model studies.	06	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Fluid Mechanics & Hydraulic Machines	R. K. Bansal	Laxmi Publications	620.106 DR -15 61459
2	Introduction to Fluid Mechanics and Fluid Machines	S. K. Som, G. Biswas and S. Chakraborty	Tata McGraw Hill	620.106 SOM-12 70654
3	Fluid Mechanics: Fundamentals and Applications	Y. A. Cengel, J. M. Cimbala	McGraw Hill	620.106 CEN-TB 58663
4	Fluid Mechanics	F. M. White	Tata McGraw Hill	620.106 WHI-17 61989

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Introduction to Fluid Mechanics	R. W. Fox, P. J. Pritchard and A. T. McDonald	Wiley India	620.106 FOX-TB 56273
2	Fundamentals of Fluid Mechanics	B. R. Munson, D. F. Young, T. H. Okiishi and W. W. Huebsch	Wiley India	620.106 MUN-13 56734
3	Mechanics of Fluids	M. C. Potter, D. C. Wiggert	Cengage Learning (Indian Edition)	620.106 POT-13 59283
4	Fluid Mechanics	V. L. Streeter, E. B. Wylie and K. W. Bedford	Tata McGraw Hill	620.106 STR-98 27082

Sanjivani College of Engineering, Kopargaon Department of Mechanical Engineering			
Semester	IV	**Subject Code**	ME213
Subject	Materials Science and Metallurgy	**No. of Lectures /Week**	3
Faculty Incharge	Mr.H.P.Varade	**No. of Practical /Week**	--
Examination Scheme	In Sem (30) End Sem (50) Continuous Assessment (20)	--	--
Assignment (One Each Unit)	06	**Practice Class Test** (One on two units)	03

1. **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 steels
   5. To make aware of destructive & non-destructive testing of materials
   6. To develop futuristic insight into new advancements in engineering materials

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

Course Outcome	Statements	Blooms Taxonomy	
		Level	Descriptor
CO1	To Classify the defects in crystal, its effect on crystal properties and to differentiate between various types of defects in crystals [BT-3]	3	Apply
CO2	To Understand the types of metals, non-metals, their properties and their characterisation techniques such as Macroscopy and Microscopy and to compare between them. [BT-3]	3	Apply
CO3	To Explain how metals and alloys are formed and how the properties change due to microstructure by using phase diagrams [BT-3]	3	Apply
CO4	To Apply different heat treatment processes for modifying the properties of steels and to compare various heat treatment processes [BT-3]	3	Apply
CO5	To Apply different tests such as destructive and non-destructive tests for Evaluating the properties of material. [BT-4]	4	Evaluate
CO6	To Understand the technological advancements in engineering materials. [BT-2]	2	Understand

3. Contents of the Course/Syllabus

Unit	Contents	No.of Hours	COs
1	**STRUCTURE AND MECHANICAL BEHAVIOUR OF MATERIALS**		
	Strusture of Materials: Basic concepts of Crystal structures, Types of crystal systems , Crystal structure of metals(BCC, FCC and HCP systems), ceramics & molecular arrangement of polymers , Miller indices , indexing of lattice planes & directions, Lattice parameters (coordination number, no. of atoms per unit cell, atomic packing factor, density-only theory no derivation and numericals) **Lattice Imperfections:** Definition, classification and significance of Imperfections Point defects: vacancy, interstitial and impurity atom defects, Their formation and effects, Dislocation - Edge and screw dislocations Burger's vector, Motion of dislocations and their significance, Surface defects -Grain boundary, sub-angle grain boundary and stacking faults, their significance, **Deformation:** Definition, elastic and plastic deformation, Mechanism of deformation and its significance in design and shaping, Critical Resolved shear stress, Deformation in single crystal and polycrystalline materials	6 Hrs.	CO1
2	**BASIC MATERIALS AND METALLOGRAPHY**		
	Basic Materials: Metallic materials, Polymeric Materials, Ceramics and Composites: Definition, composition, general properties, applications with examples **Metallography:** Classification of metal observations: their definition, difference & importance. Microscopy: specimen preparation, specimen mounting (hot & cold mounting) electrolytic polishing, etching procedure and reagents, electrolytic etching. Microscopic techniques : optical microscopy, electron microscopy techniques(Principles only) Study of Metallurgical microscope, Macroscopy: Sulphur printing, flow line observations	6 Hrs.	C02
3	**IRON-IRON CARBIDE EQUILIBRIUM DIAGRAM**		
	Solidification of pure metal, Different types of phase diagrams (Isomorphous, Eutectic, Peritectic, Eutectoid, Peritectoid) and their analysis, Importance of Iron as engineering material, Allotropic forms of Iron, Significance of alloying, Influence of carbon in Iron- Carbon alloy diagram, Iron-Iron carbide diagram and its analysis, Graphitization of Iron- Grey Cast iron, white cast iron, Nodular and malleable cast irons, their microstructures, properties 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,	8 Hrs.	C04

	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.		
5	**DESTRUCTIVE & NON-DESTRUCTIVE TESTING**		
	Study of destructive testing, Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, Numerical based on Evaluation of properties, compression test, different hardness tests-Vickers, Rockwell, Brinell, Poldi, Micro Hardness Test, Durometers, Impact test, fatigue test, creep test, Erichson Cupping Test. Non Destructive testing: Principals & procedure, advantages, disadvantages and Industrial applications of NDT, such as Visual Inspection ,Liquid /dye penetrate test, Magnaflux test, Eddy current test, Sonic & Ultrasonic testing and Radiography testing.	6 Hrs.	C05
6	**INTRODUCTION TO ADVANCED MATERIALS**		
	Introduction to New advanced materials: **6.1** Composites: Basic concepts of composites, Processing of composites, advantages over metallic materials, various types of composites and their applications **6.2** Nano Materials: Introduction, Concepts, synthesis of nanomaterials, examples, applications and Nano composites **6.3** An overview to Smart materials (e.g.: Rheological fluids) **6.4** Introduction to Functionally graded materials	4 Hrs.	CO6

4. Books:

Text Books:

1. Kodgire V. D. “Material Science and Metallurgy” Everest Publishing House
2. “Material Science & Engg.” Raghvan V., Prentice Hall of India, New Delhi. 2003

Reference Books:

1. Materials Science and Engineering by William D. Callister, Jr.Adapted by R.Balasubramaniam,Wiley India(P) Ltd.
2. Mechanical Behaviour of Materials by Courtney, McGraw Hill International New Delhi
3. Introduction of Engineering Materials, by B.K. Agrawal, McGraw Hill Pub. Co. ltd
4. Mechanical Metallurgy by G.E. Dieter, McGraw Hill International New Delhi
5. The Structure and Properties of Engineering Alloys by W.F. Smith, McGraw hill Int.
6. Engineering Physical Metallurgy, by Y. Lakhtin, Mir Publishers, Moscow
7. Introduction to Physical Metallurgy by SydneyAvner, McGraw Hill
8. Metallurgy for Engineers by E.C. Rollason - ELBS SOC and Edward Arnold, London

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	KOM (ME 214)
Subject	**Kinematics of Machines**	**No. of Lectures /Week**	4
Faculty Incharge	Mr I I Sayyad	**No. of Practical /Week**	--
Examination Scheme	In Sem (30) End Sem (50)	CA (20)	--
Assignment (One Each Unit)	06	**Class Test** (One on one units)	06

Prerequisites: -

1. Systems in Mechanical Engineering
2. Engineering Mathematics
3. Engineering Physics
4. Engineering Mechanics
5. Computer aided drawing & drafting

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 analyze the velocity and acceleration in mechanisms using analytical and graphical approach.
3. To develop the skill to propose and synthesize the mechanisms using graphical and analytical technique.
4. To develop the competency to understand & apply the principles of gear theory to design various applications.
5. To develop the competency to design a cam profile for various follower motions.

Course Outcomes:

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

CO's	**Course Outcomes**	**Blooms Taxonomy**	
		Level	**Descriptor**
CO1	Identify mechanisms in real life applications.	2	Understand
CO2	Apply kinematic analysis to simple mechanisms.	3	Apply
CO3	Analyze velocity and acceleration in mechanisms by vector and graphical method.	4	Analyze
CO4	Synthesize a four bar mechanism with analytical and graphical methods.	4	Analyze
CO5	Apply fundamentals of gear theory as a prerequisite for gear design.	5	Evaluate
CO6	Design cam profile for given follower motions.	5	Evaluate

Course Content

Unit	Topics	No. of Hours	COs
Unit-I	**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 crieterion , 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.	07	CO1
Unit-II	**Kinematic Analysis of Mechanisms: Analytical Method**		
	Analytical method for displacement, velocity and acceleration analysis of slider crank Mechanism. Velocity and acceleration analysis of four bar and slider crank mechanisms using complex algebra methods. Computer aided Kinematic Analysis of Mechanism like Slider crank and four bar mechanism. Analysis of Single and Double Hooke's joint.	07	CO2
Unit-III	**Kinematic Analysis of Mechanisms: Graphical Method**		
	Displacement, velocity and acceleration analysis of mechanisms by relative velocity method (Mechanisms upto 6 Links), Instantaneous Centre of Velocity, Kennedy's Theorem, Angular velocity ratio theorem, Analysis of mechanism by ICR method (Mechanisms upto 6 Links), Coriolis component of acceleration, Kleins construction	08	CO3
Unit-IV	**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. **Graphical Synthesis**: Inversion and relative pole method for three position synthesis of four bar and single slider crank mechanisms. **Analytical Synthesis:** Three position synthesis of four bar mechanism using Freudenstein's equation.	07	CO4
Unit-V	**Kinematics of Gears**		
	Gear: classification, Spur Gear: terminology, law of gearing, Involute and cycloidal tooth profile, path of contact, arc of contact, sliding velocity,	08	CO5

	Interference and under cutting, Minimum number of teeth to avoid interference, force analysis. Helical and Spiral Gears: terminology, geometrical relationships, virtual number of teeth for helical gears **Gear train:** types, Analysis of epicyclical gear trains, Holding torque – simple, compound and epicyclic gear trains, torque on sun and planetary gear train, compound epicyclic gear train, Gear boxes.		
Unit-VI	**Cams and Follower**		
	Cams & Followers : 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. Advanced cam curve.	06	CO6

Books & Other Resources

Text Books

1. S. S. Rattan, Theory of Machines, Third Edition, McGraw Hill Education (India) Pvt. Ltd. New Delhi.
2. Bevan T, Theory of Machines, Third Edition, Longman Publication.
3. A. G. Ambekar, Mechanism and Machine Theory, PHI.
4. J. J. Uicker, G. R. Pennock, J. E. Shigley, Theory of Machines and Mechanisms, Third Edition, International Student Edition, OXFORD

Reference Books

1. Paul E. Sandin, Robot Mechanisms and Mechanical Devices Illustrated, Tata McGraw Hill Publication.
2. Stephen J. Derby, Design of Automatic Machinery (2005, Marcel Dekker, 270 Madison Avenue, New York.
3. Neil Sclater, Mechanisms and Mechanical Devices Sourcebook, Fifth Edition, Tata McGraw Hill Publication.
4. Ghosh Malik, Theory of Mechanism and Machines, East-West Pvt. Ltd.
5. Hannah and Stephans, Mechanics of Machines, Edward Arnolde Publication.
6. R. L. Norton, Kinematics and Dynamics of Machinery, First Edition, McGraw Hill Education (India) P Ltd. New Delhi
7. Sadhu Singh, Theory of Machines, Pearson
8. Dr. V. P. Singh, Theory of Machine, Dhanpatrai and sons.
9. C. S. Sharma & Kamlesh Purohit, Theory of Machine and Mechanism, PHI.
10. M.P. Groover, Automation, production systems and computer-integrated manufacturing, Prentice-Hall of India Pvt. Ltd, New Delhi.

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	ME 215
Subject	Seminar	**No. of Lectures /Week**	--
Faculty Incharge	Mr.P.N.Patil	**No. of Practical /Week**	2
Examination Scheme	--	**OR**	50
Assignment (One Each Unit)	--	**Class Test** (One on one units)	--

1. Course Objectives:

1. To make survey on selected topics related to issues of science in society.
2. To study scientific literatures.
3. To collect relevant information from collected literature.
4. To compile the information and present it effectively.

2. Course Outcomes (COs) :

After learning the course the students will be able to-

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Study various research papers to understand existing and recent technology.	2	Understand
CO2	Identify various promising and new cutting edge technologies	2	Understand
CO3	Prepare detailed technical report describing the results.	3	Apply
CO4	Make effective communication through an oral presentation.	4	Analyze

COURSE CONTENTS

Seminar should be based on technical literature in the form of peer reviewed journals, conference proceedings and identify a current research topic relevant to Mechanical Engineering. Comprehend the seminar topic and prepare a technical report on the topic of presentation in specified format. Prepare presentation aids and deliver technical presentation in front of examiners, one of them will be guide and other will be examiner appointed by Authority. The Performance of the students will be evaluated by both examiner and guide jointly based on communication, content of seminar, delivery of seminar and ability to handle question and answer session.

Sanjivani College of Engineering, Kopargaon Department of Mechanical Engineering			
Semester	III	**Subject Code**	
Subject	Machine Drawing & Geometrical Modeling	**No. of Lectures /Week**	1
Faculty Incharge	Mr. Y.A.Bhavsar	**No. of Practical /Week**	2
Examination Scheme	--	**TW**	50
Assignment (One Each Unit)	06	**Class Test** (One on two units)	03

1. Course Objectives:

a. To develop the ability to apply Limit, Fits and Dimensional Tolerances, as well as Geometric Tolerances to components and assemblies on Engineering Drawings.
b. To develop an ability to create standard components using any Drafting Tool.
c. 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.
d. To develop an ability to create assembly models and Production Drawings of simple machine parts.
e. To develop an ability to analyze the simple mechanisms by the simulation tools.
f. 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.

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	NM (ME 217)
Subject	Numerical Methods	**No. of Lectures /Week**	--
Faculty Incharge	Dr P M Patare	**No. of Practical /Week**	2
Examination Scheme	--	PR	50
Assignment (One Each Unit)	06	**Class Test** (One on one units)	06

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. **Optimize** the solution for different real life problems with available constraints.
6. **Build** the foundation for engineering research

2. Course Outcomes (COs) :

After learning the course the students will be able to-

CO's	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	To **understand** different analytical and numerical methods to find the roots of the equations	2	Understand
CO2	To **apply** different numerical and analytical techniques to solve various types of simultaneous equations.	3	Apply
CO3	To **learn** various traditional and advanced optimization technique.	4	Analyze
CO4	To **recognize** and **learn** different numerical techniques to handle the differential equations.	4	Analyze
CO5	To **Evaluate and interpret** the data using curve fitting and regression analysis tools.	5	Evaluate
CO6	To **formulate** numerical techniques to solve the engineering problems using integration techniques	5	Evaluate

Term Work (PR)

Term work shall consist of-

SN	Title of Term Work	CO	PO	PSO	BTL
1.	Program on Roots of Equation (Validation by suitable solver, all three compulsory) a) Bisection Method, b) Newton Raphson method	CO1	1,2,5,10, 12	1,2	2
2.	Program on Simultaneous Equations (Validation by suitable solver, all three compulsory) a) Gauss Elimination Method, b) Thomas algorithm , c) Gauss-Seidal method.	CO2	1,2,5,10, 12	1,2	3
3.	Optimization technique Grey Regression Analysis	CO3	1,2,3,4,5, 10,12	1,2	4
4.	Program on ODE(Validation by suitable solver, all three compulsory) a) Euler Method, b) Runge-Kutta Methods- fourth order,	CO4	1,2,5,10, 12	1,2	4
5.	Program on PDE(Validation by suitable solver): Laplace equation	CO4	1,2,5,10, 12	1,2	4
6.	Program on Curve Fitting using Least square technique (Validation by suitable solver, all four compulsory) a) Straight line, b) Power equation, c) Exponential equation, d) Quadratic equation	CO5	1,2,4,5,1 0,12	1,2	3
7.	Program on Interpolation(Validation by suitable solver, all three compulsory) a) Lagrange's Interpolation, b) Newton's Forward interpolation,	CO5	1,2,4,5,1 0,12	1,2	3
8.	Program on Numerical Integration(Validation by suitable solver, all four compulsory) a) Trapezoidal rule, b) Simpson's Rules (1/3rd, 3/8th) [In one program only], c) Double integration: Trapezoidal rule	CO6	1,2,5,10, 12	1,2	5

5. Problem Based Learning Topics

1. Program for the Modified newton Raphson Method
2. Program for Gauss Jordon Method
3. Program for Newton Backward Difference Interpolation Method.

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Numerical Methods for Engineers	Steven C. Chapra, Raymond P. Canale	Tata McGraw Hill	511.7 CHA-04 28520
2	Numerical Methods in Engineering and Science	Dr. B. S. Garewal	Khanna Publishers	511.7 GRE-10 70477
3	Applied Numerical Methods with MATLAB for Engineers and Scientist	Steven C. Chapra	Tata McGraw Hill	511.7 CHA-15 59147
4	Applied Numerical Methods using Matlab	Rao V. Dukkipati	New Age International Publishers	511.7 RAO-15 59301

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Applied Numerical Analysis	Gerald and Wheatley	Pearson Education	510 GER-16 59566
2	Numerical Methods	E. Balagurusamy	Tata McGraw Hill	511.7 E B-07 43889
3	Computer Oriented Numerical Methods	P. Thangaraj	PHI	001 THA-13 59256
4	Introductory Methods of Numerical Analysis	S. S. Sastry	PHI	511 SAS-91 13986

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	FM (ME 218)
Subject	Fluid Mechanics	**No. of Lectures /Week**	--
Faculty Incharge	Mr Y. H. Ahire	**No. of Practical /Week**	2 Hrs
Examination Scheme	--	**PR**	50
Assignment (One Each Unit)	06	**Class Test** (One on each units)	06

1. Course Objectives:

1. To learn the skill of finding experimentally, the kinematic viscosity & pressure properties of fluid
2. To acquire the skill of performing the experiment, to find metacentric height of floating body
3. To learn to determine the Reynolds no. to differentiate between flow regimes
4. To learn Bernoulli's theorem and its verification using experimental apparatus
5. To learn the experimental skill of calibrating the flow-meters like venturimeter and notch
6. To learn the procedure of writing computer program for analyzing experimental data (friction loss)

2. Course Outcomes (COs) :

After learning the course the students will be able to-

CO's	**Course Outcomes**	**Blooms Taxonomy**	
		Level	**Descriptor**
CO1	To **conduct experiments** to determine fluid properties kinematic viscosity and pressure using measuring instruments	4	Analyze
CO2	To **determine** Metacentric height of the floating object	3	Apply
CO3	To **differentiate** laminar & turbulent flows using Reynolds experiment	4	Analyze
CO4	To **verify/demonstrate** Bernoulli's theorem using experimental apparatus	3	Apply
CO5	To **determine** coefficient of discharge for given Venturimeter & Notch devices	3	Apply
CO6	To **write and execute** computer code to calculate friction losses in pipe	3	Apply

LIST OF PRACTICALS

Sr. No.	Title	CO	PO	PSO
1	To determine kinematic viscosity of given fluid at different temperatures using Redwood viscometer.	1	1, 4, 8,9, 10,12	3
2	Determination of pressure using manometers (any two).	1		3
3	Determination of Metacentric height of floating object.	2		3
4	To perform the Reynolds experiment for determination of different regimes of flow.	3		3
5	Verification of Bernoulli's theorem using Bernoulli's apparatus.	4		3
6	To determine coefficient of discharge for given Venturimeter. (also by Virtual Lab)	5		3
7	To determine Coefficient of Discharge of V-notch. (by Virtual Lab)	5		3
8	Determination of Friction (major) losses in pipe flow, by developing computer code. (by using software)	6		3

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Fluid Mechanics & Hydraulic Machines	R. K. Bansal	Laxmi Publications	620.106 DR -15 61459
2	Introduction to Fluid Mechanics and Fluid Machines	S. K. Som, G. Biswas and S. Chakraborty	Tata McGraw Hill	620.106 SOM-12 70654
3	Fluid Mechanics: Fundamentals and Applications	Y. A. Cengel, J. M. Cimbala	McGraw Hill	620.106 CEN-TB 58663
4	Fluid Mechanics	F. M. White	Tata McGraw Hill	620.106 WHI-17 61989

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Introduction to Fluid Mechanics	R. W. Fox, P. J. Pritchard and A. T. McDonald	Wiley India	620.106 FOX-TB 56273
2	Fundamentals of Fluid Mechanics	B. R. Munson, D. F. Young, T. H. Okiishi and W. W. Huebsch	Wiley India	620.106 MUN-13 56734
3	Mechanics of Fluids	M. C. Potter, D. C. Wiggert	Cengage Learning (Indian Edition)	620.106 POT-13 59283
4	Fluid Mechanics	V. L. Streeter, E. B. Wylie and K. W. Bedford	Tata McGraw Hill	620.106 STR-98 27082

Sanjivani College of Engineering, Kopargaon Department of Mechanical Engineering			
Semester	IV	**Subject Code**	ME219(PR)
Subject	Materials Science and Metallurgy	**No. of Lectures /Week**	--
Faculty Incharge	Mr.H.P.Varade	**No. of Practical /Week**	1
Examination Scheme	In Sem (30) End Sem (50) Continuous Assessment (20)	TW	Oral (50)
Assignment (One Each Unit)	--	**Class Test** (One on two units)	--

1. **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 steels
   5. To make aware of destructive & non-destructive testing of materials
   6. To develop futuristic insight into new advancements in engineering materials

2. **Course Outcomes (Laboratory): On completion of the course, learner will be able –**

Course Outcome	Statements
CO1	To Apply the characterisation technique such as Microscopy (along with suitable image analysis software) for finding out the contents of microstructures of various metals and alloys. [BT-3]
CO2	To Apply different heat treatment processes for modifying the properties of steels and to check the modified properties of steels by applying suitable techniques [BT-3]
CO3	To Evaluate the properties of material by applying different tests such as destructive and non-destructive tests. [BT4]

List of Practical's:

A) Any eight experiments of following to be performed

Sr. No.	Title	CO
1	Study and trial of optical metallurgical microscope	1
2	Study & Demonstration of Specimen Preparation for microscopic examination	1
3	Study, Drawing and analysis of Microstructure of Steels of various compositions using suitable image analysis software.	1
4	Heat treatment of plain carbon steels and determination of relative hardness	2
5	Determination of hardenability of steel using Jominy End Quench Test.	2
6	Study and Trial of Rockwell Hardness Test	3
7	Brinell Hardness Test and Poldi Hardness Test	3
8	Magnetic Particle Test.	3
9	Dye Penetrant Test.	3
10	Impact Tests	3

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

3. Books:

Text Books:

1. Kodgire V. D. “Material Science and Metallurgy” Everest Publishing House
2. “Material Science & Engg.” Raghvan V., Prentice Hall of India, New Delhi. 2003

Reference Books:

1. Materials Science and Engineering by William D. Callister, Jr.Adapted by R.Balasubramaniam,Wiley India(P) Ltd.
2. Mechanical Behaviour of Materials by Courtney, McGraw Hill International New Delhi
3. Introduction of Engineering Materials, by B.K. Agrawal, McGraw Hill Pub. Co. ltd
4. Mechanical Metallurgy by G.E. Dieter, McGraw Hill International New Delhi
5. The Structure and Properties of Engineering Alloys by W.F. Smith, McGraw hill Int.
6. Engineering Physical Metallurgy, by Y. Lakhtin, Mir Publishers, Moscow
7. Introduction to Physical Metallurgy by SydneyAvner, McGraw Hill
8. Metallurgy for Engineers by E.C. Rollason - ELBS SOC and Edward Arnold, London

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	KOM (ME 220)
Subject	**Kinematics of Machines**	**No. of Lectures /Week**	--
Faculty Incharge	Mr I I Sayyad	**No. of Practical /Week**	02Hrs/Week
Examination Scheme	In Sem (30) End Sem (50)	OR	50
Assignment (One Each Unit)	06	**Class Test** (One on one units)	06

Prerequisites: -

1. Systems in Mechanical Engineering
2. Engineering Mathematics
3. Engineering Physics
4. Engineering Mechanics
5. Computer aided drawing & drafting

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 analyze the velocity and acceleration in mechanisms using analytical and graphical approach.
3. To develop the skill to propose and synthesize the mechanisms using graphical and analytical technique.
4. To develop the competency to understand & apply the principles of gear theory to design various applications.
5. To develop the competency to design a cam profile for various follower motions.

Course Outcomes:

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

CO's	**Course Outcomes**	**Blooms Taxonomy**	
		Level	**Descriptor**
CO1	Identify mechanisms in real life applications.	2	Understand
CO2	Apply kinematic analysis to simple mechanisms.	3	Apply
CO3	Analyze velocity and acceleration in mechanisms by vector and graphical method.	4	Analyze
CO4	Synthesize a four bar mechanism with analytical and graphical methods.	4	Analyze
CO5	Apply fundamentals of gear theory as a prerequisite for gear design.	5	Evaluate
CO6	Design cam profile for given follower motions.	5	Evaluate

Guidelines for TW Assessment

- There should be continues assessment for term work.
- Assessment must be based on assessment of theory, attentiveness during practical and understanding of the course.
- Timely submission of journals.

The student shall complete following activities as a part of TW

Sr. No.	Activity
1.	**Group A : Assignments:** i. To study of various mechanisms and to determine types of pairs, links, and degrees of freedom. ii. To solve two problems on velocity and acceleration analysis using relative velocity and acceleration method. iii. To solve two problems on velocity analysis using ICR method. iv. To draw conjugate profile for any general type of gear tooth. **v.** To draw a cam profile any two problems with combination of various follower motion with radial and off-set cam.
2.	**Group B : Experiments:** i. Speed and torque analysis of epicyclic gear train to determine holding torque.. ii. To study and verify cam jump phenomenon iii. To study manufacturing of gear using gear generation with rack as a cutter and to generate involute profile.
3.	**Group C: Software based assignments: (Any Two)** i. To design a simple planer mechanism by using any software.(Any Software) ii. To do computer programming on kinematic analysis of slider crank mechanism using Analytical Method. (Any Software) iii. To do computer programming on kinematic analysis of Hooke's joint mechanism using Analytical Method. (Any Software) iv. To generate a cam profile using any modelling software (Any Software) v. To synthesize the four bar and slider crank mechanism using relative pole and inversion method with three accuracy points. (Any Software) vi. To do computer programming on synthesis of mechanism using Chebychevs spacing, Freudensteins equation and function generation. (Any Software)
4.	**Group D : Virtual Lab:** i. Mechanics-of-Machines Lab (All Experiments)

	ii. Mechanisms and Robotics > Oldham Coupling Mechanism iii. Mechanisms and Robotics > Quick Return Mechanism **iv.** Mechanisms and Robotics > CAM Follower Mechanism
5.	**Group E: Industry/Workshop visit:** The Visit to the industries consisting automation like Assembly line, Sugar factory, Bottle feeling plants etc is mandatory to provide awareness and understanding of the course.
6.	**Self-Learning:** i. To study various types of gearboxes. ii. To make a model of any mechanism by using waste material by the group of 4 to 6 students and to give presentation using PPTs.
7.	**NPTEL REFERENCES** **i.** **NPTEL1.** Kinematics of Machines, Prof. Ashok K Mallik, IIT Kanpur **ii.** **NPTEL2.**Theory Of Mechanism by Prof. Sujatha Srinivasan IIT Madras **iii.** **NPTEL3.** Kinematics of Mechanisms And Machines by Prof.Anirvan Das Gupta, IIT Kharagpur **iv.** **NPTEL4.** Mechanism and Robot Kinematics by Prof.Anirvan Das Gupta Institute: IIT Kharagpur **v.** **Introduction to Robotics and Automation**

Books & Other Resources

Text Books

1. S. S. Rattan, Theory of Machines, Third Edition, McGraw Hill Education (India) Pvt. Ltd.New Delhi.
2. Bevan T, Theory of Machines, Third Edition, Longman Publication.
3. A. G. Ambekar, Mechanism and Machine Theory, PHI.
4. J. J. Uicker, G. R. Pennock, J. E. Shigley, Theory of Machines and Mechanisms, Third Edition, International Student Edition, OXFORD

Reference Books

1. Paul E. Sandin, Robot Mechanisms and Mechanical Devices Illustrated, Tata McGraw Hill Publication.

2. Stephen J. Derby, Design of Automatic Machinery (2005, Marcel Dekker, 270 Madison Avenue, New York.
3. Neil Sclater, Mechanisms and Mechanical Devices Sourcebook, Fifth Edition, Tata McGraw Hill Publication.
4. Ghosh Malik, Theory of Mechanism and Machines, East-West Pvt. Ltd.
5. Hannah and Stephans, Mechanics of Machines, Edward Arnolde Publication.
6. R. L. Norton, Kinematics and Dynamics of Machinery, First Edition, McGraw Hill Education (India) P Ltd. New Delhi
7. Sadhu Singh, Theory of Machines, Pearson
8. Dr. V. P. Singh, Theory of Machine, Dhanpatrai and sons.
9. C. S. Sharma & Kamlesh Purohit, Theory of Machine and Mechanism, PHI.
10. M.P. Groover, Automation, production systems and computer-integrated manufacturing, Prentice-Hall of India Pvt. Ltd, New Delhi.

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	ME 221
Subject	**Mandatory Course-IV** Innovative Project Base	**No. of Lectures /Week**	2
Faculty Incharge	Ms S M Gujrathi	**No. of Practical /Week**	--
Examination Scheme	--	CA (20)	--
Assignment (One Each Unit)	--	**Class Test** (One on one units)	--

1. Course Objectives:

1. Carry out a substantial innovative - based project
2. Demonstrate capacity to lead and manage change through collaboration with others
3. Analyze data and synthesize research findings
4. Report research findings in written and verbal forms

2. Course Outcomes (COs) :

On completion of this subject, participants will have the knowledge, skills and understanding to enable them to:

CO's	**Course Outcomes**	**Blooms Taxonomy**	
		Level	**Descriptor**
CO1	Apply critical thinking skills	3	Apply
CO2	Apply foundational research skills to address a research question	2	Understand
CO3	Demonstrate planning, time and leadership skills	4	Analyse
CO4	Demonstrate a capacity to communicate research results clearly, comprehensively and persuasively.	5	Evaluate

COURSE CONTENTS

Projects should be based on society based problems, innovative ideas, product development, application development etc. It is expected to add substantial innovative based projects by doing review of existing systems, peer reviewed journals, live survey by preparing questionnaire etc. in order to formulate the problem faced by society. Accordingly students should submit project report consists of detailed design with working model if any. The Performance of the students will be evaluated by both examiner and guide jointly based on communication, problem identified, whether model/design/application is in working condition or not, presentation delivery and facing to question and answer round.

Sanjivani College of Engineering, Kopargaon

(An Autonomous Institute affiliated to SPPU,Pune)

D E C L A R A T I O N

We, the Board of Studies (Mechanical Engineering) , hereby declare that, We have designed the Curriculum of **SY B Tech Semester-IV** of 2020 Pattern w.e.f. A.Y **2021-2022** as per the guidelines . So, we are pleased to submit and publish this FINAL copy of the curriculum for the information to all the concerned stakeholders.

Submitted by

Dr M V Nagarhalli
BoS Chairman

Approved by

Dr A B Pawar
Dean Academics

Dr A G Thakur
Director

Sanjivani Rural Education Society's

Sanjivani College of Engineering, Kopargaon

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

B. Tech. Mechanical Engineering

2020 Pattern

Curriculum

(B. Tech. with effect from Academic Year 2020-2021)

(T. Y. B. Tech. Sem-V & VI 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 ethical Mechanical 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 ofthe 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 activitieswith an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess

societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives (PEOs)

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

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

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- 2020 PATTERN
THIRD YEAR B. TECH: MECHANICAL ENGINEERING

T.Y.B. Tech SEM V 2020

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
			L	T	P		Theory			TW	OR	PR	Total
							CIA	ISE	ESE				
PCC	ME301	Production Technology	3	-	-	3	20	30	50	-	-	-	100
PCC	ME302	Machine Design –I	3	-	-	3	20	30	50	-	-	-	100
PCC	ME303	Metrology and QC	3	-	-	3	20	30	50	-	-	-	100
PCC	ME304	Heat Transfer	3	-	-	3	20	30	50	-	-	-	100
PEC	ME305	Professional Elective-I	3	-	-	3	20	30	50	-	-	-	100
PCC	ME306	Machine Design –I Lab	-	-	2	1	-	-	-	25	-	-	25
PCC	ME307	Metrology and QC Lab	-	-	2	1	-	-	-	-	25	-	25
PCC	ME308	Heat Transfer Lab	-	-	2	1	-	-	-	-	-	50	50
PCC	ME309	Production Technology Lab			2	1	-			-	50	-	50
PRJ	ME310	Mini Project based on Skill based Credit Course	-	-	2	1	50	-	-	-	-	-	50
MLC	ME311	Mandatory Learning Course-V	1	-	-	NC	-	-	-	-	-	-	-
		Total	**16**		**10**	**20**	**150**	**150**	**250**	**25**	**75**	**50**	**700**

T.Y.B. Tech SEM VI

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
			L	T	P		Theory			TW	OR	PR	Total
							CIA	ISE	ESE				
PCC	ME312	Applied Thermodynamics	4	-	-	4	20	30	50	-	-	-	100
PCC	ME313	Machine Design –II	4	-	-	4	20	30	50	-	-	-	100
PCC	ME314	Hydraulic and Pneumatics	3	-	-	3	20	30	50	-	-	-	100
HSMC	HS315	Corporate Readiness -II	2	-	-	2	50	-	-	-	-	-	50
PRJ	PR316	IPR & EDP	2	-	-	2	20	-	30	-	-	-	50
PEC	ME317	Professional Elective-II	3	-	-	3	20	30	50	-	-	-	100
PCC	ME318	Hydraulic and Pneumatics Lab	-	-	2	1	-	-	-	50	-		50
PCC	ME319	Applied Thermodynamics Lab	-	-	2	1	-	-	-	-		50	50
PCC	ME320	Machine Design –II Lab	-	-	2	1	-	-	-	-	50	-	50
PRJ	ME321	Creational Activity Lab	-	-	2	1	-	-	-	50	-	-	50
MLC	ME322	Mandatory Learning Course-VI	1	-	-	NC	-	-	-	-	-	-	-
		Total	**19**	**-**	**8**	**22**	**150**	**120**	**230**	**100**	**50**	**50**	**700**

Professional Elective – I		Professional Elective – II	
ME305A	Refrigeration System	ME317A	Turbo Machinery
ME305B	Reliability Engineering	ME317B	Operation Research
ME306C	Industrial Tribology	ME317C	Mechanical System Design

ME311	**Mandatory Learning Course-V**	**Design Thinking**
ME322	**Mandatory Learning Course-VI**	**Programing Skills**

Production Technology (ME 301) (2020Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA:**	20 Marks
Credits:	**3**	**Total:**	100 Marks

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Prerequisite Course: (Physics, Manufacturing, BME**)**

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Course Objectives:

1.	The students should understand machine tools and various machining operations, and economy of machining processes
2.	To select process parameter and tools for obtaining desired machining characteristic
3.	To provide the students the knowledge of modern manufacturing processes.
4.	To analyse and understand the metal cutting phenomena
5.	The students should understand the program on CNC lathe and milling.
6.	The students should understand selection of jigs and fixtures.

Course Outcomes (COs):

CO's	**Course Outcomes**	**Blooms Taxonomy**	
		Level	**Descriptor**
CO1	Summarize various tools, tools geometry, operations carried out drilling and milling machines and **Determine** machining time calculation.	3	Apply
CO2	**Determine** machining time calculation for cylindrical and plunge grinding.	3	Apply
CO3	**Understand** the different advance manufacturing processes and their applications	2	Understand
CO4	Understand the mechanism of metal cutting and **determine** various forces, wear and life of the tool.	3	Apply
CO5	Write/**Execute** program of specified component to be operate on CNC lathe and Milling machine.	3	Apply
CO6	Able to **design** jigs and fixtures for specified component.	3	Apply

Course Contents

Unit	Contents	No.of Hours	COs
1	**Drilling and Milling Machines**		
	Drilling: Fundamentals of drilling process, twist drill geometry, tool holders. Types of drilling machines, operations performed on drilling machines. Types of drills. (machining time calculation) **Milling Machines**: Fundamentals of milling process, cutters - types and geometry. Operations performed on milling machines. Dividing head, methods of indexing. (machining time calculation) Advanced cutting tools used in drilling and milling.	6 Hrs.	CO1
2	**Finishing Processes**:		
	Grinding machines Introduction: Types and Operations of grinding machines. Grinding wheel – Shapes, Designation and selection, Mounting, Balancing and Dressing of grinding wheels, Machining time calculation for cylindrical and plunge grinding. **Super-finishing processes** – Introduction to Honing, Lapping, Buffing and Burnishing.	6 Hrs	C02
3	**Advanced Machining Processes**		
	Introduction, classification of advanced machining processes. Principles, Working, Process Parameters, Advantages, Limitations and Application for following processes: Abrasive Jet Machining (AJM), Ultra Sonic Machining (USM), Electric Discharge Machining (EDM), Laser Beam Machining (LBM), Plasma arc machining (PAM), Electron Beam machining (EBM) and Electro Chemical Machining (ECM)	6 Hrs	C03
4	**Theory of Metal cutting**		
	Single point cutting tool : Tool geometry, Mechanics of shearing (orthogonal and oblique), Shear plane angle, Shear stress, strain and Shear strain rate. Process parameters and their effect on machining. Merchant's circle of forces (analytical) Estimation of shear force, Normal shear force, Friction force, Normal friction force, Material Removal Rate (MRR), Cutting power estimation. **Introduction to advanced tools** -Carbides tips and poly crystalline diamond tools (PCD) Tool life, Tool wear, Effect of process parameters on tool life, Taylor's tool life equation.(Numerical)	6 Hrs	C04
5	**CNC Technology**		CO5
	Introduction, Classification, Construction and working of NC, CNC, DNC and machining centre. CNC axes and drives. Automatic Tool Changer (ATC) and Automatic pallet changer (APC) CNC Programming: Word address format (WAF) – ISO Standards, G & M codes, Type of CNC Control systems, Manual part programming (plain milling and Turning), Subroutine, Canned cycles.	6 Hrs	

6	**Jigs and Fixtures**		
	Concept of Degree Of Freedom, 3-2-1 Principle of location, General guidelines to design Jigs and Fixtures, significance of jigs and fixture **Jigs** : Definition. Elements of Jig with the types, Location guidelines, Principles of clamping, Principles of guiding element, Channel Jig, Template Jig, Plate Jig, Angle plate Jig, Turn over Jig, Box Jig, and Latch type Jig. (Design Jig for any one component) **Fixtures** : Definition. Elements of Fixtures, Location guidelines, Principles of clamping, Principles of setting element, Turning Fixture, Welding Fixture, Milling Fixture. (Design Fixture for any one component) Introduction to Assembly and Inspection Fixtures. Indexing Fixtures. Advanced materials used in jigs and fixtures (Teflon, aluminium).Introduction to Templates fixtures	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	1	3		2											
CO2	2	3		2		2									
CO3	2														
CO4	2	3	2	2											
CO5	3	3	3	2	3	2			3	2	2	2	3		
CO6	3	3	3	3	3				3	2	2	2	2		

Text Books

Sr. No.	Authors	Title	Edition	Year	Publication
1	B. S. Raghuwanshi	A Course in Workshop Technology Vol. II			Dhanpat Rai & CO
2	W. A. J. Chapman	Workshop Technology Part 1, 2 and 3			Taylor & Francis
3	Anul Goel	Manufacturing Process – 2,			Technical
4	P C Sharma,	Production Technology (Manufacturing Processes)			S Chand

Reference Books

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

Machine Design-I (ME 302) (2020 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA :**	20 Marks
Credits:	**3**	**Total:**	100 Marks
Insem Exam :	1.5 Hrs	**End Sem Exam :**	2.5 Hrs

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Prerequisite Course: (Strength of Machine Elements, Basics of Mechanical Engineering)

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Course Objectives:

1. Student shall gain appreciation and understanding of the design function in Mechanical Engineering, different steps involved in designing and the relation of design activity with manufacturing activity.
2. The student shall learn to choose proper materials for different machine elements depending on their physical and mechanical properties. They will learn to apply the knowledge of material science in real life situations.
3. Student shall gain a thorough understanding of the different types of failure modes and criteria. They will be conversant with various failure theories and be able to judge which criterion is to be applied for a particular situation.
4. Student shall gain design knowledge of the different types of elements used in the machine design process, for e.g. shafts, couplings etc. and will be able to design these elements for each application.
5. Students shall gain a thorough understanding about the design of the various types of springs.
6. Students shall gain thorough knowledge about the design of clutch and brake.

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Ability to identify and understand failure modes for mechanical elements and design of machine elements based on strength.	2	Understand
CO2	Ability to design Shafts, Keys and Coupling for industrial applications.	3	Apply
CO3	Ability to design machine elements subjected to fluctuating loads.	3	Apply
CO4	Ability to design Power Screws for various applications.	3	Apply
CO5	Ability to design various Springs for strength and stiffness.	2	Understand
CO6	Ability to design various Clutch and brake	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	3	2	1	-	-	-	-	-	1	-	-	3	-	-
CO2	3	2	2	1	1	-	-	-	-	1	-	-	3	-	-
CO3	3	2	2	1	-	-	-	-	-	1	-	-	3	-	-
CO4	3	2	2	-	1	-	-	-	-	1	-	-	2	-	-
CO5	3	-	1	2	1	-	-	-	-	1	-	-	1	-	-
CO6	3	-	-	2	1	1	-	-	-	1	-	-	1	-	-

Course Contents

Unit	Contents	No.of Hours	COs
1	**Design of Simple Machine Elements**		
	Introduction to Machine Design, product life cycle, types of stress, strains, Design considerations - Strength, Rigidity, Manufacture, Assembly and Cost, Standards and codes, Use of preferred series, Factor of safety, Service factor. Design of Cotter joint, Knuckle joint, Levers - hand / foot lever, components subjected to eccentric loading. Use of Design data books.	6 Hrs.	CO1
2	**Design of Shafts, Keys and Couplings**		
	Shaft design on the basis of strength, torsional rigidity and lateral rigidity, A.S.M.E. code for shaft design. Hollow shaft, Design of keys (square and rectangular key) and splines. Design of Flange Coupling and Flexible Bushed Pin Coupling.	6 Hrs	C02
3	**Design for Fluctuating Load**		
	Stress concentration - causes & remedies, fluctuating stresses, fatigue failures, S-N curve, endurance limit, notch sensitivity, endurance strength modifying factors, design for finite and infinite life, cumulative damage in fatigue failure, Soderberg, Gerber, Goodman, Modified Goodman diagrams, Fatigue design of components under combined stresses:- Theoretical treatment only.	6 Hrs	C03
4	**Power Screws**		
	Forms of threads, multiple start screws, Torque analysis and Design of power screws with square and trapezoidal threads, Self-locking screw, Collar friction torque, Stresses in power screws, design of a C-Clamp. Design of screw jack.	6 Hrs	C04
5	**Mechanical Springs**		
	Types, applications and materials for springs, Stress and deflection equations for helical compression Springs, Style of ends, Design of helical compression and tension springs, Springs in series and parallel, Concentric helical springs, Surge in springs, Helical torsion Spring, Design of Multi-leaf springs. (Theoretical treatment only).	6 Hrs	
6	**Friction Clutches and brakes**		
	Clutch: Introduction, Torque transmission capacity, multidisc clutches, friction materials, cone clutches, centrifugal clutches Brakes - Introduction, Energy to be dissipated, Heating of brakes, Shoe or Block brakes (Single & Double), internal and external shoe brakes, self-locking brakes, Differential band brakes, Internal expanding brakes.	6 Hrs.	C05

Self-Learning: Differential/compound screw without mathematical treatment. Disk Brakes,

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Mechanical Engineering Design	Shigley J.E. and Mischke C.R.	McGraw Hill Publ. Co. Ltd.	621.815
2.	Design of Machine Elements	Spotts M.F. and Shoup T.E	Prentice Hall International	621.815
3.	Design of Machine Elements	Bhandari V.B	Tata McGraw Hill Publication Co. Ltd.	621.815
4.	Fundamentals of Machine Components Design	Juvinal R.C	John Wiley and Sons	621.815

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Machine Design	Black P.H. and O. Eugene Adams	McGraw Hill Book Co. Inc.	621.815
2.	Machine Components Design	Willium C. Orthwein	West Publishing Co. and Jaico Publications House.	--
3.	Theory and Problems of Machine Design,	Hall A.S., Holowenko A.R. and Laughlin H.G	Schaum's Outline Series	--
4.	Design of Machine Elements,	C.S.Sharma and Kamlesh Purohit	PHI Learing Pvt. Ltd	621.815
5.	Machine Design	D.K.Aggarwal & P.C.Sharma	S.K Kataria and Sons	621.815
6.	Machine Design: Fundamentals and Applications	P. C. Gope	PHI Learing Pvt. Ltd	621.815
7.	Design Data	P.S.G	P.S.G. College of Technology, Coimbatore.	621.815
8.	Machine Design data book	Bhandari, V. B.	Tata McGraw Hill Publication Co. Ltd.	621.815

CIA Activities :

Sr No	Title of CIA	PO
1.	Design of spring of railway wagon	PO1, PO3, PO6
2.	Design of spring loaded safety valve with one case study	PO1, PO3, PO6
3.	Design of screw-jack of bus	PO1, PO3, PO6
4.	Design of belt drive of flour mill with one case study	PO1, PO3, PO6
5.	Design of leaf spring of truck with one case study	PO1, PO3, PO6
6.	Design of screw jack of truck with one case study	PO1, PO3, PO6
7.	Design of shock-absorber of two-wheeler with one case study	PO1, PO3, PO6
8.	Design of C-clamp with one case study	PO1, PO3, PO6

Rubrics for CIA-II Presentation

Criterion	**WEIGHTAGE**	**Criterion**	**NEEDS IMPROVEMENT (LEVEL 1)**	**MEETS EXPECTATION (LEVEL 2)**	**EXCEEDS EXPECTATION (LEVEL 3)**
A	**30%**	**Literature Review**	Thoroughly, concisely, describes previous and related work; clearly explains how current work fits into broader field.	Describes previous and related work; makes connection to current work.	Mentions other work done in field;
B	**30%**	**Knowledge of CIA**	Demonstrates deep knowledge; answer the questions with explanations and elaboration.	Adequate knowledge of most topics; answer the questions, but fails to elaborate	Adequate knowledge of most topics; answer the questions, but fails to elaborate
C	**30%**	**Presentation**	Presented in logical sequence; introduction and background give proper context; key points and conclusions are clear and well developed	Most information presented in logical sequence; clear introduction; adequate background; some irrelevant information	Some problems with sequencing, lacks clear transitions; incomplete or overly detailed introduction; emphasis given to less important information.
D	**10%**	**Submission of CIA**	Submission of CIA report two weeks late	Submission of CIA on submission date	Submission of CIA prior to submission date

Assessment sheet for CIA 2022-2023

R. N.	PRN	Name of Student	DATE OF CONDUCTION	A (3)	B (3)	C (3)	D (1)	SCORE 10	SIGN (Student)
				Literature Review	Knowledge of CIA	Presentation	Submission of CIA		
1									

Metrology and Quality Control (ME303) (2020 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	2 Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA:**	20 Marks
Credits:	**3**	**Total:**	100 Marks

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Prerequisite Course: (if Any)-Nil

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Course Objectives: (Please specify Six Objectives) Students are expected to

1. Understand the knowledge of basics of Measurements, Metrology and Measuring devices.
2. Understand thread, gear and surface roughness metrology.
3. Understand the advances in Metrology such as use of CMM, Laser, Machine Vision System.
4. Select and apply appropriate Quality Control Technique for given application.
5. Select and Apply appropriate Quality Management Tool
6. Understand and apply statistical quality control (SQC) for given application

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

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	To Understand, Identify and apply methods and devices for measurement of length, angle etc. and to design the gauges.	3	Apply
CO2	To Identify and apply methods and devices for measurement of gear, thread parameters, surface roughness and geometric features of parts.	3	Apply
CO3	To Understand the advances in Metrology such as use of CMM, Laser, Machine Vision System.	2	Understand
CO4	To Select and apply appropriate Quality Control Technique such as check sheets, Pareto charts, flowchart, cause and effect diagrams, histogram, scatter diagram and control charts for given application	3	Apply
CO5	To Select and Apply appropriate Quality Management Tool	3	Apply
CO6	To apply statistical quality control (SQC) technique for given application to improve quality of processes / products and to analyze whether a process is under statistical control.	3	Apply

Course Contents

Unit	Contents	No.of Hours	COs
1	**Unit-I Fundamentals of Metrology, Comparators and Design of Gauges**		
	Introduction: Principles of Engineering metrology, Measurement standards, Types and sources of errors, Accuracy and Precision, Calibration: Concept and procedure, traceability, Linear And Angular Measurements(Conventional and Digital) **Comparators:** Mechanical, Pneumatic, Optical, Electrical (LVDT). **Design of Gauges** : Tolerances, Limits and Fits [IS 919-1993], Region of uncertainty, Taylor's principle, Types of gauges, Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials, Considerations of gauge design (numerical).Gauge R & R.	8 Hrs.	CO1
2	**Unit-II Thread and Gear Metrology, Surface Roughness Metrology**		
	Geometric Form Measurement: Straightness, Flatness, Roundness - Straight edge, use of level beam comparator, autocollimator, testing of flatness of surface plate. **Measurement of Thread form:** Thread form errors, Measurement of Minor, Major and Effective diameter (Three Wire Method),Best wire size(Derivation and Numerical) Flank angle and Pitch, Floating Carriage Micrometer (Numerical). **Gear Metrology**: Errors in Spur Gear form, Gear tooth Vernier, Constant chord, Base tangent (Numerical), Gear Rolling Tester. Profile Projector, Tool maker's microscope and their applications **Surface Roughness Measurement**: Introduction to Surface texture, Parameters for measuring surface roughness, Surface roughness measuring instrument: TalySurf, Surface roughness tester.	6 Hrs.	CO2
3	**Unit – III Advances in Metrology**		
	Coordinate Measuring Machine (CMM): Fundamental features of CMM – development of CMMs – role of CMMs – types of CMM and Applications, types of probes **Machine Vision Systems:** vision system measurement – Multisensory systems. **Interferometry:** Principle, Concept of Optical Flat and its types, NPL Interferometer **Laser Metrology:** Basic concepts of lasers, advantages of lasers, laser interferometers, types, applications	4 Hrs.	CO3
4	**Unit – IV Introduction to Quality and Quality Tools**		
	Concept of Quality: Various Definitions and Quality Statements, Cost of quality & value of quality, Deming's cycles & 14 Points, Juran Trilogy approach, Old and New Seven Quality Tools, 5-Why technique, 8 Disciplines (8-D) technique, Quality Circles, Areas and criteria for National and International Quality Awards.	6 Hrs.	CO4

Unit	Contents	No.of Hours	COs
5	**Unit –V Total Quality Management**		
	TQM: Introduction, Quality Function Deployment, 5S, Kaizen, Poka yoke, Kanban, JIT,FMECA, Zero defects, TPM. Six Sigma: DMAIC - Concept and Applications. **Quality Management System** Need for quality management system – design of quality management system – quality management system requirements – ISO 9001, TS-16949, ISO-14000, Introduction to IATF-16949, Quality Audit-terminology, types of QA, Quality conformance and Quality Assurance.	6 Hrs.	CO5
6	**Unit –VI Statistical Quality Control (SQC)**		
	Statistical quality control: Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable (**X & R** Chart) & Attribute (**P & C** Chart), Process capability, Statistical Process Control (Numerical). Production Part Approval Method (PPAP). **Acceptance Sampling:** Sampling Inspection, OC Curve and its characteristics, sampling methods, Sampling Plan: Single, Double (Numerical), Multiple, Comparison of Plan, calculation of sample size, AOQ, Probability of Acceptance (Numerical)	6 Hrs.	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	3	2	2	1		2			2	2		1	1		
CO2	2	1				2			2	2		1	1		
CO3	2					2			2	2		1	1		
CO4	3					2			2	2		1	1		
CO5	2					2			2	2		1	1		
CO6	2	2	1	1	2	2			2	2		1	1		

Text Books:-

Sr. No.	Title of Book	Authors	Publication House
1.	Engineering Metrology	Jain R.K.	Khanna Publication
2.	Engineering Metrology	I. C. Gupta	Dhanpath Rai Publication
3.	Metrology and Measurements	Bewoor A. K. and Kulkarni V. A	Tata McGraw hill Publication.
4.	Quality Handbook	Juran J. M.	McGraw Hill Publications.
5.	Statistical Quality Control	Grant S.P.	Tata McGraw hill Publication
6.	A text book of Metrology	M. Mahajan	Dhanpatrai and Co.
7.	Statistical Quality Control	M. Mahajan	Dhanpatrai and Co.

Reference Books:

Sr. No.	Title of Book	Authors	Publication House
1.	Metrology for engineers	Galyer J.F & Shotbolt C.R.	Cengage Learning
2.	Handbook of Industrial Metrology	ASTME	Prentice Hall of India Ltd
3.	Fundamentals of Dimensional Metrology	Connie Dotson	Thomson Publn., 4th Edition
4.	Quality control	Basterfield D. H.	Pearson Education India, 2004
5.	Modern Methods for Quality control and Improvement	Harrison M. Wordsworth, Stefeen Godfrey	Willy Publication

CIA Activities:

Sr No	Title of Activity	PO Attained
1	Case Study or Research paper study on given particular topic along with presentation and report.	PO1,PO2,PO9, PO10,PO12
2	Self learning numerical Group assignments using MS-EXCEL/MINITAB or any other appropriate software tool	PO1,PO2,PO3,PO5,PO6 PO10,PO12

Note :

1. CIA will be conducted in two section. First part of CIA will carry 10 marks for Class test based on Unit-I to Unit-VI and second part of CIA will consist of presentation, Problem based learning, Self-Learning, Case study or Research paper study etc.
2. The assessment rubrics for the evaluation of CIA should be decided.

Heat Transfer (ME 304) (2020 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA :**	20 Marks
Credits:	**3**	**Total:**	100 Marks
Examination hr	**2 hr**	**Pattern:**	2019

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Prerequisite Course: Basic Thermodynamics, Basic Mechanical Engineering, Fluid Mechanics.

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Course Objectives:

1. Identify the important modes of heat transfer and their applications.
2. Formulate and apply the general three dimensional heat conduction equations.
3. Analyse the thermal systems with internal heat generation and lumped heat capacitance.
4. Understand the mechanism of convective heat transfer
5. Determine the radiation heat transfer between surfaces.
6. Understand different applications of Heat transfer.

Course Outcomes (COs): (Strictly Six Outcomes need to be specified here)

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Identify the various modes of heat transfer and implement the basic heat conduction equations for steady one dimensional thermal system.	3	Apply
CO2	Determine the general heat conduction equation to thermal systems with internal heat generation, fins and transient heat conduction.	3	Apply
CO3	Analyze the heat transfer rate in forced convection.	3	Apply
CO4	Analyze the heat transfer rate in Natural convection, Condensation & Boiling.	3	Apply
CO5	Calculate heat transfer by radiation between two objects with simple geometries.	3	Apply
CO6	Analyze the Heat Transfer Equipment and investigate their performance.	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	-	1	-	-	-	-	1	1	-	1	-	-	2
CO2	3	2	1	2	-	-	-	-	2	1	-	1	-	-	2
CO3	3	-	2	-	-	-	-	-	-	-	-	1	-	-	2
CO4	3	2	2	2	-	-	-	-	2	1	-	1	-	-	2
CO5	3	2	1	1	-	-	-	-	2	1	-	1	-	-	2
CO6	3	2	2	2	-	-	-	-	2	1	-	1	-	-	2

(Specify values as: 3: High Level,2: Medium Level, 1: Low Level for mapping of Cos to POs)

Course Contents

Unit	Contents	No.of Hours	COs
1	**Introduction and Basic Concept**		
	Introduction-Modes and mechanisms of heat transfer: Basic laws of heat transfer for all three modes (Numerical treatment), concept of Thermal conductivity, Thermal diffusivity and heat transfer coefficient. Conduction Heat Transfer: General heat conduction equation in Cartesian (derivation), Cylindrical and Spherical coordinates (No Deriviation). steady, unsteady state heat transfer, Initial and boundary conditions (Numerical treatment),Thermal insulation, types of insulation Critical radius of Insulation for Cylinder and Sphere, Thermal resistance, Thermal contact Resistance. 1-Dsteady state heat conduction in plane wall, cylinder and sphere without heat generation (Numerical treatment)	8 Hrs.	CO 1
2	**Conductive Heat Transfer**		
	1-D steady state heat conduction with heat generation: Application of 1-D Poisson's heat conduction equation for plane wall and cylinder with various boundary conditions. **Heat transfer through fins:** Types, applications, Governing Equation for constant cross sectional area fins, solution for infinitely long & insulated fin tip (no derivation), fin efficiency & fin effectiveness. **Transient Conduction and thermal Insulation** Concept of Internal Temperature Gradient (ITG), lumped capacity analysis, dimensionless numbers in unsteady state Heat transfer, Time constant of thermocouple, Biot no. and Fourier no.	6 Hrs.	CO2
3	**Convective Heat Transfer**		
	Convective Heat Transfer: classification of convection, Local and overall heat transfer coefficient., dimensionless numbers in forced convection (no deriviation), velocity and thermal boundary layer (only Concept) **External Forced Convective Heat Transfer** Flow over a flat horizontal plate, Cylinder and sphere (Laminar and turbulent), numerical based on empirical correlation **Internal Forced Convective Heat Transfer** concept of hydraulic diameter, Flow through a pipe or tube (Turbulent flow, Laminar flow), numerical based on empirical correlation	6 Hrs.	CO3
4	**Natural Convection**		
	Heat Transfer by Natural Convection: Introduction, dimensionless numbers, Convection around a flat horizontal/vertical plate, horizontal cylinder, numerical based on empirical correlation. Introduction to mixed convection.	6 hrs.	CO 4

	Condensation and Boiling: Boiling heat transfer, types of boiling, pool boiling curve and forced boiling phenomenon, condensation heat transfer, film wise and drop wise condensation.		
5	**Radiation**		
	Irradiation, radiosity, concept of black body, grey body, laws of radiation: Planck, Wien, Kirchhoff, Lambert, Stefan Boltzmann Laws, heat exchange between two black bodies, concepts of shape factor. Laws of shape factor,Calculation of radiation heat transfer between two surfaces, radiation shields and electrical analogy.	6 Hrs.	CO 5
6	**Applications of Heat Transfer**		
	Heat exchangers: Classification and applications, heat exchanger analysis – LMTD, effectiveness– NTU method for parallel and counter flow heat exchanger, LMTD correction factor, cross flow heat exchanger, design criteria for heat exchanger, Introduction to TEMA, ASME standards. **Application of heat transfer:** heat pipe, thermo well, cooling of electronic equipment, phase change materials, heat transfer improvement methods	6 Hrs.	CO 6

List of Practical:

Pr No	Description	CO	PO
1.	Determination of Thermal Conductivity of insulating powder	**1**	**1,2, 9,10,11,12**
2.	Determination of Thermal Conductivity of Composite wall	**1**	**1,2, 9,10,11,12**
3.	Determination of Emissivity of a Test surface	**6**	**1,2, 9,10,11,12**
4.	Determination of Stefan Boltzmann Constant	**6**	**1,2, 9,10,11,12**
5.	Determination of heat transfer coefficient in Natural Convection	**4**	**1,2, 9,10,11,12**
6.	Determination of heat transfer coefficient in Forced Convection	**4**	**1,2, 9,10,11,12**
7.	Determination of temperature distribution, fin efficiency in Natural / Forced Convection	**2, 4**	**1,2, 9,10,11,12**
8.	Determination of effectiveness of heat exchanger using software	**5**	**1,2,5, 9,10,11,12**

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Elements of Heat Transfer	M.N. Ozisik	McGraw Hill	
2.	Fundamentals of Heat and Mass Transfer	F.P. Incropera, D.P. Dewit	John Wiley	
3.	Heat and Mass Transfer – Fundamentals and Applications	Y. A. Cengel and A.J. Ghajar	Tata McGraw Hill	
4.	A Textbook on Heat Transfer	S.P. Sukhatme	Universities Press	
5.	Fundamentals of Engineering Heat and Mass Transfer	R.C. Sachdeva	New Age Science.	
6.	Thermal Engineering	R.K.Rajput	Laxmi Publications	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Basic Heat and Mass Transfer	A.F. Mills	Pearson	
2.	Heat Transfer	S. P. Venkatesan	AneBooks	
3.	Fundamentals of Heat and Mass Transfer	J.P. Holman	McGraw–Hill	
4.	Fundamentals of Heat and Mass Transfer	M. Thirumaleshwar	Pearson Education	
5.	Process Heat Transfer	Kern D. Q	Tata Mc Graw-Hill	
6	Engineering Thermodynamics	Nag P.K	Tata Mc Graw-Hill	

Professional Elective-I - Refrigeration System (ME 305) (2020 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**Home Assignments:**	20 Marks
Credits:	**3**	**Total:**	100 Marks

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Prerequisite Course: Basic Knowledge of Basic Thermodynamics and Heat Transfer.

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Course Objectives: (Please specify Six Objectives)

1. Student should able to understand the fundamental principles and explain applications of refrigeration
2. Understand, conceptualize and determine cooling capacity and coefficient of performance of vapour compression refrigeration system.
3. Understand, conceptualize and find coefficient of performance of compound vapour compression refrigeration system and vapour absorption refrigeration system.
4. Explain properties and environmental issues of refrigerants
5. Understand functions and working of various components of refrigeration system.
6. Explain refrigeration system control and understand cryogenics system.

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Discuss the fundamental principles, applications of refrigeration and determine coefficient of performance of air cycle refrigeration systems.	3	Apply
CO2	Understand, conceptualize and determine cooling capacity and coefficient of performance of vapour compression refrigeration system.	4	Analyse
CO3	Understand, conceptualize and find coefficient of performance of compound vapour compression refrigeration system and vapour absorption refrigeration system.	3	Apply
CO4	Explain properties, environmental issues of different refrigerants and compare different refrigerants.	3	Understand
CO5	Understand functions, working and analyse the performance of various components of refrigeration system.	4	Analyse
CO6	Explain refrigeration system control and understand cryogenics system.	5	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														
CO2	3	2													3
CO3	3	2													3
CO4	2	2	2			2	2	2							
CO5	3	2	2												3
CO6	3	2								2		2			3

Course Contents

Unit	Contents	No.of Hours	COs
1	**Introduction, Applications of Refrigeration and Air Cycle Refrigeration**		
	Introduction: Review of basics thermodynamics and heat transfer, History of refrigeration, Ice production by nocturnal cooling in ancient India and application of evaporative cooling in India. Applications of Refrigeration: Household refrigerator with types, Freezers, Ice plant, Industrial Refrigeration, Cold chain for vaccination, Chemical and process industries, Dairy plant, Petroleum refineries, Cold storage, Food processing and food chain, Preservation of fruits, vegetables and beverages, Water cooler, Refrigerated trucks, Miscellanous. Air cycle refrigeration systems: Bell Coleman cycle, (Numericals), Aircraft refrigeration cycles.	6 Hrs.	CO 1
2	**Vapour Compression Refrigeration System**		
	Vapour Compression Refrigeration system (VCRS), Basic block diagram of VCRS, Tons of refrigeration (TR), Coefficient of performance (COP), Energy efficiency Ratio (EER), Ideal refrigeration cycle – Reversed Carnot cycle, Numericals, Deviations of practical cycles from carnot cycle, Standard vapour compression refrigeration cycle, Numericals, Actual VCRS, Effect of suction and discharge pressure, sub cooling and superheating on performance.	6 Hrs.	C0 2
3	**Compound Vapour Compression Refrigeration System and Vapour Absorption Refrigeration System**		
	Introduction, Compound vapour compression refrigeration system with intercooling for single and multiple evaporator, Numericals. Vapour absorption Refrigeration System (VARS): Basic principle of VARS, Aqua-ammonia absorption refrigeration system, Properties of Mixtures, Lithium bromide-water absorption Systems, Three fluid Electrolux system. Numericals, Solar energy	6 Hrs.	C0 3

	based adsorption refrigeration systems.		
4	**Refrigerants and Steam jet Refrigeration System**		
	Types of Refrigerants, designation of refrigerant, Properties of refrigerants, Ozone layer depletion, environment and performance issues, Primary and secondary refrigerants, Synthetic and natural refrigerants, Introduction of CFCs and HCFCs, Refrigerant mixtures – zeotropic and azeotropic mixtures, Applications of various refrigerants, Case study - Comparison between different refrigerants. Leak detection in refrigeration equipment. Steam Jet Refrigeration system.	6 Hrs.	C0 4
5	**Refrigeration System Components**		
	Compressors - Reciprocating compresses - Performance and power requirements of the ideal and actual compressor, Centrifugal compressors, Screw compressors Rotary- single vane and multi-vane compressor, Wise motion compressor (optional). Condensers - Classification, Condensing capacity and Heat Rejection Ratio, Correlations for condensing heat transfer coefficients, Effects of fouling and noncondensible gases on performance. Evaporators - Classification, Correlations for boiling heat transfer coefficients for various configurations, Design and performance aspects, Effects of pressure drops and frost formation. Expansion devices - Capillary tubes - Applications, operating characteristics, Thermostatic expansion valves, Automatic expansion valves, Float valves, Electronic expansion valves.	6 Hrs.	C0 5
6	**Refrigeration System Control and Cryogenics**		
	Part- I Refrigeration System Control Capacity Controls of compressors, Measurement and Instruments - Temperature and Pressure measurement of refrigeration system, uncertainty analysis, Controls in Refrigerator. Control of moisture and other contaminants in refrigerant systems, Refrigerant containment, recovery, recycling, and reclamation, Insulation systems for refrigerant piping, Lubricants in refrigerant systems. Troubleshooting of refrigeration system – symptom, possible cause and action. **Part – II Cryogenics** Low temperature refrigeration - Cryogenics – Introduction and Applications, Cascade refrigeration system, Numericals, Liquification of gases, methods of air liquefaction, Linde‟s and Claude‟s cycle, Numericals, Adiabatic demagnetisation.	6 Hrs.	CO 6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Refrigeration and Air conditioning	Arora, C.P	Tata-McGraw Hill	ISBN 0-07-463010-5
2.	Basic Refrigeration and Air Conditioning	P .N. Ananthanarayanan	McGraw Hill	
3.	Refrigeration and Air conditioning	Manohar Prasad	New Age International	
4.	Refrigeration and Air conditioning	R.S. Khurmi J.K. Gupta	Eurasia Publishing House (P) Ltd.	ISBN 978-81-219-2781-9

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	2018 ASHRAE Handbook -Refrigeration	ASHRAE Technical Committees, Task Groups, and Technical Resource Groups	ASHRAE	ISBN 978-1-939200-98-3 ISSN 1930-7217
2.	2013 ASHRAE Handbook -Fundamentals	ASHRAE Technical Committees, Task Groups, and Technical Resource Groups	ASHRAE	ISBN 978-1-936504-46-6 ISSN 1523-7230
3.	Principles of Refrigeration	Roy J Dossat	Pearson Education	
4.	Air Conditioning and Refrigeration Journals – Cold chain for covid – 19 Vaccine	ISHRAE Members	ISHRAE	Volume 11 Number 4 November – December 2020
5.	Air Conditioning and Refrigeration Journals –	ISHRAE Members	ISHRAE	Volume 20 Number 6 November –

	Integration of HVAC and Fire Safety			December 2020

Online Resources:

NPTEL – Refrigeration and Air Conditioning by Ravi Kumar

Reliability Engineering (ME305B)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	2 Hrs./Week (if applicable)	**Home Assignments:**	20 Marks
Credits:	**3**	**Total:**	100 Marks

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Prerequisite Course: (if Any)- NIL

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Course Objectives: (Please specify Six Objectives)

1. To introduce the basic concepts of reliability, various models of reliability
2. To analyse reliability of various systems
3. To introduce techniques of reliability improvement
4. To introduce the concepts of availability and maintainability.
5. To introduce the concept of system failure analysis
6. To understand the reliability testing of the systems.

Course Outcomes (COs): After the learning this course, the learners will be able to;

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Calculate the system failure rate	2	Understand
CO2	Determine the reliability of the complex systems	2	Understand
CO3	Model the systems for reliability improvement	3	Apply
CO4	Determine availability and maintainability of systems	5	Evaluate
CO5	Analyse the system failures	4	Analyse
CO6	Conduct the test for reliability testing	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	3	1												
CO2	2	3	1												
CO3	2	3	1												
CO4	2	3	1												
CO5	2	3	1												
CO6	2	3	1												

Course Contents

Unit	Contents	No.of Hours	COs
1	**Fundamental concepts of Reliability**		
	Reliability terminologies, Role of the reliability function in the organization, Interrelationship of safety, quality and reliability, life characteristic phases, Product liability-Significance, importance of reliability, Introduction to maintainability, availability. Concepts of Failure, failure density, failure Rate, hazard rate, pdf, cdf. Modes of failure, Mean Time To Failure (MTTF), Mean Time Between Failure (MTBF), Numericals based on calculation of failure rate, hazard rate. Warranty Management and Life cycle cost	6 Hrs.	1
2	**Network Modeling and Reliability Evaluation**	6 Hrs	CO
	Basic concepts – Evaluation of network Reliability / Unreliability – Series systems, Parallel systems, Series - Parallel systems, partially redundant systems – Types of redundancies - Evaluation of network Reliability / Unreliability using conditional probability method – Paths based and Cutset based approach – complete event tree and reduced event tree methods.		2
3	**System reliability Analysis**	6Hrs.	C0
	Reliability Improvement- Redundancy, element redundancy, unit redundancy, standby redundancy-types of stand by redundancy, parallel components single redundancy, multiple redundancies (Numericals). Introduction to Reliability allocation or apportionment, reliability apportionment techniques – equal apportionment, AGREE, ARINC, Minimum effort method (Numericals).		3
4	**Availability and maintainability**	6Hrs.	C0
	Objectives of maintenance, types of maintenance, Maintainability, factors affecting maintainability, system down time, availability - inherent, achieved and operational availability (Numerical treatment). Introduction to Reliability Centered Maintenance.		4
		6Hrs.	C0
5	**Reliability in Design & Development**		
	Reliability techniques- Failure mode, effects analysis (FMEA), RPN , Failure mode, effects and criticality analysis (FMECA)-Case Studies, Basic symbols, Fault Tree construction and analysis	6Hrs.	5
6	**Reliability Testing**		CO
	Reliability Life Testing - Test time calculations, Burn-in testing, Acceptance testing, accelerated life testing and Experimental Design - Reliability Growth Testing - Growth process, Idealized growth curve and other growth modals Introduction to reliability testing, Stress strength interaction, Introduction to Markov model Testing for Reliability and Durability- Accelerated Life Testing	8Hrs.	6

	and Highly Accelerated Life Testing (HALT), highly accelerated stress Screening (HASS).		

Text Books

1. Srinath L S "Reliability Engineering", Affiliated East-West Press Limited, New Delhi, 2002.
2. L.S. Srinath, Concepts of Reliability Engg., Affiliated East-Wast Press (P) Ltd., 1985
3. A.K. Govil, Reliability Engineering, Tata McGraw-Hill Publishing Co. Ltd., 1983
4. E. Balagurusmy, Reliability Engineering, Tata McGraw-Hill Publishing Co. Ltd., 1984
5. Dhillon B S, "Engineering Maintainability", Prentice Hall of India, New Delhi, 2000
6. B.S. Dhillon, Quality Control and Reliability in Engineering Design, Marcel Dekker Inc., 1985
7. R. Ramakumar, Reliability Engineering Fundamentals, Pearson Education
8. A K Govil, Reliability Engineering, Tata McGraw-Hill

Reference Books

1. Ebling CE, "An introduction to Reliability and Maintainability Engineering" Tata Mc Graw Hill, Delhi, 2004
2. K.C. Kapur, L.R. Lamberson, Reliability in Engineering Design, John Wiley & Sons, 1977.
3. C.O. Smith, Introduction to Reliability in Design, McGraw-Hill Book Co., 1976.
4. Alessandro Birolini, Reliability Engineering, Theory and Practice, Springer-Verlag Berlin Heidelberg 2007
5. Kishor S. Trivedi and Andrea Bobbio, Reliability and Availability Engineering, Cambridge University Press 2017
6. Kishore K. Pochampall and Surendra M. Gupta, Realibility Analysis with Minitab, CRC Press,2018

Industrial Tribology (ME305C) (2020 Pattern)

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

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Prerequisite Course: Engineering Mathematics, Engineering Mechanics, Material Science, Strength of Materials, Fluid Mechanics

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Course Objectives: (Please specify Six Objectives)

1. To know about properties of lubricants, modes of lubrication, additives etc.
2. To Select suitable/proper grade lubricant for specific application.
3. To select suitable material combination for tribological contact.
4. To Apply the basic theories of friction, wear and lubrications about frictional behavior commonly encountered sliding surfaces.
5. To suggest an explanation to the cause of tribological failures.
6. To design bearing, friction, wear test rig for laboratory purposes.

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Use basic fundamentals of Tribology for understanding of friction and wear behaviour of the mechanical systems.	2	Understand
CO2	Determine tribological performance parameters of sliding contact in different lubrication regimes.	4	Analyze
CO3	Analyze the systems with proper hydrostatic lubrication.	4	Analyze
CO4	Design and select appropriate bearings for Elasto-hydrodynamic and Gas lubrication.	4	Apply
CO5	Choose suitable Materials for Tribological Applications	3	Apply
CO6	Know the working and use of surface measuring instruments	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								
CO2	2	2											2		
CO3	2	2	1										2	1	
CO4	2	1											2		
CO5	2	1				1	1					2		1	
CO6	2	3		1		1						1			

Course Contents

Unit	**Contents**	No.of Hours	COs
1	**Fundamentals of Tribology**		
	History and significance of Tribology and economical considerations of tribology in industry, Factors influencing Tribological phenomena, Tribology in industry (Maintenance), Tribological properties of material, SAE oils. Friction- Introduction, laws of friction, Friction classification, causes of friction, Theories of dry friction, Friction measurement, Stick-slip motion and friction instabilities. Wear-classification, wear between solids, wear between solid and liquids, factors affecting wear, Theories of wear, Wear measurement, Approaches to friction control and wear prevention. (Numerical).	6 Hrs.	CO1
2	**Hydrodynamic Lubrication**		
	Lubrication-Definition, basic modes of lubrication, properties of lubricants, additives, EP lubricants, Recycling of used oil, oil conservation, oil emulsion, Bearing Terminology-Types of Sliding contact, rolling contact bearings, Comparison between sliding and rolling contact bearing. Theory of hydrodynamic lubrication, mechanism of pressure development in oil film, Two dimensional Reynold‘s equation and its limitations, Petroff`s equation , Stribeck's curve. Infinitely long journal bearing, infinitely short journal bearing and finite bearing, designing journal bearing using Raimondi and Boyd approach, Hydrodynamic thrust bearing-Introduction, types , Flat plate thrust bearing-Pressure equation, load, centre of pressure, frictional force equation , Tilting pad	6 Hrs.	C02

	thrust bearing- bearing-Pressure equation, load, centre of pressure, frictional force equation. (Numericals on Raimondi and Boyd approach and thrust bearing only)		
3	**Hydrostatic Lubrication**		
	Hydrostatic lubrication-Basic concept, advantages, limitations, viscous flow through rectangular slot, load carrying capacity, flow requirement of hydrostatic step bearing, energy losses, optimum design of stepped bearing, compensators and their actions. Applications of hydrostatic bearings **Squeeze film lubrication** - Basic concept, circular and rectangular plate approaching a plane (Numericals on hydrostatic bearing, Squeeze film lubrication).	6 Hrs.	C03
4	**Elasto-hydrodynamic Lubrication and Gas Lubrication**		
	Elasto-hydrodynamic lubrication- Principle and applications, pressure viscosity term in Reynold's equation, Hertz theory, Ertel-Grubin equation, lubrication of spheres. Applications of EHD and gas bearings. **Gas(air) lubricated bearings** -Introduction, advantages, disadvantages, applications of tilting pad bearing, hydrostatic and hydrodynamic bearing with air lubrication, Active and passive magnetic bearings(working principle, types and advantages over conventional bearing). (Theoretical treatment only) . Applications of gas bearings.	6 Hrs.	C04
5	**Materials for Tribological Applications**		
	Introduction to tribological relevant properties of materials. An overview of engineering materials having potential for tribological application. Characterization and evaluation of Ferrous materials for tribological requirements/applications, Selection of ferrous materials for rolling element bearings, gears, crank shafts, piston rings, cylinder liners, etc. Non-ferrous materials and their applications such as sliding bearings, piston rings, cylinder liners, etc., materials for dry friction materials. Composite materials (PM, CMC and MMC) for tribological applications.	6 Hrs.	C05
6	**Surface Topography Measurements**		
	Electron microscope and friction and wear measurements - Laser method. Sliding friction and wear abrasion test, rolling contact and fatigue test, solid particle and erosion test, Use of transducers and instruments in Tribology. Introduction to basic surface texture of metals and application of different techniques to measure surface texture.	6 Hrs.	CO 6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Introduction to Tribology and Bearings	B. C. Majumdar	S.CHAND and Company Ltd. New Delhi	629.248.MAJ-99 21130-O
2.	Theory and Practice of Lubrication for Engineers	Fuller D. D.	John Wiley and Sons	
3.	Design of Machine Elements	V. B. Bhandari.	McGraw-Hill, 199	621.815.BHA-17 62482-O

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Principles of Tribology	Halling J	McMillan Press Ltd.	
2.	Basic Lubrication Theory	Cameron A	Wiley Eastern Ltd	621.89.CAM-81 41055-O
3.	Handbook of Tribology: materials, coatings and surface treatments	B. Bhushan, B.K. Gupta	McGraw-Hill, 199	

Machine Design-I Lab (ME 306) (2020 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	- Hrs. / Week	**In-Sem Exam :**	-
Practical:	2 Hrs./ Week	**End Sem Exam:**	-
Tutorials :	- Hrs./Week (if applicable)	**TW :**	25 Marks
Credits:	**1**	**Total:**	25 Marks

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Prerequisite Course: (Strength of Machine Elements, Basics of Mechanical Engineering)

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Course Objectives:

1. Student shall gain appreciation and understanding of the design function in Mechanical Engineering, different steps involved in designing and the relation of design activity with manufacturing activity.
2. The student shall learn to choose proper materials for different machine elements depending on their physical and mechanical properties. They will learn to apply the knowledge of material science in real life situations.
3. Student shall gain a thorough understanding of the different types of failure modes and criteria. They will be conversant with various failure theories and be able to judge which criterion is to be applied for a particular situation.
4. Student shall gain design knowledge of the different types of elements used in the machine design process, for e.g. shafts, couplings etc. and will be able to design these elements for each application.
5. Students shall gain a thorough understanding about the design of the various types of springs.
6. Students shall gain thorough knowledge about the design of clutch and brake.

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Ability to identify and understand failure modes for mechanical elements and design of machine elements based on strength.	2	Understand
CO2	Ability to design Shafts, Keys and Coupling for industrial applications.	3	Apply
CO3	Ability to design machine elements subjected to fluctuating loads.	3	Apply
CO4	Ability to design Power Screws for various applications.	3	Apply
CO5	Ability to design various Springs for strength and stiffness.	2	Understand
CO6	Ability to design various Clutch and brake	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	3	2	1	-	-	-	-	-	1	-	-	3	-	-
CO2	3	2	2	1	1	-	-	-	-	1	-	-	3	-	-
CO3	3	2	2	1	-	-	-	-	-	1	-	-	3	-	-
CO4	3	2	2	-	1	-	-	-	-	1	-	-	2	-	-
CO5	3	-	1	2	1	-	-	-	-	1	-	-	1	-	-
CO6	3	-	-	2	1	1	-	-	-	1	-	-	1	-	-

List of Practical:

Pr No	Description	CO	PO
1.	**Two design projects on Assemblies covering above syllabus**. The design project shall consist of half imperial sheets (A2 size) involving assembly-drawing with a bill of material and overall dimensions and drawings of individual components. The Project should be assigned to a group of three to five students. **Project 1 shall be based on any one of the following topics-** i) Cotter joint/ knuckle joint/turn buckle for a specified application. ii) Transmission Shaft/Machine tool spindles/coupling for specified application. iii) Hand or foot operated levers/lever for safety valve. **Project 2 shall be based on any one of the following topics-** i) Bench vice/Machine vice for specified applications. ii) Bottle type/toggle jack for vehicles. iii) Lead screw for machine tool/other applications. iv) Design of Clutches and brakes Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary for selection of standard components. Drawings of design project should be done manually.	**CO1, CO2, CO3, CO4, CO5, CO6**	**PO1, PO3, PO6**
2.	Preparation of program using programing languages/modern tools for design of following elements: (any one) 1. Knuckle joint 2. Cotter joint 3. Spring 4. Power screw 5. Lever	**CO1, CO3, CO6**	**PO1 PO6**

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Mechanical Engineering Design	Shigley J.E. and Mischke C.R.	McGraw Hill Publication Co. Ltd.	621.815
2.	Design of Machine Elements	Spotts M.F. and Shoup T.E	Prentice Hall International	621.815
3.	Design of Machine Elements	Bhandari V.B	Tata McGraw Hill Publication Co. Ltd.	621.815
4.	Fundamentals of Machine Components Design	Juvinal R.C	John Wiley and Sons	621.815

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Machine Design	Black P.H. and O. Eugene Adams	McGraw Hill Book Co. Inc.	621.815
2.	Machine Components Design	Willium C. Orthwein	West Publishing Co. and Jaico Publications House.	--
3.	Theory and Problems of Machine Design,	Hall A.S., Holowenko A.R. and Laughlin H.G	Schaum's Outline Series	--
4.	Design of Machine Elements,	C.S.Sharma and Kamlesh Purohit	PHI Learing Pvt. Ltd	621.815
5.	Machine Design	D.K.Aggarwal & P.C.Sharma	S.K Kataria and Sons	621.815
6.	Machine Design: Fundamentals and Applications	P. C. Gope	PHI Learing Pvt. Ltd	621.815
7.	Design Data	P.S.G	P.S.G. College of Technology, Coimbatore.	621.815
8.	Machine Design data book	Bhandari, V. B.	Tata McGraw Hill Publication Co. Ltd.	621.815

Metrology and Quality Control Lab (ME307) (2020 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	0 Hrs. / Week	**In-Sem Exam :**	00 Marks
Practical:	2 Hrs./ Week	**End Sem Exam:**	00 Marks
Tutorials :	- Hrs./Week (if applicable)	**Oral:**	25 Marks
Credits:	**1**	**Total:**	25 Marks

List of Practicals: Any eight experiments out of following to be performed

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

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	To Understand, Identify and apply methods and devices for measurement of length, angle, gear parameters, thread parameters, surface roughness and geometric features of parts etc.	3	Apply
CO2	To check errors and/or calibrate measuring instruments.	4	Analyse
CO3	To select and apply appropriate Quality Control/Quality Management Tool to solve quality related problem.	4	Analyse

Part (A)

Pr No	Description	CO
1.	Demonstration of linear measuring instruments and their applications for linear measurements.	**1**
2.	Demonstration of angular measuring instruments and Angular measurements by using sine bar/sine centre/any other angular measuring instruments.	**1**
3.	Error determination of linear / angular measuring instruments.	**2**
4.	Calibration of measuring instrument. Example – Dial gauge, Micrometer, Vernier (any one) (Refer ISO 17025).	**2**
5.	Verification of dimensions and geometry of given components using Mechanical/Pneumatic comparator. [An assignment with this experiment write-up as, Introduction to use of Standard CODE viz. ASME-Y14.5, ISO-1101].	**1**
6.	Demonstration of surfaces inspection using optical flat/interferometers OR Demonstration of surface roughness measurement using surface roughness tester.	**1**
7.	Determination of geometry and dimensions of given composite object using profile projector and/or tool maker’s microscope.	**1**

8.	Measurement of thread parameters using floating carriage diameter measuring machine.	**1**
9.	Measurement of spur gear parameters using Gear Tooth Vernier / Span Micrometer / Gear Rolling Tester.	**1**
10.	Determination of given geometry using coordinate measuring machine (CMM).	**1**

Part: B] Statistical Quality Control (SQC) (Any Two) Note - Use of computational tools [such as Minitab / Matlab / MS Excel] are recommended

1. Analyze the fault in given batch of specimens by using seven quality control tools for engineering application / Case study on any of seven quality control tools.
2. Determination of process capability from given components and plot variable control chart/ attribute chart.
3. Case study on various tools in Total Quality Management (TQM)

Part: C] Industrial visit to: Calibration lab / CMM Lab / Gear Inspection Unit/Automotive Industry / Engineering Industry.

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		
CO2	3	2										2	2		
CO3	2	2			2	2			2	2		2	2		

Text Books:

Sr. No.	Title of Book	Authors	Publication House
1.	Engineering Metrology	Jain R.K.	Khanna Publication
2.	Engineering Metrology	I. C. Gupta	Dhanpath Rai Publication
3.	Metrology and Measurements	Bewoor A. K. and Kulkarni V. A	Tata McGraw hill Publication.
4.	Quality Handbook	Juran J. M.	McGraw Hill Publications.
5.	Statistical Quality Control	Grant S.P.	Tata McGraw hill Publication
6.	A text book of Metrology	M. Mahajan	Dhanpatrai and Co.
7.	Statistical Quality Control	M. Mahajan	Dhanpatrai and Co.

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Metrology for engineers	Galyer J.F & Shotbolt C.R.	Cengage Learning
2.	Handbook of Industrial Metrology	ASTME	Prentice Hall of India Ltd
3.	Fundamentals of Dimensional Metrology	Connie Dotson	Thomson Publn., 4th Edition
4.	Quality control	Basterfield D. H.	Pearson Education India, 2004
5.	Modern Methods for Quality control and Improvement	Harrison M. Wordsworth, Stefeen Godfrey	Willy Publication

Heat Transfer (ME 308) (2020 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA :**	20 Marks
Credits:	**3**	**Total:**	100 Marks
Examination hr	**2 hr**	**Pattern:**	2019

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Prerequisite Course: Basic Thermodynamics, Basic Mechanical Engineering, Fluid Mechanics.

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Course Objectives:

1. Identify the important modes of heat transfer and their applications.
2. Formulate and apply the general three dimensional heat conduction equations.
3. Analyse the thermal systems with internal heat generation and lumped heat capacitance.
4. Understand the mechanism of convective heat transfer
5. Determine the radiation heat transfer between surfaces.
6. Understand different applications of Heat transfer.

Course Outcomes (COs): (Strictly Six Outcomes need to be specified here)

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Identify the various modes of heat transfer and implement the basic heat conduction equations for steady one dimensional thermal system.	3	Apply
CO2	Determine the general heat conduction equation to thermal systems with internal heat generation, fins and transient heat conduction.	3	Apply
CO3	Analyze the heat transfer rate in forced convection.	3	Apply
CO4	Analyze the heat transfer rate in Natural convection, Condensation & Boiling.	3	Apply
CO5	Calculate heat transfer by radiation between two objects with simple geometries.	3	Apply
CO6	Analyze the Heat Transfer Equipment and investigate their performance.	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	-	1	-	-	-	-	1	1	-	1	-	-	2
CO2	3	2	1	2	-	-	-	-	2	1	-	1	-	-	2
CO3	3	-	2	-	-	-	-	-	-	-	-	1	-	-	2
CO4	3	2	2	2	-	-	-	-	2	1	-	1	-	-	2
CO5	3	2	1	1	-	-	-	-	2	1	-	1	-	-	2
CO6	3	2	2	2	-	-	-	-	2	1	-	1	-	-	2

(Specify values as: 3: High Level,2: Medium Level, 1: Low Level for mapping of Cos to POs)

List of Practical:

Pr No	Description	CO	PO
1.	Determination of Thermal Conductivity of insulating powder	**1**	**1,2, 9,10,11,12**
2.	Determination of Thermal Conductivity of Composite wall	**1**	**1,2, 9,10,11,12**
3.	Determination of Emissivity of a Test surface	**6**	**1,2, 9,10,11,12**
4.	Determination of Stefan Boltzmann Constant	**6**	**1,2, 9,10,11,12**
5.	Determination of heat transfer coefficient in Natural Convection	**4**	**1,2, 9,10,11,12**
6.	Determination of heat transfer coefficient in Forced Convection	**4**	**1,2, 9,10,11,12**
7.	Determination of temperature distribution, fin efficiency in Natural / Forced Convection	**2, 4**	**1,2, 9,10,11,12**
8.	Determination of effectiveness of heat exchanger using software	**5**	**1,2,5, 9,10,11,12**

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Elements of Heat Transfer	M.N. Ozisik	McGraw Hill	
2.	Fundamentals of Heat and Mass Transfer	F.P. Incropera, D.P. Dewit	John Wiley	
3.	Heat and Mass Transfer– Fundamentals and Applications	Y. A. Cengel and A.J. Ghajar	Tata McGraw Hill	
4.	A Textbook on Heat Transfer	S.P. Sukhatme	Universities Press	
5.	Fundamentals of Engineering Heat and Mass Transfer	R.C. Sachdeva	New Age Science.	
6.	Thermal Engineering	R.K.Rajput	Laxmi Publications	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Basic Heat and Mass Transfer	A.F. Mills	Pearson	
2.	Heat Transfer	S. P. Venkatesan	AneBooks	
3.	Fundamentals of Heat and Mass Transfer	J.P. Holman	McGraw–Hill	
4.	Fundamentals of Heat and Mass Transfer	M. Thirumaleshwar	Pearson Education	
5.	Process Heat Transfer	Kern D. Q	Tata Mc Graw-Hill	
6	Engineering Thermodynamics	Nag P.K	Tata Mc Graw-Hill	

Production Technology Lab (ME 309) (2020 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	- Hrs. / Week	**OR Exam :**	-- Marks
Practical:	2 Hrs./ Week	**PR Exam:**	-- Marks
Tutorials :	- Hrs./Week (if applicable)	**TW :**	50 Marks
Credits:	**1**	**Total:**	50 Marks

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Prerequisite Course: BME, Engineer Graphics

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Course Objectives:

1. **To set the manufacturing set-up appropriately and study corresponding set up parameters**
2. **To select appropriate process parameter for obtaining desired characteristic on work piece.**
3. **To understand the operational problems and suggest remedial solution for adopted manufacturing process.**

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Performed gear cutting operation and study the corresponding set up parameters..	3	Apply
CO2	Select appropriate process parameter for obtaining desired characteristic on work piece.	3	Apply
CO3	Understand the operational problems and suggest remedial solution for adopted manufacturing process	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	3	3			1			2						
CO2	2	3	3		3	1			2						
CO3	2	3	3			1			2						

List of Practical's

Pr No	Description	No.of Hours	COs	PO
1	Spur Gear cutting using simple indexing head	4 Hrs.	CO1	
2	Development and execution of one simple turning job on a CNC (Trainer) machine.	4 Hrs	CO2	
3	Assembly of two parts using Drilling, threading, kurling, step turning operations.	4 Hrs	CO3	
	Journal consisting of following assignments.			
1	Two views of at least one jig and one fixture designed, for a component on a half imperial sheet.(manual drafting)	2 Hrs		
2	Process planning sheets for job assembly of plate including Bill of material, Limits Fits Tolerance.	1 Hrs.		
3	Assembly Drawing of job no c. (Bill of material, Limits Fits Tolerance, Dimensions with tolerances should consider while drawing sheet)	1 Hrs.		

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.	

Mini Project based on Skill based Credit Course (ME 310) (2020 Pattern)

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

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/an application using the languages/programs and concepts learnt in the theory with a good look and feel effects.	6	Create

Active verbs developed based on Bloom's Taxonomy

Knowledge	Understand	Apply	Analyze	Evaluate	Create
define	explain	solve	analyze	reframe	design
identify	describe	apply	compare	criticize	compose
describe	interpret	illustrate	classify	evaluate	create
label	paraphrase	modify	contrast	order	plan
list	summarize	use	distinguish	appraise	combine
name	classify	calculate	infer	judge	formulate
state	compare	change	separate	support	invent
match	differentiate	choose	explain	compare	hypothesize
recognize	discuss	demonstrate	select	decide	substitute
select	distinguish	discover	categorize	discriminate	write
examine	extend	experiment	connect	recommend	compile
locate	predict	relate	differentiate	summarize	construct
memorize	associate	show	discriminate	assess	develop
quote	contrast	sketch	divide	choose	generalize
recall	convert	complete	order	convince	integrate
reproduce	demonstrate	construct	point out	defend	modify
tabulate	estimate	dramatize	prioritize	estimate	organize
tell	express	interpret	subdivide	find errors	prepare
copy	Identify	Manipulate	survey	grade	produce
discover	indicate	Paint	advertise	measure	rearrange
duplicate	Infer	Prepare	appraise	predict	rewrite
enumerate	relate	produce	Break down	rank	role-play

Guidelines for Team Formation, Guide Allotment and Evaluation:

- A group of minimum 2 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 constituted 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
- Developing a computer program (in Python, MatLAB or any suitable language) as a solution to the existing problem
- Applying IoT technique to the existing lab setup
- Applying 6 Sigma or 5S techniques to the Department labs
- 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:
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**

Design Thinking (ME 311) (2020 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	1 Hrs. / Week	**In-Sem Exam :**	-
Practical:	- Hrs./ Week	**End Sem Exam:**	-
Tutorials :	- Hrs./Week (if applicable)	**Home Assignments: Oral:**	-
Credits:	**-**	**Total:**	-

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Prerequisite Course: (if Any) The subject Machine Design-II has a prerequisite as Strength of Materials, and Applied Mechanics as major subjects

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Course Objectives:

1. To bring awareness on innovative design and new product development.
2. To explain the basics of design thinking.
3. To familiarize the role of reverse engineering in product development.
4. To train how to identify the needs of society and convert into demand.
5. To introduce product planning and product development process.

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

Course Contents

Unit	**Contents**	No. of Hours	COs
1	**Introduction to Design Thinking**		
		3 Hrs.	CO1
2	**Empathize Phase: Customer Journey Mapping**		
		3 Hrs.	C02
3	**Analyze Phase: 5-Whys and How might we...**		
		4 Hrs.	C03
4	**Solve Phase: Ideation: Free Brainstorming & Make/Test Phase: Prototype**		
		4 Hrs.	C04

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Karmic Design Thinking	Prof. Bala Ramadurai,		
2.	Exploring Engineering: An Introduction to Engineering and Design",	Philip Kosky, Robert T. Balmer, William D. Keat, George Wise,	4th edition, Elsevier, 2016.	
3.	History of Modern Design	David Ralzman	2nd edition, Laurence King Publishing Ltd., 2010	
4.	Design Thinking	AVA Publishing, 2010.	AVA Publishing, 2010.	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Engineering Design: A Systematic Approach	G. Pahl, W.Beitz, J. Feldhusen, KH Grote	3rd edition, Springer, 2007.	
2.	Ten Faces in Innovation	Tom Kelley, Jonathan Littman	Currency Books, 2006.	
3.	Designing for Growth: A Design Thinking Tool Kit for Managers	Jeanne Liedtka and Tim Ogilvie	New York: Columbia University Press, 2011	
4.	Design: Creation of Artifacts in Society	Prof. Karl Ulrich, U. Penn		
5.	Change by Design.	Tim Brown		

Applied Thermodynamics (ME 312)

Teaching Scheme		Examination Scheme	
Lectures:	4 Hrs. / Week	**CIA:**	20 Marks
		In-Sem Exam :	30 Marks
		End Sem Exam:	50 Marks
Credits:	**4**	**Total:**	100 Marks

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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 its Performance
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 controlling methods.
4. To learn about steam generator and analyse its performance.
5. To understand about reciprocating air compressor and evaluate the performance
6. To learn about vapour compression & vapour absorption refrigeration systems

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

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Explain basic engine terminology, air standard cycle, actual cycle and valve timing diagram	2	Understand
CO2	Describe combustion performance of SI and CI engines.	2	Understand
CO3	Determine performance and emission parameters of IC Engines	3	Apply
CO4	Calculate boiler efficiency, equivalent evaporation, energy balance of boiler.	3	Apply
CO5	Determine the volumetric efficiency, isothermal efficiency of reciprocating air compressor	3	Apply
CO6	Calculate performance parameters of vapour compression refrigeration system	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	1	-	-	-	-	-	-	-	-	-	1	-	-	2
CO2	2	1	-	-	-	-	-	-	-	-	-	1	-	-	2
CO3	3	2	-	2	-	-	2	-	2	1	-	1	-	-	2
CO4	3	2	-	2	-	-	-	-	1	1	-	1	-	-	2
CO5	3	2	-	2	-	-	-	-	1	1	-	1	-	-	2
CO6	3	2	-	2	-	-	-	-	1	1	-	1	-	-	2

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Course Contents

Unit no.	Unit title and contents	No. of Hours	COs
1	**Introduction to Internal Combustion (IC) 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 cycles, Cycle of operation in Four stroke and Two-stroke IC engines and their comparative study, Applications, Intake and exhaust system, Valves actuating mechanisms, Valve timing diagram.	8	CO1
2	**Combustion in IC Engine**		
	SI Engines:- Spark ignition Engine mixture requirements, Fuel-Air ratio, Simple, Electronic Fuel Injection System, Qualities and Properties of fuels in S.I. Engine, Combustion stages in SI engines, Abnormal Combustion, Theory of Detonation and Parameters affecting detonations. **CI Engines**: 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 SI and CI engines, Dopes and Additives.	8	C02
3	**IC Engine Testing and Emission**		
	Engine Testing: Basic Performance Parameters of I.C. Engine, Methods to determine power and efficiencies of I.C. Engine, characteristic curves, heat balance sheet,	8	C03

	Determination of IP, BP, FP, Mean effective pressure, Fuel consumption, Air Consumption. **Emission & Control**: Introduction to Indian Driving Cycle, Methods to measure emission such as Non Dispersive Infrared Red, Bharat stage norms. Emission control methods and systems for SI and CI engines, catalytic convertors.		
4	**Steam Generators**		
	Steam Generators: Classification, Constructional details and working of low pressure boilers and high pressure boilers, Boiler mountings and accessories, Introduction to IBR Act, Boiler performance Calculations - Equivalent Evaporation, Boiler efficiency, Heat balance Sheet.	8	C04
5	**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. Introduction to pre filters, after filters, Air dryers, Reservoir and Instrumentation for Air Compressor	8	C05
6	**Refrigeration Systems**		
	Refrigeration: Reversed Carnot Cycle, unit of refrigeration, Simple Vapour Compression Cycle, Refrigerating Effect, Compressor Power & COP. Simple Vapor Absorption Cycle. Applications of VCC and VAC, Numerical on simple saturation cycle, liquid sub cooling.	8	CO6

Text Books

Sr. No	Title of Book	Authors	Publication House
1.	Internal Combustion Engines	V. Ganesan	Tata McGraw-Hill
2.	Fundamentals of Internal Combustion Engines	H.N. Gupta,	PHI Learning Pvt. Ltd.
3.	Applied Thermodynamics	Onkar Singh	New Age International Publishers
4.	Thermal Engineering - I	Mahesh M Rathore	McGraw Hill Education (India) Private Ltd
5.	Thermal Engineering	Sadhu Singh	Pearson India Education Services Pvt. Ltd
6.	Applied Thermodynamics	Onkar Singh	New age international publishers

7.	Basics and Applied Thermodynamics	P.K. Nag	Tata McGraw Hill publications

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Internal Combustion Engine Fundamentals	Heywood	Tata McGraw-Hill
2.	Internal Combustion Engine	Domkundwar & Domkundwar	Dhanpat Rai & Co.
3.	Thermal Engineering	S.Domkundwar,C.P. Kothandaraman, A. Domkundwar	Dhanpat Rai & Co
4.	Applied Thermodynamics	T.D. Eastop and A.McConkey	Pearson

Machine Design-II (ME313)

Teaching Scheme		Examination Scheme	
Lectures:	4 Hrs. / Week	**CIA**	20 Marks
		In-Sem Exam :	30 Marks
		End Sem Exam:	50 Marks
Credits:	**4**	**Total:**	100 Marks

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Prerequisite Course: Machine Design-I, Strength of Materials, Applied Mechanics

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Course Objectives:

1. Enable students to attain the basic knowledge required understanding, analyzing, designing and select machine elements required in transmission systems.
2. Reinforce the philosophy that real engineering design problems are open-ended and challenging
3. Impart design skills to the students to apply these skills for the problems in real life industrial applications
4. Inculcate an attitude of team work, critical thinking, communication, planning and scheduling through design projects
5. Create awareness amongst students about safety, ethical, legal, and other societal constraints in execution of their design projects
6. Develop an holistic design approach to find out pragmatic solutions to realistic domestic and industrial problems

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

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Determine the dimensions of spur gear for given power transmitting capacity	3	Apply
CO2	Determine the dimensions of helical and bevel gear for given power transmitting capacity	3	Apply
CO3	Calculate dimensions of worm and worm gear considering strength and wear rating	3	Apply
CO4	Calculate required capacity of Rolling contact bearing and its selection from manufacturer's Catalogue	3	Apply
CO5	Estimate sizes of belt drives and selection of belt from manufacturer catalogue for given power transmitting capacity	3	Apply
CO6	Determine the dimensions threaded joint to avoid the failure	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	2	2	3	-	1	2	2	-	2	3	-	-
CO2	3	3	3	3	2	2	-	2	1	1	-	2	2	-	-
CO3	3	2	2	3	2	3	2	2	2	2	-	1	2	-	-
CO4	3	3	3	2	-	2	-	1	1	2	-	1	2	-	-
CO5	2	3	3	2	-	3	-	2	2	1	-	2	3	-	-
CO6	3	3	2	2	-	2	-	1	2	1	-	1	2	-	-

Course Contents

Unit	Contents	No.of Hours	COs
1	**Spur Gear**		
	Introduction to gears: Gear Selection, material selection, Basic modes of tooth failure, Gear Lubrication Methods. Spur Gears: Number of teeth and face width, Force analysis, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength (Buckingham's) equation, Estimation of module based on beam and wear strength, Estimation of dynamic tooth load by velocity factor and Buckingham's equation.	8	CO1
2	**Helical and Bevel Gears**		CO2
	Types of helical and Bevel gears, Terminology, Virtual number of teeth, and force analysis of Helical and Straight Bevel Gear. Design of Helical and Straight Bevel Gear based on Beam Strength, Wear strength and estimation of effective load based on Velocity factor (Barth factor) and Buckingham's equation. Mountings of Bevel Gear. (No numerical on force analysis of helical & Bevel Gear)	8	
3	**Worm and Worm Wheel**		
	Worm and worm gear terminology and proportions of worm and worm gears, Single and double enveloping, Force analysis of worm gear drives, Friction in Worm gears, efficiency of worm gears, Self-locking properties of worm and worm wheel drive, Worm and worm gear material, Strength and wear ratings of worm gears (Bending stress factor, speed factor, surface stress factor, zone factor) IS 1443-1974, Thermal consideration in worm gear drive, Types of failures in worm gear drives.	8	C03

4	**Rolling Contact Bearings**		
	Types of rolling contact Bearings, Static and dynamic load carrying capacities, Stribeck's Equation, Equivalent bearing load, Load- life relationship, Selection of bearing life, Selection of rolling contact bearings from standard and commercially available manufacturer's catalogue, e.g. SKF, NTN. Design for cyclic loads and speed, bearing with probability of survival other than 90% Taper roller bearing: Force analysis and selection criteria. (Theoretical Treatment only)	8	C04
5	**Belt drive**		
	Materials and construction of flat and V belts, geometric relationships for length of belt, power rating of belts, concept of slip & creep, initial tension, effect of centrifugal force, maximum power condition, Selection of Flat and V-belts from standard and commercially available manufacturer's catalogue, belt tensioning methods, relative advantages and limitations of Flat and V- belts, construction and applications of timing belts, V-Belt drive with variable speed ratio, its effect on belt design and applications.	8	C05
6	**Threaded joints**		
	Basic types of screw fasteners, Bolts of uniform strength, I.S.O. Metric screw threads, Bolts under tension, Eccentrically loaded bolted joint in shear, Eccentric load perpendicular and parallel to axis of bolt, Eccentric load on circular base.	8	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	Design of machine elements	V. B. Bhandari	Tata Mc Graw Hill Public Co. Ltd.
2.	Machine Design	P. C. Sharma and D. K. Agarwal	S.K. Kataria & Sons
3.	Machine Design	U. C. Jindal	Pearson
4.	Machine Design	S. G. Kulkarni	Tata McGraw Hill Education Private Limited
5.	Machine Design	Pandya and Shah	Charotar Publishing House Pvt. Ltd.
6.	Machine Design	Sadhu Singh	Khanna Publishing

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Design Data	P. S. G. College of Technology, Coimbatore.	P. S. G. College of Technology, Coimbatore.
2.	Fundamentals of Machine Components Design	Juvinal R. C.	John Wiely and Sons.
3.	Mechanical Engineering Design	Shigley J.E. and Mischke C.R.	Mc Graw Hill Pub. Co. Ltd.
4.	Design of Machine elements	Spotts M.F. and Shoup T.E.	Prentice Hall International.
5.	Machine Design	Black P.H. and O. Eugene Adams	Mc Graw Hill Book Co. Ltd.

Hydraulic and Pneumatics (ME314)

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

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Prerequisite Course: Fluid Mechanics, Manufacturing Processes and Machines, Mechatronics

Course Objective

1. To study governing laws used in fluid power systems
2. To study fluid power applications
3. To study working principles of various components
4. To study selection of different components
5. To study how to design fluid power systems
6. To study low-cost automation

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

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Understand working principle of Hydraulic pumps	3	Apply
CO2	Select actuators and fluid power accessories as per system requirements	3	Apply
CO3	Understand construction and working of fluid control valves	3	Apply
CO4	Construct simple hydraulic circuits, along with its components	3	Apply
CO5	Construct simple pneumatic circuits, along with its components	3	Apply
CO6	Analyze working of hydraulic and pneumatic circuits and select its components from standard manufacturer's catalog.	3	Apply

Course Contents

Unit	Contents	No. of Hours	COs
1	**Basics of Fluid Power and Pumps**	6	CO1
	Fluid power basics, advantages and limitations, fluid power distribution, standard symbols, energy loss in hydraulic systems. Pumps - types, classification, principle of working and constructional details of vane pumps, gear pumps, radial and axial plunger pumps, screw pumps, power and efficiency calculations, and characteristics curves		
2	**Actuators and Power Unit**	6	CO2
	Linear and rotary actuators- types, construction and characteristics. Cylinder mountings, cushioning of cylinders. Power units and accessories - types of power units, reservoir assembly, constructional details. Accumulators, Intensifiers		
3	**Fluid Power Control**	6	CO3
	Direction control valves - center positions, methods of actuation, two stage valves, Flow control valves - pressure and temperature compensated. Pressure control valves - pressure reducing valve, sequence valve, unloading valve, brake valve, back pressure valve, counter balance valve, check valve, servo valves, cartridge valves, proportional valves.		
4	**Hydraulic Circuits**	6	CO4
	Hydraulic circuits: Simple reciprocating, regenerative, speed control (meter in, meter out and bleed off), sequencing, synchronization, traverse and feed, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, unloading circuit, motor breaking circuit etc.		
5	**Pneumatics – Components, Control Valves and Circuits**	6	CO5
	Compressors - Types, principle of working and constructional details. Comparison of pneumatic with hydraulic power transmissions. Types of filters, pressure regulators, lubricators, mufflers, dryers, direction control valves, pneumatic actuators, shuttle valve, two pressure valve, quick exhaust valve and time delay valves, electro-pneumatics. Speed regulating methods, pneumatic circuits, reciprocating, cascading time delay etc. Application of pneumatics in low-cost automation and in industrial automation.		
6	**System Analysis and Design**	6	CO6
	Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads, design considerations for cylinders, Design of hydraulic/pneumatic circuits for practical application, selection of different components such as reservoir, control elements, actuators, accumulator, intensifier, filters, pumps. (Students are advised to refer manufacturers' catalogues for design and use simulation tool like Automation Studio for analysis).		

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	-	-	1	-	-	-	-	-	-	-	1	-	-
CO2	3	2	-	-	1	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	1	-	-	-	-	-	-	-	1	-	-
CO4	3	2	1	1	2	-	-	-	-	-	-	-	1	-	-
CO5	3	2	2	2	2	-	-	-	-	2	-	-	1	-	-
CO6	3	2	3	3	3	-	-	-	-	2	-	-	1	-	-

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	Fluid Power with application	Esposito A,	Prentice Hall
2.	Oil Hydraulic system- Principle and maintenance	Majumdar S.R,	Tata McGraw Hill
3.	Hydraulics and Pneumatics	Stewart H. L	Taraporewala Publication

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Industrial Hydraulics	Pipenger J.J	McGraw Hill
2.	Industrial Fluid Power	Pinches	Prentice Hall
3.	Fluid Power Design Handbook	Yeaple,	-

Corporate Readiness (HS315)

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

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Prerequisite Course: Quantitative aptitude, Verbal and Non-verbal communication

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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 develop required aptitude skills.

3. To design the functional and chronological resume.

4. To demonstrate the importance of critical thinking ability and expression in group discussions

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	Remember placement processes of various organizations and modern job search approach.	1	Remember
CO2	ıderstand Industry Specific skill set with a view to design an Ideal Resume	2	Understand
CO3	Apply the knowledge of GD & Presentation Skill during Industry Assessments for Placement/Internship/Industry Training/Higher Studies/Competitive Exams etc.	3	Apply
CO4	Analyse and apply the critical thinking ability as required during Aptitude/Technical Tests	4	Analyse
CO5	Evaluate Technical/General Dataset to interpret insights in it.	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	-	-	-	-	-	-	-	02	00	02	01	01	-	-	-
CO2	-	-	-	-	-	-	-	02	03	03	03	01	-	-	-
CO3	-	-	-	-	-	-	-	01	03	03	02	01	-	-	-
CO4	01	01	-	-	-	-	-	-	-	01	01	-	-	-	-
CO5	01	01	-	-	-	-	-	-	-	-	-	-	-	-	-

Course Contents

Unit	**Contents**	No. of Hours	COs
1	**Placement Awareness**		
	Discussion over Different Companies for recruitment, their eligibility criteria and placement procedures. Revision and Assessment of Quantitative Aptitude	6 Hrs.	CO1
2	**Resume Writing**		
	Keywords, resume examples for industry, professional font, active language, important achievements, Proofread and edit. Innovative resume building- video resume	5Hrs.	CO2
3	**Group Discussion and Presentation skills**		
	Why GDs are implemented commonly, Aspects which make up a Group Discussion, Tips on group discussion, do's and don'ts of GD and Presentation skills.	5Hrs.	CO3
4	**Logical Reasoning I**		
	Coding and Decoding (Visual Reasoning and series), Statement & Conclusions (Syllogisms), Relationships (Analogy), Data arrangements, Crypt arithmetic.	5Hrs.	CO4
5	**Logical Reasoning II**		
	Data Interpretation, Data Sufficiency, Blood relation and dices, Clocks and Calendar, Direction sense and cubes, Logical connectives, Puzzle	5Hrs.	CO5

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	A Modern Approach to Verbal & Non-Verbal Reasoning	R.S. Agarwal.	
2.	Reasoning verbal and Non-Verbal	B. S. Sijwali.	
3.	Master the Group Discussion & Personal Interview - Complete Discussion on the topics asked by reputed B-schools & IIMs	Sheetal Desarda	

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Logical Reasoning	M. K. Panday.	
2.	Logical and analytical reasoning	K. Gupta.	
3.	Multi-dimensional reasoning	Mishra & Kumar Dr. Lal.	

IPR and EDP (PR316)

Teaching Scheme		Examination Scheme	
Lectures:	2 Hrs. / Week	**CIA:**	10
		In-Sem Exam :	15 marks
		End Sem Exam:	25 Marks
Credits:	**2**	**Total:**	50 Marks

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Prerequisite Course: NIL

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Course Objectives:

1. To introduce the basic concepts of IPR
2. To teach patent and Design as an IPR
3. To teach copy right and trademark as an IPR
4. To make aware the selection type of IPR for appropriate inventions
5. To identify the Skill sets required to be an entrepreneur
6. To understand the Role of supporting agencies and Governmental initiatives to promote Entrepreneurship

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

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Interpret the need and importance of intellectual property rights.	2	Understand
CO2	Elaborate the process for Patent and Design registration	2	Understand
CO3	Explain the process for copy right and trademark registration	2	Understand
CO4	Select the IPR tool for protection of invention	3	Apply
CO5	Evaluating the Entrepreneurial abilities within an Individual.	5	Evaluate
CO6	Creating a Detailed Project Report with a due consideration to various supporting agencies and Governmental initiatives to promote Entrepreneurship.	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	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	-	2	3	3	3	-	-	-
CO6	-	-	-	-	-	-	-	-	2	3	3	3	-	-	-

Course Contents

Unit	**Contents**	No.of Hours	COs
1	**Introduction to IPR**	6	
	Introduction to Concept of Property, Types of Property, General Characteristics of Property Rights, Need of Intellectual property, Introduction to Intellectual Property, Philosophy of IPR, Different forms of Intellectual Property, IPR in India : Genesis and Development, International Organizational and Treaties, WIPO and its Role, International Treaties.		1
2	**Patent and Design**	6	CO
	Definition of Patents, Elements of Patentability: Novelty, Non-Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter, Anticipation, Registration Procedure, Time Frame and Cost, Rights and Duties of Patentee, International Protection, Commercialization, Infringement, Patent Databases, IP protection of Semiconductors and Integrated Circuits, Case studies What is a Design, Difference from Patent, how can Designs be protected, Procedure for Registration, Effect of Registration and Term of Protection, Non-Patentable Subject Matter, Infringement, Patenting biotechnological invention, Case studies		2
3	**Copyrights and Trademarks**	8	C0
	Introduction to Copyright, what is covered by Copyright, How long does copyright last, Why Protect Copyright, Registration Procedure, Term of protection, Ownership of copyright, Related Rights - Distinction between related rights and copyrights, Infringement. Difference between copyrights and other IPRs, Case studies Introduction to Trademarks, Different kinds of marks: brand names, logos, signatures, symbols, well known marks, Non-Registrable Trademarks, Registration of Trademarks, Rights of holder and assignment and licensing of marks, Infringement., Introduction to Geographical Indications.		3

4	**Trade Secrets and IP Regime**	6	C0
	What are trade secrets; how trade secrets are to be maintained; how trade secrets are used in trade and businesses, Case studies Need of IP Valuation, IPR as an Instrument of Development, Impact of Intellectual Property System on Economic Growth, Role of Intellectual Property in Technology Transfer, Introduction to Biopiarcy and popular cases, Career opportunities in IPR.		4
5	**Entrepreneurship: Introduction**	6	C0
	Concept and Definitions: Entrepreneur & Entrepreneurship, Entrepreneurship and Economic Development, A Typology of Entrepreneurs. **5.2 Entrepreneurial Competencies:** The Entrepreneur's Role, Entrepreneurial Skills: creativity, problem solving, decision making, communication, leadership quality; Self-Analysis, Culture & values, Risk-taking ability, Technology knowhow. **Factor Affecting Entrepreneurial Growth:** Economic & Non-Economic Factors, EDP Programmes. **Steps in Entrepreneurial Process:** Deciding Developing Moving Managing Recognizing.		5
6	**DPR & Various Support Systems for Entrepreneurship**	8	CO
	Project Report Preparation: Specimen Format of Project Report; Project Planning and Scheduling using PERT / CPM; Methods of Project Appraisal – Feasibility Study both Economic and Market Preparation projected financial statement. **Role of Support Institutions and Management of Small Business:** Director of Industries, DIC, SIDO, SIDBI, Small Industries Development Corporation (SIDC), SISI, NSIC, NISBUED, State Financial Corporation (SFC) EPC, ECGC. **Various Governmental Initiatives:** Make in India, Start Up India, Stand Up India, Digital India, Skill India. **Case Studies of Successful Entrepreneurs**		6

Text Books

1. Watal, Jayashree " Intellectual Property Rights in The WTO And Developing Countries ", Oxford University Press.
2. R. Anita Rao & Bhanoji Rao, Intellectual Property Rights- A Primer, Eastern Book Co.
3. Shiv Sahai Singh, The Law of Intellectual Property Right, Eastern Book Co
4. Prabuddha Ganguli Intellectual property right – Unleashing the knowledge economy, , Tate McGraw Hill Publishing company ltd.

Reference Books and Acts

1. Subbaram N.R, " Handbook of Indian Patent Law and Practice, S. Viswanathan Printers and Publishers Pvt. Ltd.,1998
2. Indian Patent Act, 1970 (With recent Amendments)
3. The Design Act 2020 (With recent Amendments)
4. The trademarks Act 1999 (With recent Amendments)
5. Copy right act 1957 ((With recent Amendments)

Turbo Machinery (ME317A)

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

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Prerequisite Course: Basic Mechanical Engg., Basic thermodynamics, Fluid Mechanics

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Course Objectives:

1. To provide the knowledge of basic principles, governing equations and applications of turbo machine.
2. To explain construction and working principle and evaluate the performance characteristics of Impulse water turbine
3. To explain construction and working principle and evaluate the performance characteristics of Reaction water turbine.
4. To explain construction and working principle and evaluate the performance characteristics of steam turbine.
5. To explain construction and working principle and evaluate the performance characteristics of Centrifugal pump.
6. To explain construction and working principle and evaluate the performance characteristics of Centrifugal, Axial flow compressor.

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

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Determine work done, vane efficiency for different types of vanes.	3	Apply
CO2	Calculate performance parameters of Pelton Wheel.	3	Apply
CO3	Describe the working of reaction hydraulic turbines along their performance parameters.	3	Apply
CO4	Calculate performance parameters of Steam turbine with the use of velocity triangles.	3	Apply
CO5	Determine performance parameters of centrifugal pump.	3	Apply
CO6	Determine performance parameters of centrifugal compressor and study performance characteristics of Axial flow compressor.	3	Apply

Course Contents

Unit	Contents	No.of Hours	COs
1	**Introduction to Turbo Machinery and Impact of Jet**		
	Introduction to Turbo Machinery Turbo machines (Hydraulic & Thermal), Classification of Turbo machines, Fundamental equation governing turbo machines, Different losses associated with turbo-machinery, Applications of Turbo machines. **Impact of Jet** Impulse momentum principle and its applications, Force exerted on fixed and moving flat plate, curved vanes, series of flat plates and radial vanes, velocity triangles and their analysis, work done equations, vane efficiency.	6 Hrs.	CO1
2	**Impulse Water Turbines**		
	Introduction to Hydro power plant, classification of hydraulic turbines construction, principle of working, velocity diagrams and analysis, design aspects, performance parameters, performance characteristics, specific speed, selection of turbines, multi-jet Pelton wheel.	6 Hrs	C02
3	**Reaction Water Turbines**		
	Classifications, Francis, Propeller, Kaplan Turbines, construction features, velocity diagrams and analysis with numerical, degree of reaction, performance characteristics. Draft tubes: types and analysis, causes and remedies for cavitation phenomenon **(Theoretical treatment only)**, Governing of turbines	6 Hrs	C03
4	**Steam Turbines**		
	Steam nozzles: types and applications, Equation for velocity and mass flow rate [No numerical treatment]. **Steam Turbines:** Classifications, construction details, compounding of steam turbines **(Theoretical treatment only)**, velocity diagrams and analysis of Impulse and reaction turbines **(single stage)** with numerical, governing of steam turbine, performance characteristics. Losses in steam turbines, selection of turbines.	6 Hrs	C04
5	**Centrifugal Pumps**	6 Hrs	C05
	Classification of rotodynamic pumps, components of centrifugal pump, types of heads, velocity triangles and their analysis, effect of outlet blade angle, cavitation, NPSH, Thomas's cavitation factor, priming of pumps, installation, specific speed, performance characteristics of centrifugal pump, series and parallel operation of pumps, selection of pumps.		
6	**Centrifugal & Axial Compressor**		
	Centrifugal compressor: Classification of compressors, Construction, velocity	6 Hrs.	C06

	diagram, flow process on T-S Diagram, Euler's work, actual work input, performance characteristics, various losses in centrifugal compressor. **(Numerical)** **Axial Compressor:** Construction, stage velocity triangles and its analysis, enthalpy entropy diagram, stage losses and efficiencies, performance characteristics. Application of centrifugal and axial flow compressor **[Theoretical treatment only]**		

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	2	-	-	-	-	-	-	-	-	1	-	-	2
CO2	3	3	-	-	1	-	-	-	-	2	-	1	-	-	3
CO3	3	3	2	1	1	-	-	-	-	2	-	1	-	-	3
CO4	3	3	2	3	1	-	-	-	-	2	-	1	-	-	3
CO5	3	3	-	3	1	-	-	-	-	2	-	1	-	-	3
CO6	3	3	-		1	-	-	-	-	2	-	1	-	-	3

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	Steam and Gas Turbines and Power Plant Engineering	R. Yadav	Central Publ. house Allahabad
2.	Hydraulics, Fluid Mechanics and Machinery	Modi P N & Seth S N	Standard Book House New Delhi
3.	Fluid mechanics and hydraulic machines	Dr. R.K. Bansal	Laxmi Publication
4.	Thermal Engineering	Sadhu Singh & Sukumar Pati	Pearson Publication
5.	An Introduction to energy conversion, Volume III – Turbo Machinery	V. Kolambi and Manohar Prasad	New Age International
6.	Introduction to Fluid Mechanics and Fluid Machines	S.K.Som, G.Biswas, Sumon Chakraborty	Tata McGraw Hill Education, Third Edition
7.	Gas Turbine	Ganeshan V.	Tata McGraw Hill Education, Third Edition

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Fundamentals of Turbomachinery	William W. Peng	John Wiley & Sons.
2.	Thermal Turbomachines	Dr. Onkar Singh	Wiley India
3.	Theory of Hydraulic Machinery	V. P. Vasandani	Khanna Publishers, Delhi
4.	Fluid Mechanics, Thermodynamics of Turbomachinery	S.L. Dixon	IV edition, Butterworth-Heinemann Publ., 1966.
5.	Hydraulic machines	Dr.Jagdish Lal	Metropolitan Books Co.Pvt.Ltd.,Delhi

Operation Research (ME317B)

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

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Prerequisite Course: Mathematics I, II and III

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Course Objectives:

1. To familiarize the students with the use of practice oriented mathematical applications for optimization functions in an organization.
2. To familiarize the students with various tools of optimization
3. To make aware students the techniques of process time minimization
4. To make students aware about various techniques for project management
5. To familiarize the students with sequencing techniques
6. To familiarize the students with multistage decision-making techniques

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

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Formulate and Solve linear real-life problems using decision method like Simplex method	3	Apply
CO2	Formulate and solve the transportation and assignment models to optimize available resources.	3	Apply
CO3	Formulate and solve competitive strategies problems using games theory and replacement analysis.	3	Apply
CO4	Plan, schedule, and control project activities using CPM and PERT techniques	3	Apply
CO5	Optimise the Queuing model for real life problems	3	Apply
CO6	Decide optimal strategies using sequencing model and conflicting situations	3	Apply

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

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

Course Contents

Unit	Introduction: Operation Research	No. of Hours	COs
1	**Introduction**: Definition, Evolution and Classification of Quantitative Methods and Operations Research Techniques, Methodology, Advantages and Limitations. **Linear Programming Problem:** Introduction, Formulation of LPP, Solution of LPP by Simplex Method.	6	1
	Transportation & Assignment Model	6	2
2	Introduction, Formulation, Basic Method of Solving Transportation Problem. Optimization Methods like UV and Stepping Stone Method. **Assignment Problem**- Hungarian Method to solve Assignment Problem.		
	Theory of Games and Replacement Analysis	6	3
3	**Theory of Games**: Introduction, Minimax and Maximin Principle, Solution of Game with Saddle Point, Solution by Dominance, m x n size Game Problem, **Replacement Analysis**: Replacement of Items that Deteriorate, Replacement of Items that Fail Suddenly.		
	Project Management and Simulation	6	4
4	**Network Models**: Fulkerson ‘s rule, concept and types of floats, CPM and PERT, Crashing Analysis and Resource Scheduling.		
	Queuing Theory and Sequencing Models	6	5
5	**Queuing Theory:** Introduction, Basis Structure, Terminology (Kendal's Notations) and Applications. **Queuing Model M/M/1**: /FIFO, M/M/C.		

	Sequencing and Decision Theory		
6	**Sequencing models**: Solution of sequencing Problem - Processing of n jobs through two machines, Processing of n jobs through three machines, Processing of two jobs through m Machines, Processing of n jobs through m Machines. **Decision Theory:** Meaning and Steps in Decision Making, Types of Management Decisions, Decision under Certainty, under Risk, under Uncertainty.	6	6

A. Text Books:

1. Prem Kumar Gupta, D. S. Hira, Problems in Operations Research: Principles and Solutions, S. Chand, 1991.
2. J. K. Sharma, Operations Research: Theory and Application, Laxmi pub. India.
3. Operations Research, S. D. Sharma, Kedar Nath Ram Nath-Meerut.
4. Manohar Mahajan, Operation Research, Dhanpatrai Publication,

B. Reference Books:

1. Hillier F.S., and Lieberman G.J., Operations Research, Eight Edition, Mc. Tata McGraw Hill, India.
2. Ravindran, ―Engineering optimization Methods and Applications 2nd edition, Wiley, India.
3. Ravindran, Phillips and Solberg, Operations Research Principles and Practice, Second Edition, Mc. WSE Willey,
4. Operations Research - An introduction, Hamdy A Taha, Pearson Education.

Mechanical System Design (ME 317C)

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

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Prerequisite Course: Engineering Mechanics, Manufacturing Process, Strength of Materials, Machine design, Engineering Mathematics, Theory of Machines, Dynamics of Machinery, and IC Engines.

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Course Objectives:

1. Ability to apply the statistical considerations in design and analyze the defects and failure modes in components
2. To enable student to design machine tool gearbox
3. To enable student to design material handling systems
4. To enable student to design cylinders and pressure vessels and to use IS code
5. To enable student select materials and to design internal engine components
6. To introduce student to optimum design and use optimization methods to design mechanical components.

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

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Estimate reliability of machine components using statistical considerations and analyze the defects and failure modes in components.	3	Apply
CO2	Design material handling systems	4	Analyze
CO3	Determine dimensions of cylinder and pressure vessels using IS2825 code.	4	Analyze
CO4	Design internal combustion engine components.	4	Analyze
CO5	Determine optimum dimensions of mechanical components	3	Apply
CO6	Design multi speed machine tool gear box.	4	Analyze

Course Contents

Unit	Contents	No. of Hours	COs
1	**Statistical Consideration in Design**		
	Frequency distribution: Histogram and frequency polygon, **Normal distribution** : Units of central tendency and dispersion **Standard deviation**: Population combinations, design for natural tolerances, design for assembly, statistical analysis of tolerances, mechanical reliability and factor of safety.	6	CO1
2	**Design of Belt Conveyor System for Material Handling**		
	System concept, basic principles, objectives of material handling system, unit load and containerization. **Belt conveyors**: Flat belt and troughed belt conveyors, capacity of conveyor, rubber covered and fabric ply belts, belt tensions, conveyor pulleys, belt idlers, tension take-up systems, power requirement of horizontal belt conveyors for frictional resistance of idler and pulleys. Screw conveyor: Introduction to design of screw conveyor.	6	C02
3	**Design of Cylinders and Pressure Vessels**		
	Design of Cylinders: Thin and thick cylinders, Lame's equation, Clavarino's and Bernie's equations, auto-frettage and compound cylinders, gasketed joints in cylindrical vessels. ***Design of Pressure vessel*** : Modes of failures in pressure vessels, unfired pressure vessels, classification of pressure vessels as per ASME, categories and types of welded joints, weld joint efficiency, stresses induced in pressure vessels, materials for pressure vessel, thickness of cylindrical shells and design of end closures as per code, nozzles and openings in pressure vessels, reinforcement of openings in shell and end closures, area compensation method, types of vessel supports.	6	C03
4	**Design of I.C. Engine Components**		
	Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, construction of cylinder liners, design of piston and piston-pins, piston rings	6	C04
5	**Optimum Design**		
	Objectives of optimum design, adequate and optimum design, Johnson's Method of optimum design, primary design equations, subsidiary design equations and limit equations, optimum design with normal specifications of simple machine elements- tension bar, transmission shaft and helical spring, Pressure vessel	6	C05
6	**Design of Machine Tool Gear Box**		
	Introduction to machine tool gearboxes, design and its applications, basic considerations in design of drives, determination of variable speed range, graphical representation of speed and structure diagram, ray diagram, selection	6	C06

	of optimum ray diagram, gearing diagram, deviation diagram. (Note: Full design problem to be restricted up to 2 Stages only)		

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	-
CO2	3	2	2	-	-	-	-	2	2	2	-	2	2	-	-
CO3	3	2	2	2	-	2	2	2	2	2	-	2	2	1	-
CO4	3	2	2	2	-	-	-	-	2	2	-	2	3	-	2
CO5	2	2	2	-	-	-	-	-	-	-	-	2	3	-	-
CO6	3	2	3	2	-	-	-	-	2	2	-	3	2	-	-

Text Books

1. Bhandari V.B. ―Design of Machine Elements‖, Tata McGraw Hill Pub. Co. Ltd.
2. Juvinal R.C, Fundamentals of Machine Components Design, Wiley, India

References books:

1. Design Data- P.S.G. College of Technology, Coimbatore.
2. Shigley J. E. and Mischke C.R., ―Mechanical Engineering Design‖, McGraw Hill Pub. Co
5. M. F. Spotts, ‐Mechanical Design Analysis‖, Prentice Hall Inc.
6. Black P.H. and O. Eugene Adams, ‐Machine Design McGraw Hill Book Co. Inc.
7. Johnson R.C., ―Mechanical Design Synthesis with Optimization Applications‖, Von Nostrand Reynold Pub.
8. S.K. Basu and D. K. Pal, ‐Design of Machine Tools, Oxford and IBH Pub Co.
9. Rudenko,‖Material Handling Equipment‖, M.I.R. publishers, Moscow
10. P. Kannaiah ,‖Design of Transmission systems‖, SCIETCH Publications Pvt Ltd.
11. Pandy, N. C. and Shah, C. S., Elements of Machine Design, Charotar Publishing House.
12. Mulani, I. G., ―Belt Conveyors‖
13. Singiresu S. Rao, Engineering Optimization: Theory and Practice, John Wiley & Sons

Hydraulic and Pneumatics Lab (ME318)

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

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Prerequisite Course: Fluid Mechanics, Manufacturing Processes and Machines, Mechatronics

Course Objective

1. To study governing laws used in fluid power systems
2. To study fluid power applications
3. To study working principles of various components
4. To study selection of different components
5. To study how to design fluid power systems

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

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Understand ISO symbols for Hydraulics and pneumatics	1	Remember
CO2	Evaluate performance of hydraulic pumps on basis of characteristics curves	3	Apply
CO3	Understand construction and working of Direction, Pressure and flow control valves	3	Apply
CO4	Construct simple hydraulic circuits, along with its components	3	Apply
CO5	Construct simple pneumatic circuits, along with its components	3	Apply
CO6	Analyze working of hydraulic and pneumatic circuits and select its components from standard manufacturer's catalog.	3	Apply

List of Experiments

1. Assignment: Symbols for different components as per standards

2. Test on Gear/Vane/Piston pump and plotting performance characteristics

3. Following experiments to be done on hydraulic trainer (any 3)
   a. Regenerative circuit
   b. Speed control circuit
   c. Sequencing circuit
   d. Traverse and feed circuit etc.

4. Following experiments to be done on pneumatic trainer (any 3)
   a. Automatic reciprocating circuit
   b. Speed control circuit

c. Pneumatic circuit involving Shuttle valve/ Quick exhaust valve / Two pressure valve

5. Construct and study Electro pneumatic circuits for simple applications
6. Test on pressure relief valve/flow control valve
7. Design of simple hydraulic systems used in practice using manufacturers' catalogue and analysis using software such as Automation Studio.
8. Design of simple pneumatic systems used in practice using manufacturers' catalogue and analysis using software such as Automation Studio.
9. Industrial visit to study Hydraulic / Pneumatic based Automation systems

Text Books

Sr. No.	Title of Book	Authors	Publication House
4.	Fluid Power with application	Esposito A,	Prentice Hall
5.	Oil Hydraulic system-Principle and maintenance	Majumdar S.R,	Tata McGraw Hill
6.	Hydraulics and Pneumatics	Stewart H. L	Taraporewala Publication

Reference Books

Sr. No.	Title of Book	Authors	Publication House
4.	Industrial Hydraulics	Pipenger J.J	McGraw Hill
5.	Industrial Fluid Power	Pinches	Prentice Hall
6.	Fluid Power Design Handbook	Yeaple,	-

Applied Thermodynamics Lab (ME 319)

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

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Prerequisite Course: Thermodynamics, Basic Mechanical Engineering

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Course Objectives:

1. To estimate performance parameters by conducting a test on I. C. Engines and study emissions with its controlling methods.
2. To study automobile service station.
3. To learn about steam generator, air compressor, refrigeration system and analyze its performance
4. To write computer code for analyzing refrigeration system

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

COs	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	Conduct experiment to determine performance factors of SI and CI engines and study constituents of exhaust gases	4	Analyze
CO2	Prepare and present report of visit of automobile service station.	3	Apply
CO3	Conduct trial on boiler, air compressor, vapor compression test rig to determine performance parameters.	4	Analyze
CO4	Write and execute computer code to analyze vapor compression cycle.	3	Apply

List of Practicals

Pr No	Description	CO
1.	Morse Test on Multi cylinder Petrol engine for determination of Friction power.	**3**
2.	Variable load test on diesel engine to determine various efficiencies, SFC	**3**
3.	Trial on diesel engine to prepare heat balance sheet.	**3**
4.	Visit to Automobile service station	**1,2**
5	Trial on Vapour Compression Refrigeration test rig	**3**
6.	Trial on boiler to determine boiler efficiency, equivalent evaporation and Energy Balance.	**4**
7.	Trial on Positive Displacement Air Compressor.	**5**
8.	Demonstration & study of commercial exhaust gas analyzers.	**2**
9.	Thermal Analysis of refrigeration cycle using suitable software/computer code (virtual lab)	**6**

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	-	-	-	1	1	-	1	1	-	-	-	-	3
CO2	2	-	-	-	-	1	1	-	1	1	-	1	-	-	3
CO3	3	3	-	-	-	1	1	-	1	1	-	-	-	-	3
CO4	2	2	-	-	3	-	-	-	-	-	-	1	-	1	3

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	Internal Combustion Engines	V. Ganesan	Tata McGraw-Hill
2.	Fundamentals of Internal Combustion Engines	H.N. Gupta,	PHI Learning Pvt. Ltd.
3.	Applied Thermodynamics	Onkar Singh	New Age International Publishers
4.	Thermal Engineering - I	Mahesh M Rathore	McGraw Hill Education (India) Private Ltd
5.	Thermal Engineering	Sadhu Singh	Pearson India Education Services Pvt. Ltd
6.	Applied Thermodynamics	Onkar Singh	New age international publishers
7.	Basics and Applied Thermodynamic	P.K. Nag	Tata McGraw Hill publications

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Internal Combustion Engine Fundamentals	Heywood	Tata McGraw-Hill
2.	Internal Combustion Engine	Domkundwar & Domkundwar	Dhanpat Rai & Co.
3.	Thermal Engineering	S. Domkundwar,C.P. Kothandaraman, A. Domkundwar	Dhanpat Rai & Co
4.	Applied Thermodynamics	T.D. Eastop and A.McConkey	Pearson

Machine Design-II Lab (ME 320)

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

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Prerequisite Course: Machine Design-I, Strength of Materials, Applied Mechanics.

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Course Objectives:

1. Enable students to attain the basic knowledge required understanding, analyzing, designing and select machine elements required in transmission systems.
2. Impart design skills to the students to apply these skills for the problems in real life industrial applications
3. Develop an holistic design approach to find out pragmatic solutions to realistic domestic and industrial problems

Course Outcome (CO's) : At the end of the course students will be able to

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Prepare design procedure and make effective presentation	3	Apply, Mechanism
CO2	Design gear box for elevator system/ hoisting system/ machine tool gear box/ two/ four wheeler gear box.	3	Apply, Mechanism
CO3	Draw assembly of gear box and detailed drawing of machine components	3	Apply, Mechanism

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	2	-	2	2	-	1	2	2	-	-	2	-	-
CO2	3	2	3	2	-	2	-	2	2	-	2	2	3	-	-
CO3	3	3	2	2	3	2	-	2	2	2	2	2	2	-	-

List of Practical

Pr. No	Description	CO
1.	Preparing a design procedure of gear box for any one industrial applications including two stage gear box for lifting applications such as lift, hoist, elevator or conveyor system or multi speed gear box for machine tool applications like lathe, drilling, milling machines, gear box used for two and four wheelers.	**CO1**
2.	Preparing a detailed drawing of individual components of gear box and specifying manufacturing tolerances (Defining the fits between the mating components and selection of tolerances accordingly), surface finish symbols and geometric tolerances on each drawing so as to make it working or production drawing.	**CO3**
3.	Preparing 3D part drawing of gear box components and its assembly using CAD software and prepare a sheet with labeled assembly drawing with a part list and overall dimensions	**CO3**
4.	Design spur/helical/bevel or worm gear pair for given power transmission capacity of gear box. (Open ended problems)	**CO2**
5.	Design shaft and keys for mounting of gears and prepare an arrangement of gear box for power transmission. (Open ended problems)	**CO2**
6.	Select Ball/Cylindrical roller/Taper roller bearings for supporting the gear box shafts using manufactures catalogue. (Open ended problems)	**CO2**
7.	Determine the dimensions of gear box casing and bearing caps empirically and select standard components such as bolts, nuts, washer, seals from data for a gearbox.	**CO2**
8.	Each Student shall complete any one of the following assignments in the form of presentation and report 1. Design of Flywheel. 2. Design for Manufacturing, Assembly, and safety 3. Case study of one patent/ copyright/trademark from the product design point of view. (Patent of product which is used in day to day applications) 4. Application of belt drive and its selection method for Industrial application. (By using Manufacturer's Catalog). 5. Application of chain drive and its selection method for Automobile application. (By using Manufacturer's Catalog). 6. Mounting of machine elements on transmission shaft (like Bearings, gears, Pulley, Sprocket, etc). 7. Selection of Bearing from Manufacturer's Catalog. 8. Construction and details of Gears. 9. Methods of lubrication (grade of lubricant), mounting of worm gear and effect of dry running on life. 10. Feasibility of worm and worm wheel replacement and Life span for reliable operation	**CO1**

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	Design of machine elements	V. B. Bhandari	Tata Mc Graw Hill Public Co. Ltd.
2.	Machine Design	P. C. Sharma and D. K. Agarwal	S.K. Kataria & Sons
3.	Machine Design	U. C. Jindal	Pearson
4.	Machine Design	S. G. Kulkarni	Tata McGraw Hill Education Private Limited
5.	Machine Design	Pandya and Shah	Charotar Publishing House Pvt. Ltd.
6.	Machine Design	Sadhu Singh	Khanna Publishing

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Design Data	P. S. G. College of Technology, Coimbatore.	P. S. G. College of Technology, Coimbatore.
2.	Fundamentals of Machine Components Design	Juvinal R. C.	John Wiely and Sons.
3.	Mechanical Engineering Design	Shigley J.E. and Mischke C.R.	Mc Graw Hill Pub. Co. Ltd.
4.	Design of Machine elements	Spotts M.F. and Shoup T.E.	Prentice Hall International.
5.	Machine Design	Black P.H. and O. Eugene Adams	Mc Graw Hill Book Co. Ltd.

Creational Activity Lab (ME321)

Teaching Scheme		Examination Scheme	
Practical:	2 Hrs./ Week	**Term-work:**	50 Marks
Credits:	**1**	**Total:**	50 Marks

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Prerequisite Course: -

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Course Objectives:

1. To encourage students to be member of professional bodies/clubs/chapters.
2. To enhance mini project developed by students in the view of product development.
3. To validate and test enhanced mini project.
4. To motivate students for participation and interaction in extra-curricular or co-curricular activities.

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

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Understand working of professional bodies and participate in events organized by such bodies.	2	Understand
CO2	Analyse implemented code and create working product.	4	Analyse
CO3	Apply different testing methods and tools.	3	Apply
CO4	Apply their knowledge to participate in extra-curricular or co-curricular activities.	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	1	2	-	-	-	3	-	2	2	-	-	1	-	-	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	2	
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	2	
CO4	1	2	2	-	-	3	-	2	2	-	-	1	-	-	2

Course Description

- The course will acquaint students with a variety of technical activities and skills which helpto develop their employability skills required for placement. The course will focus on skill and personality development of students.
- Course is divided in two categories i.e compulsory activities and elective activities organizedin different buckets. From elective activities student has to select one bucket.
- Groups of students will be same as Semester-V Mini Project groups

Guidelines

I] Compulsory Activities:

1. Membership of Professional body or Member of Coding groups and participation in at least one event organized by respective body.
2. Completion of project in view of product development.
3. Testing of Mini Project performed in SEM-V.

II] Group of students have to select one Bucket from Following

Bucket 1: Certification

Standard certification from any organization or any National or International certification which help to develop their employability skills required for placement or any software course certification.

Bucket 2: Publication

Publication of paper in reputed journal in association with expert faculty.OR
Presentation and Publication in National or International conference.

Bucket 3: Achievement

State /National level winner in extra-curricular or co-curricular activities, which includesSports, Arts, Coding or Hackathon Competition, Idea or Innovation.

Bucket 4: Product Development and Projects

End product development and PatentOR
Winner in State or National project competition.OR
Project Presented at National Level competition.

Bucket 5: Any other domain chosen by student in consult with faculty member

Mandatory Learning Course-VI Programming Skills (ME322)

Teaching Scheme **Examination Scheme**

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

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Prerequisite Course: Fundamentals of programming

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Course Objectives:

1. Understand the fundamentals of statistical analysis
2. Determine various statistical parameters using MATLAB
3. Understand the basic principles of Data visualization
4. Understand the algorithms used in Artificial Intelligence
5. Understand the fundamentals of Machine learning
6. Predict the behaviour of various mechanical system using SIMULINK

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

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Understand the fundamentals of statistical analysis	2	Understand
CO2	Determine various statistical parameters using MATLAB	3	Apply
CO3	Understand the basic principles of Data visualization	2	Understand
CO4	Understand the algorithms used in Artificial Intelligence	2	Understand
CO5	Understand the fundamentals of Machine learning	2	Understand
CO6	Predict the behaviour of various mechanical system using SIMULINK	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	-	-	3	-	-	-	-	2	1	1	2	-	-
CO2	3	1	-	-	3	-	-	-	-	2	1	1	2	-	-
CO3	3	1	-	-	3	-	-	-	-	2	1	1	2	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	-	2	2	2	3	-	-	-	-	2	1	1	2	-	-

Course Contents

Unit	Contents	No.of Hours	COs
1	**Statistical Analysis**		
	Relationship between attributes: Covariance, Correlation Coefficient, Chi Square Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts, Using Box Plots to compare distribution) and other statistical graphs	1	CO1
2	**MATLAB Essentials Programming**		
	Commands and Syntax, Packages and Libraries, Introduction to Data Types Data Structures in Vectors, Matrices, Arrays, Importing and Exporting Data.	1	C02
3	**Data Visualization**		CO3
	Principles of data visualization - different methods of presenting data in business analytics. Concepts of Size, Shape, Color Various Visualization types Bubble charts, Case study for data visualization practices	1	
4	**Foundations for AI**		
	AI: Application areas, AI Basics (Divide and Conquer, Greedy, Branch and Bound, Gradient Descent), NN basics (Perceptron and MLP, FFN, Backpropagation) Practice assignment	1	C04
5	**Foundations for ML**		
	ML Techniques overview, Validation Techniques (Cross-Validations), Feature Reduction/Dimensionality reduction, Principal components analysis (Eigen values, Eigen vectors, Orthogonality)	1	C05
6	**Modelling and simulation of systems using MATLAB Simulink**		
	Modelling with Artificial Neural Network Modelling of simple fuzzy system using MATLAB Modelling of simple state space system	1	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	Applied statistics and probability for engineers	Douglas C Montgomery & George C Runger	Wiley
2.	MATLAB an introduction with applications	Rao V Dukkipati	New age international
3.	Introduction to Machine Learning	Alex Smola and S.V.N. Vishwanathan	Cambridge university press
4.	Modeling and simulation of systems using MATLAB and Simulink	Devendra K chaturvedi	CRC press

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Linear regression Analysis: Theory of computing	Xin Yan & Xiao Gang so	World scientific
2.	Numerical methods in Engineering with MATLAB	Jaan kiusalaas	Cambridge
3.	Introduction to Simulink with engineering applications	Steven T Karris	Orchard publications