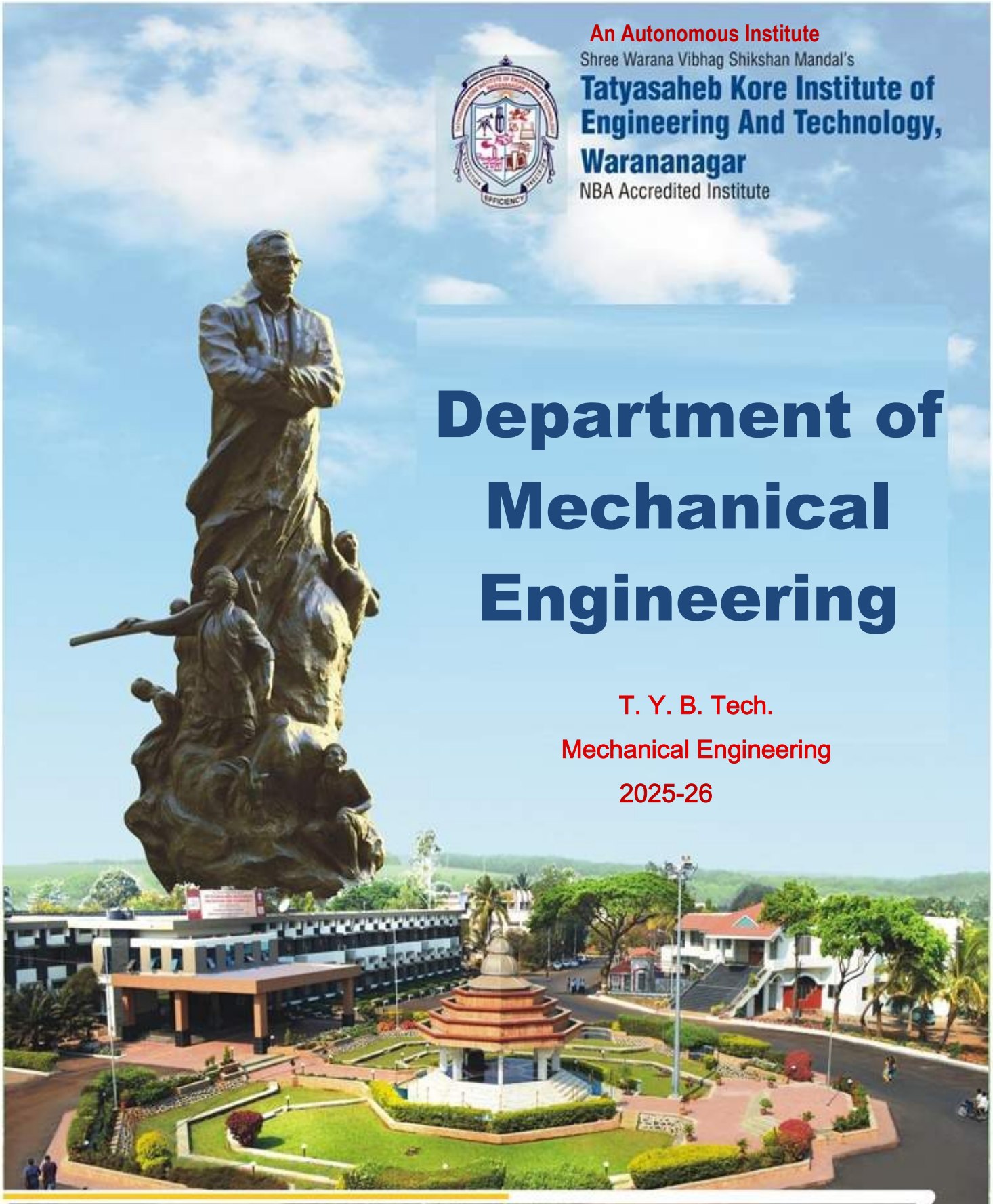
An Autonomous Institute

Shree Warana Vibhag Shikshan Mandal's

Tatyasaheb Kore Institute of Engineering And Technology, Warananagar

NBA Accredited Institute



Department of Mechanical Engineering

T. Y. B. Tech.

Mechanical Engineering

2025-26

B. Tech. In Mechanical Engineering

Syllabus Structure and Curriculum under Autonomy

SWVSM'S

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar
An Autonomous Institute

Abbreviations

Sr.No.	Acronym	Definition
1	ISE	In-SemesterExamination
2	ISE-I	In-SemesterExamination-I
3	ISE-II	In-SemesterExamination-II
4	ESE	EndSemesterExamination
5	ISA	In-Semester Assessment (Term Work)
6	L	Lecture
7	T	Tutorial
8	P	Practical
9	CH	Contact Hours
10	C	Credit

Course/ Subject Categories

Sr. No.	Acronym	Definition
1	BSC	Basic Science Course
2	ESC	Engineering Science Course
3	PCC	Professional Core Course
4	OE	Open Elective
5	MDM	Multidisciplinary Minor
6	PEC	Professional Elective Course
7	EEC	Entrepreneurship/Economics/ Management Courses
8	VEC	Value Education Course
9	ELC	Experiential Learning Courses
10	VSEC	Vocational and Skill Enhancement Course
11	AEC	Ability Enhancement Course
12	HSSM	Humanities Social Science and Management

SWVSM'S

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar
An Autonomous Institute

Course/ Subject Categories

Year of Implementation	UG/PG	Subject Category	Branch	Sem	Course Number
23	UG	PCC	ME	5	01

Course Term work and POE Code

Year of Implementation	UG/PG	Subject Category	Branch Code	Sem	Course Number	T- Term work P- POE A- Audit Course
23	UG	PCC	ME	5	01	T / L P / A

SWVSM'S

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar
An Autonomous Institute

(National Education Policy (NEP) 2020 Structure)

Vision

To be a leading Mechanical Engineering department recognized for fostering innovation, academic excellence, and ethical professionalism, contributing significantly to industry advancements and societal welfare.

MISSION STATEMENTS

- M1 Provide a dynamic learning environment that cultivates technical proficiency, critical thinking, and problem-solving skills among students.
- M2 Foster collaboration with industries to ensure curriculum relevance, facilitate internships, and promote entrepreneurial initiatives.
- M3 Promote a culture of research and innovation, encouraging faculty and students to engage in impactful projects addressing contemporary challenges.
- M4 Prioritize inclusivity by providing equal educational opportunities to all students, especially those from rural and underprivileged backgrounds.
- M5 Instill a commitment to lifelong learning, ethical values, and social responsibility, preparing graduates to make meaningful contributions to society and the environment.

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Third Year B. Tech. (Mechanical Engineering)

Semester-V

(National Education Policy (NEP) 2020 Structure)

Credit Scheme

(To be implemented from 2025 - 26)

Sr. No.	Category	Sub Category	Course Code	Name of Course	Teaching Scheme					Examination & Evaluation Scheme			
					L	T	P	C	CH	Component	Marks	Min for Passing	
1	Programme Course	PCC	23UGPCC-ME501	Theory of Machine– II	3	-	–	3	3	ESE	60	24	40
										ISE	40	16	
		PCC	23UGPCC-ME502	Heat and Mass Transfer	3	-	–	3	3	ESE	60	24	40
										ISE	40	16	
		PCC	23UGPCC-ME503	Design of Machine Elements-I	3	-	–	2	3	ESE	60	24	40
										ISE	40	16	
		PEC-1	23UGPEC1-ME504	Professional Elective Course-1 (Specify PEC-1 Basket)	3	-	–	2	3	ESE	60	24	40
										ISE	40	16	
2	Multidisciplinary Courses	MDM-3	23UGMDM3-ME505	Multidisciplinary Minor-3	3	-	2	4	5	ESE	60	24	40
										ISE	40	16	
		OE-2	23UGOE2-ME506	Open Elective (OE) -2 (Specify OE-2 Basket)	3	-	–	3	3	ESE	60	24	40
										ISE	40	16	
3	Programme Course	PCC	23UGPCC-ME501LP	Theory of Machine– II Lab	–	-	2	1	2	ISA	25	10	20
										POE	25	10	
		PCC	23UGPCC-ME502LP	Heat and Mass Transfer Lab	–	-	2	1	2	ISA	25	10	20
										POE	25	10	
		PCC	23UGPCC-ME503L	Design of Machine Elements-I Lab	–	-	2	1	2	ISA	25	10	10
		PCC	23UGPCC-ME507LP	CNC & CMM Lab	–	-	2	1	2	ISA	25	10	30
										POE	50	20	
					18	0	10	21	28	0	800	320	320

Program Electives Courses (PEC) Basket

PEC – 1			
Category	**Sub Category**	**Course Code**	**Name of Course**
Programme Course	PEC-1	23UGPEC1-ME5041	Manufacturing Engineering
		23UGPEC1-ME5042	Computer Integrated Manufacturing
		23UGPEC1-ME5043	Additives Manufacturing

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Third Year B. Tech. (Mechanical Engineering)

Semester-V

(National Education Policy (NEP) 2020 Structure)

Credit Scheme

(To be implemented from 2024 - 25)

Open Electives Basket Offered

Sr. No.	Sem	Category	Course Code	Name of Course	Teaching Scheme					Examination & Evaluation Scheme			
					L	T	P	C	CH	Component	Marks	Min for Passing	
1	V	OE-2	23UGOE2-ME5061	Product design and development	2	–	2	3	4	ESE	60	24	40
										ISE	40	16	
2	V	OE-2	23UGOE2-ME5062	Hybrid and Electric Vehicles	2	–	2	3	4	ESE	60	24	40
										ISE	40	16	
					4	0	4	6	8		200	80	80

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Third Year B. Tech. (Mechanical Engineering)

Semester-VI

(National Education Policy (NEP) 2020 Structure)

Credit Scheme

(To be implemented from 2025 - 26)

Sr. No.	Category	Sub Category	Course Code	Name of Course	Teaching Scheme					Examination & Evaluation Scheme			
					L	T	P	C	CH	Component	Marks	Min for Passing	
1	Programme Course	PCC	23UGPCC-ME601	Metrology and Quality control	3	–	–	2	3	ESE	60	24	40
										ISE	40	16	
			23UGPCC-ME602	Fluid and Turbo Machinery	3	–	–	2	3	ESE	60	24	40
										ISE	40	16	
			23UGPCC-ME603	Design of Machine Elements-II	3	–	–	2	3	ESE	60	24	40
										ISE	40	16	
		PEC-2	23UGPEC2-ME604	Professional Elective Course-2 (Specify PEC-2 Basket)	2	1	–	3	3	ESE	60	24	40
										ISE	40	16	
		PEC-3	23UGPEC3-ME605	Professional Elective Course-3 (Specify PEC-3 Basket)	3	–	–	3	3	ESE	60	24	40
										ISE	40	16	
2	Multidisciplinary Courses	MDM-4	23UGMDM4-ME606L	Multidisciplinary Minor-4	2	–	–	2	2	ISA	50	20	20
3	Skill Courses	VSEC	23UGVSEC-ME607L	Computational Techniques and Programming	2	1	–	2	3	ISA	25	10	10
4	Programme Course	PCC	23UGPCC-ME601LP	Metrology and Quality control Lab	–	–	2	1	2	ISA	25	10	20
										POE	25	10	
			23UGPCC-ME602L	Fluid and Turbo Machinery Lab	–	–	2	1	2	ISA	25	10	10
			23UGPCC-ME603LP	Design of Machine Elements-II Lab	–	–	2	1	2	ISA	25	10	20
										POE	25	10	
			23UGPCC-ME608L	3D Printing Lab	–	–	2	1	2	ISA	50	20	20
		PEC-3	23UGPEC3-ME605LP	Professional Elective Course-3 (Specify PEC-3 Basket)	–	–	2	1	2	ISA	25	10	20
										POE	25	10	
					18	2	10	21	30	0	800	320	320

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Third Year B. Tech. (Mechanical Engineering)

Semester-VI

(National Education Policy (NEP) 2020 Structure)

Credit Scheme

(To be implemented from 2025 - 26)

Program Electives Courses (PEC) Basket

PEC - 2			
Category	**Sub Category**	**Course Code**	**Name of Course**
Programme Course	PEC-2	23UGPEC2-ME6041	Industrial Fluid Power
		23UGPEC2-ME6042	Power and Energy Engineering
		23UGPEC2-ME6043	Production Management

PEC - 3			
Category	**Sub Category**	**Course Code**	**Name of Course**
Programme Course	PEC-3	23UGPEC3-ME6051	Internal Combustion Engine
		23UGPEC3-ME6052	Tribology
		23UGPEC3-ME6053	Piping Design

Exit Option to Qualify B. Tech. Vocational completion of T. Y. B. Tech

Sr. No.	Category	Sub Category	Course Code	Name of Course	Teaching Scheme					Examination & Evaluation Scheme			
					L	T	P			Component	Marks	Min for Passing	
1	Skill Courses	VSEC	23UGVSEC-ME609L	AVEVA E3D Design	2	--	2	3	4	ISA	50	20	20
2	Experiential Learning Courses	ELC	23UGELC-ME610L	Mini Project	1	--	4	3	5	ISA	50	20	20
3		ELC	23UGELC-ME611L	Industrial Internship (2 Weeks)	--	--	6	2	6	ISA	50	20	20
					3	0	12	8	15	0	150	60	60

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Final Year B. Tech. (Mechanical Engineering)

Semester-III to VIII

Multidisciplinary Minor (MDM) Courses

(National Education Policy (NEP) 2020 Structure)

Credit Scheme

(To be implemented from 2024 - 27)

Multidisciplinary Minor (MDM) in Mechanical Engineering

Sr. No.	Sem.	Category	Course Code	Name of Course	Teaching Scheme					Examination & Evaluation Scheme			
					L	T	P	C	CH	Component	Marks	Min for Passing	
1	III	MDM-1	23UGMDM1-ME307L	3D CAD Modelling	2	–	–	2	2	ISA	50	20	20
2	IV	MDM-2	23UGMDM2-ME406L	Materials and Applications	2	–	–	2	2	ISA	50	20	20
3	V	MDM-3	23UGMDM3-ME505	Machining Processes with CNC	3	–	2	4	5	ESE	60	24	40
										ISE	40	16	
4	VI	MDM-4	23UGMDM4-ME606L	GDT Techniques in Engineering	2	–	–	2	2	ISA	50	20	20
5	VII	MDM-5	23UGMDM5-ME706L	Additive Manufacturing (3D Printing)	2	–	–	2	2	ISA	50	20	20
6	VIII	MDM-6	23UGMDM6-ME804L	Automation and Robotics in Manufacturing	2	–	–	2	2	ISA	50	20	20
					13	0	2	14	15		350	140	140

Third Year B. Tech. In Mechanical Engineering

National Education Policy (NEP) 2020 Structure

23UGPCC-ME501 - THEORY OF MACHINE – II

Lectures : 03 Hrs/Week
Credits : 03

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	Understand the basic theory of gears.
2	Analyze the various types of gear trains used for transmission of motion and power
3	Study the gyroscopic effect on different vehicles, aero plane and ship.
4	Study and analyze the problems on balancing of rotary masses.
5	Study the force analysis of simple mechanisms.
6	Study the flywheel.

Course Outcomes:		**Bloom's Taxonomy**
Co's	At the end of successful completion of the course, the student will be able to	
CO1	Understand the basic theory of gears.	Understand Analyze
CO2	Analyze the various types of gear trains used for transmission of Motion and power.	Apply Analyze
CO3	Study the gyroscopic effect on different vehicles, aero plane and ship.	Apply Analyze
CO4	Study the force analysis of simple mechanisms.	Apply Evaluate
CO5	Study and analyze the problems on balancing of masses.	Understand Analyze
CO6	Study design of flywheel.	Apply Analyze

Description		
This course is designed to provide basic knowledge of mechanism which is necessary for machine development and design. This syllabus covers basic elements of mechanism such as gears, balancing etc. to help students to construct machines.		
Prerequisites	**1.**	Knowledge of mathematics
	2.	Knowledge of applied mechanics

Sr. No.	Topic	Hrs.
01	**Toothed Gearing** Geometry of motion, Gear geometry, Types of gear profile- Involute & cycloidal, Theory of Spur gear, Interference in Involute tooth gears and methods for its prevention, Path of contact, Contact ratio.	07
02	**Gear Trains** Types of Gear trains - Simple, Compound, Reverted, epicyclic gear train, Tabular method for finding the speeds of elements in epicyclic gear train, Differential gear box.	06
03	**Gyroscope** Gyroscopic couple, spinning and Precessional Motion, Gyroscopic couple and its effect on i) Aero plane ii) Ship iii) Two –Wheeler.	07
04	**Static and dynamic Force analysis of Mechanisms** Velocity and acceleration of slider crank mechanism by analytical method, Inertia force and torque, D"Alembert"s principle, Dynamically equivalent system, force analysis of reciprocating engine mechanism .	07
05	**Balancing** Static and Dynamic balancing of rotary masses. Number of masses rotating in single plane and different planes.	06
06	**Flywheel** Turning moment diagrams, Fluctuation of energy, Coefficient of fluctuation of speed, Rimmed flywheel.	07

References	
Text Books	
1	Theory of Machines, Rattan S.S. ,Tata McGraw Hill, Publications.
2	Mechanism and Machine Theory, Rao, Dukkipati , New Age International
3	Theory of Machines , J. K. Gupta & R. S. Khurmi , S. Chand Publications

Reference Books	
1	Theory Of Machines And Mechanisms, John J. Uicker, Gordon R. Pennock & Joseph E. Shigley, Oxford University Press, 4th Edition.
2	Theory of Machines, Thomas Beven, Pearson Publisher, 3 rd Edition.
3	Theory of Mechanisms & Machines, Jagdish Lal, Publisher, Metropolitan Book Company.

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	**Name of Faculty** : Dr. N.S.Dharashivkar	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

23UGPCC-ME502– HEAT AND MASS TRANSFER

Lectures : 03 Hrs/Week
Credits : 03

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	Students will learn about basic concept of heat transfer modes, their basic laws, and analysis of heat transfer problems in conduction, convection, radiation and combined modes.
2	Students will also learn general or differential equations for conduction and radiation as well as governing equations of convection so that students can solve real time heat transfer problem.
3	Students will earn about design and analysis of heat exchanger devices by using LMTD and NTU approach.

Course Outcomes:	
Co's	At the end of successful completion of the course, the student will be able to
CO1	Explain the fundamental modes of heat and mass transfer, their governing laws, and the analogy between heat, mass, and momentum transfer.
CO2	Derive and solve the one-dimensional steady-state and unsteady-state heat conduction equations for various geometries (plane wall, cylinder, and sphere) with and without internal heat generation using appropriate analytical methods.
CO3	Estimate rate of heat transfer and other performing parameters under convection and radiation modes.
CO4	Design and analyze heat exchangers using LMTD and NTU methods for parallel and counter flow arrangements, and assess the impact of fouling and other design considerations on performance.
CO5	Identify the impact of boundary conditions on heat transfer and to generate mathematical equations for solutions of problems.
CO6	Solve the combine modes heat transfer problem

Unit No.	Course Contents	Hours
Unit 1	**Introduction to Heat and Mass Transfer:** **Basic concepts:** Modes of heat transfer, Basic laws of heat transfer, Introduction to combined modes of heat transfer, Thermal conductivity and its variation with temperature for various Engg. Materials (Description only), Introduction to mass transfer, Modes of mass transfer, Analogy between heat, mass and momentum transfer, Fick's law of diffusion, Derivation of Generalized differential equation of heat	10

	conduction in Cartesian co-ordinates, its reduction to Fourier, Laplace and Poisson's equations, Generalized Heat conduction equation in cylindrical and spherical coordinates (no derivation). **One dimensional steady state heat conduction without heat generation:** Reduction of Generalized differential equation of Heat Conduction to one dimension (1D), Heat conduction through plane wall; cylinder; sphere, electrical analogy, concept of thermal resistance and conductance, composite slab, composite cylinder, critical radius of insulation for cylinder and sphere.	
Unit 2	**Heat Conduction with Heat Generation and Unsteady State Heat Conduction** **One dimensional steady state heat conduction with heat generation:** One dimensional steady state heat conduction with uniform heat generation for plane wall; cylinder; and sphere (with numerical on plane wall and cylinder only) **One dimensional unsteady state heat conduction:** Lumped Heat capacity Analysis, Biot and Fourier number and their significance, (Numerical based on Lumped Heat capacity Analysis)	**6**
Unit 3	**Extended Surfaces** Types and applications of fins, Heat transfer from rectangular and pin fins. Fin effectiveness and efficiency, Analysis of fin with insulated end and infinite long fin.	**6**
Unit 4	**Convection Heat Transfer** Mechanism of natural and forced convection. Concept of Hydrodynamic and thermal boundary layer, Local and average convective coefficient for laminar and turbulent flow for flat plate and pipe. **Natural convection:** Dimensional analysis, Physical significance of dimensionless numbers, correlations for natural convection over vertical plate, cylinder. **Forced convection:** Dimensional analysis, Physical significance of dimensionless numbers, Correlations for forced convection over flat plate and closed conduits.	**6**
Unit 5	**Radiation** Nature of thermal radiation, absorptivity, reflectivity, transmissivity, emissive power and emissivity, blackbody, gray body, and white body Kirchhoff's law, Wein's law and Planck's law, and deduction of Stefan Boltzmann law. Lambert cosine rule, Intensity of radiation. Energy exchange by radiation between two black surfaces with non-absorbing medium in between and in absence of reradiating surfaces. Shape factor and its characteristics. Energy exchange by radiation between two gray surfaces without absorbing medium, concept of radiosity and irradiation. Radiation shields.	**6**
Unit 6	**Heat Exchangers** Classification and types of heat exchangers, Fouling factor, and Overall heat transfer coefficient, Heat Exchanger analysis using LMTD and NTU methods for parallel and counter flow, Design consideration of Heat exchangers	**6**

References	
Text Books	
1	"Heat and Mass Transfer", R.K.Rajput, S. Chand and Company Ltd., New Delhi., 5th Edition
2	"Heat Transfer", J.P. Holman, Tata McGraw Hill Book Company, New York, 2nd Edition
3	"Fundamentals of Heat and Mass Transfer", R.C. Sachdeva, Willey Eastern Ltd., New York, 2nd Edition
4	"Heat and Mass transfer", M.M.Rathod, Laxmi Publications

Reference Books	
1	"Heat Transfer – A Practical approach",Yunus. A .Cengel, Tata McGraw Hill
2	"Heat Transfer" Chapman A.J., Tata McGraw Hill Book Company, NewYork
3	"Fundamentals of Heat and Mass Transfer", Frank P.Incropera, David P.Dewitt,Wisley India. 5th Edition
4	"A Text Book on Heat Transfer", Dr. S. P. Sukhatme, Orient Longman Publication Hyderabad
5	"Heat and Mass Transfer", S.C.Arora and S. Domkundwar, Dhanpat Rai and Sons, Delhi

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Kamble Gautam S.	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

23UGPCC-ME503 – DESIGN OF MACHINE ELEMENTS –I

Lectures : 03 Hrs/Week
Credits : 02

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	Study basic principles of machine design.
2.	Understand the principles involved in evaluating the dimensions of a mechanical component to satisfy functional and strength requirements
3	Learn use of catalogues and design data book.
4	Develop detail drawings of mechanical components

Course Outcomes:		**Bloom's Taxonomy**
Co's	At the end of successful completion of the course, the student will be able to	
CO1	Identify and apply basic principles of machine design	Knowledge
CO2	Design machine elements on the basis of strength concept	Apply Analyze Evaluate
CO3	Solve the design problems for various machine elements used in industries	Analyze Evaluate
CO4	Prepare assembly and detail drawings for different machine elements.	Knowledge Analyze Create
CO5	Use design data books and standard practices.	Apply
CO6	Select machine elements from Manufacturers catalogue by applying standard design criteria.	Apply

Unit No.	**Course Contents**	**Hours**
Unit 1	**Fundamentals of Machine Design:** Concept of Machine design, Types of loads, Factor of safety- its selection and significance, Theories of failure (Maximum Principle stress, Maximum shear stress and Maximum Distortion Energy), Phases of design of machine elements, Review and selection of various engineering material properties and I.S. coding for ferrous materials, Factors governing selection of Engineering materials.	**5**
Unit 2	**Design of Mechanical Elements:** a) Design of machine elements under static loading- Knuckle joint, Turn buckle and bell crank Lever. (Numerical on Knuckle Joint and Bell crank Lever), b) Forms of threads, Terminology of threads, Trapezoidal and Acme threads, Design of power screw and nuts (Numerical on Power Screw with Square	**8**

	thread).	
Unit 3	**Design of Shaft, Keys, and Couplings:** Design of solid and hollow shafts, ASME code for shaft design, Splined Shaft (Theory), Types and Design of Keys, Types of Couplings, Design of Rigid flange coupling, Bushed pin type flexible coupling.	**7**
Unit 4	**Design of Joints:** Design of bolted joints subjected to following conditions- 1) Joints in shear 2) Joints subjected to load perpendicular to the axis of bolt. Design of welded joints- 1) Strength of transverse and parallel fillet welds 2) Eccentric load in the plane of weld (Theoretical Treatment) 3) Welded joint subjected to bending moment. (Theoretical Treatment)	**9**
Unit 5	**Design of springs:** Types of springs and their applications, Styles of end, Design of Helical Compression Spring subjected to static loading.	**5**
Unit 6	**Design of Pulley and Selection of Belts:** Design of Pulley- flat and V belt pulley, Selection of flat belt, V belt as per the standard manufacturers catalogue	**6**

References	
Text Books	
1	"Design of Machine Elements", V. B. Bhandari., Tata McGraw Hill Publication, 3rd Edition.
2	"A Text Book of Machine Design", R.S. Khurmi and J. K. Gupta.
3	"Machine Design", Pandya Shah, Charotar Publication.
4	"Machine Design", U. C. Jindal, Pearson Education

Reference Books	
1	"Design of Machine Element", J. F. Shigley, Tata McGraw Hill Publication.
2	"Design of Machine Element" M. F. Spotts, Pearson Education Publication, 6th Edition.
3	"Machine Component Design", Robert C. Juvniall, Willey Ltd, 5th Edition
4	PSG Design data Book, PSG College Coimbatore

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : 1.Prof. R.T.Salunkhe, 2.Dr. S.V.Lingraju, 3.Prof. P.N.Deshmukh	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING
TKIET Warananagar

23UGPEC1-ME5041- MANUFACTURING ENGINEERING

Lectures : 03 Hrs/Week
Credits : 02

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	Understand the fundamentals of metal cutting processes, including the mechanics of chip formation, cutting forces, and the influence of cutting parameters such as speed, feed, and depth of cut.
2	Analyze tool geometry and cutting tool materials, including the design and application of single-point and multi-point cutting tools, with an emphasis on improving tool life and surface finish.
3	Evaluate machinability of different materials and identify the factors affecting tool wear, heat generation, and the role of cutting fluids in enhancing machining performance.
4	Apply the principles of jigs and fixtures to design effective work-holding devices for drilling and milling operations, ensuring accuracy, repeatability, and productivity.
5	Understand the design and function of press tools, including die and punch design, strip layout, and calculations related to press operations like blanking and piercing.
6	Gain knowledge of CNC technology and tooling systems, including the construction and operation of CNC machines, automation tools like ATC/APC, and modern advancements in tooling and work holding.

Course Outcomes:

Co's	At the end of successful completion of the course, the student will be able to	**Blooms Taxonomy**
CO1	**Understand** how metal cutting works, including chip formation, types of chips, and the effect of cutting parameters like speed, feed, and depth of cut.	Understand
CO2	**Explain** tool wear mechanisms, calculate tool life using Taylor's equation, and suggest ways to improve surface finish and machining performance.	Apply Analyze
CO3	**Identify** the parts and angles of single-point and multi-point cutting tools and understand how tool geometry influences cutting efficiency.	Remember Understand
CO4	**Design** simple jigs and fixtures for drilling and milling by understanding principles of workpiece location, clamping, and support.	Apply Create
CO5	**Solve** basic problems related to press tool operations such as die and punch design, strip layout, press force, and center of pressure.	Apply
CO6	**Describe** the construction and working of CNC machines, their tooling systems, automatic tool changers, and work-holding methods.	Understand

Description		
This course covers the fundamentals of metal cutting, tool design, and machinability, emphasizing cutting mechanics, tool geometry, and cutting fluids. It also includes the design of jigs, fixtures, and press tools, along with an introduction to CNC machines and modern tooling systems for efficient and precise manufacturing.		
Prerequisites	**1.**	**Engineering Mechanics** – for understanding force, motion, and stress analysis in machining.
	2.	**Materials Science** – to study material behavior relevant to cutting and tool performance.
	3.	**Basic Manufacturing Processes** – to provide foundational knowledge of machining and production techniques.

Unit No.	Course Contents	Hours
Unit 1	**Theory of Metal Cutting** Wedge action in cutting, Cutting parameters: speed, feed, and depth of cut. Orthogonal and oblique cutting, Chip formation, types of chips, cutting ratio. Shear plane, shear angle, (Numerical Treatment on Orthogonal Rake cutting), force measurement using tool dynamometers.	7
Unit 2	**Tool Life and Machinability** Tool materials: properties and types, Advanced cutting tools, Machinability: factors, machinability index, Tool wear: types and mechanisms, Taylor's tool life equation (Numerical Treatment) Surface finish: influencing factors and enhancements, Heat generation in machining: effects and cutting fluid selection.	7
Unit 3	**Tool Geometry** Geometry of single-point cutting tool: angles and nomenclature, Geometry of multi-point tools: drills, milling cutters, reamers, Tool geometry influence on machining performance.	6
Unit 4	**Drilling Jigs and Milling Fixtures** Applications and importance in manufacturing, difference in Drilling Jigs and Milling Fixtures, Elements of jigs and fixtures: locating, clamping, indexing devices, Auxiliary elements: tenons, setting blocks, Fool-proofing devices, and types of bushes used, Types and uses of drilling jigs and milling fixtures,	8
Unit 5	**Press Tools** Introduction, Press terminology, Press operations, types of presses, types of dies, clearances, strip layout, calculation of press capacity, center of pressure, Design consideration for die elements (Theoretical treatment only). Problems on Blanking and Piercing operations	7
Unit 6	**CNC Technology and CNC tooling** Introduction, Construction and working of CNC, DNC and machining center, CNC axes and drives. Automatic Tool Changer (ATC) and Automatic pallet changer (APC), New trends in Tool Materials, Turning tool geometry and Tool inserts (coated and uncoated), Modular tooling system for Turning, Milling, Tools presetting, Work holding	5

References	
Text Books	
1	"Elements of Workshop Technology Vol. II", S. K Hajra Choudhury , Media Promoters and Publishers, Mumbai.
2	"Text Book of Production Engineering", P.C. Sharma, S. Chand Publication, 11th Edition.
3	"Machine Tool Engineering" G.R. Nagarpal, Khanna Publication.
4	"Principles of Modern Manufacturing", Groover, Wiley Publication. 5th Edition.
Reference Books	
1	"Production Technology", HMT –Tata McGraw-Hill Publishing Ltd,. ISBN, 0070964432, 9780070964433., (2001).
2	Metal Cutting Theory and Tool design" Mr. Arshinnov, MIR Publication.
3	"Fundamentals of Tool Design" ASTME,Prentice-Hall of India Private Ltd., New Delhi Publication, (1976).
4	"Tool Design", Donaldson,THM Publication, 3rd Edition
5	"Machine Tool Engineering", G.R. Nagarpal, Khanna Publication.

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Prof. R. G. Kshirsagar	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

23UGPEC1-ME5042- - Computer Integrated Manufacturing

Lectures : 03 Hrs/Week
Credits : 02

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	Understand the basic concepts, scope, benefits, and limitations of Computer Integrated Manufacturing Systems (CIMS).
2	Explore the role of computers in product design, manufacturing planning, and control.
3	Study group technology (GT), computer-aided process planning (CAPP), and production control systems.
4	Analyze flexible manufacturing systems (FMS), transfer lines, and automated assembly lines in the context of CIM.
5	Learn about automation technologies, industrial robots, material handling systems, and storage solutions in modern manufacturing.
6	Understand data acquisition systems, database management, and communication networks supporting CIM environments.

Course Outcomes:

Co's	At the end of successful completion of the course, the student will be able to	**Blooms Taxonomy**
CO1	**Explain** the basic concepts, structure, elements, and phases of Computer Integrated Manufacturing Systems and identify obstacles in their implementation.	Understand
CO2	**Describe** the role of computers in product design, manufacturing planning, and control within CAD, CAM, and concurrent engineering frameworks.	Understand
CO3	**Outline** the principles of group technology (GT), computer-aided process planning (CAPP), and production control methods used in manufacturing.	Remember/understand
CO4	**Identify** the structure and components of flexible manufacturing systems (FMS), transfer lines, and automated assembly lines.	Remember/understand
CO5	**Recognize** various automation technologies such as industrial robots, automated material handling systems, AGVs, and storage systems	Understand
CO6	**Summarize** the methods of data acquisition, database management, and communication systems used to integrate manufacturing processes.	Understand

Description		
Computer-integrated manufacturing (CIM) refers to the use of computer-controlled machineries and automation systems in manufacturing products. CIM combines various technologies like computer-aided design (CAD) and computer-aided manufacturing (CAM) to provide an error-free manufacturing process that reduces manual labor and automates repetitive tasks. The CIM approach increases the speed of the manufacturing process and uses real-time sensors and closed-loop control processes to automate the manufacturing process. It is widely used in the automotive, aviation, space and ship-building industries.		
Prerequisites	**1.**	Basic elements of an automated system
	2.	Material handling and identification technologies
	3.	Manufacturing systems

Unit No.	Course Contents	Hours
Unit 1.	**Basic Concept of CIMS** Scope, islands of automation, architecture of CIM, elements of CIM, benefits, limitations, Types of production ,obstacles in implementation Planning for CIMS, Phases of CIM implementation, Economic and social justification of CIM.	**6**
Unit 2	**Role of Computers in design and manufacturing** Product Design and CAD, application of computers in design, CAM – manufacturing planning and control, scope of CAD / CAM and CIM, Concurrent engineering, Design for manufacturing and assembly ,Case studies on Concurrent engineering, Design for manufacturing and assembly	**7**
Unit 3	**Group Technology, Computer Aided Process Planning and Control & Computer Aided Production planning and Control** Concept, design and manufacturing attributes, part families, composite part, methods of grouping, PFA, classification and coding system- OPITZ, benefits and limitations of GT,Computer Aided Process Planning and Control: retrieval and generative type CAPP, role of CAPP in CIM,Master Production Schedule – Material Requirement planning – Capacity Planning-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II)	**7**
Unit 4	**Flexible Manufacturing Systems, Transfer lines, Assembly Lines in CIMS** Concept of flexible & rigid manufacturing, manufacturing cell and FMS structure, types, components of FMS, Distributed Numerical Control (DNC), Building Blocks of FMS, Flexible Assembly System, Transfer Lines, applications, benefits, Automates assembly lines, Design for assembly.	**7**
Unit 5	**Automation and Material Handling Systems in CIM** Industrial Robots: Types, Joint Configurations,Robot Applications: Loading/Unloading, Automated Material Handling, Automatic Guided Vehicles (AGVs): Types, Guidance Technologies, Management, and Safety, Automated Storage and Retrieval Systems (AS/RS)	**6**
Unit 6	**Data Acquisition, Database Management Systems&Communication in CIMS** Data acquisition system, type of data, automatic data identification methods, bar code technology, machine vision.(b) Data and database management system, types of DBMS models- hierarchical, network and relational models and their applications,requirements of shop floor communication, types and components of communication systems in CIM, Networking concepts, network topology, ISO-OSI reference model for protocols, MAP/TOP, TCP/IP	**7**

References	
Text Books	
1	Automation, Production systems and Computer Integrated Manufacturing, 3/e - M.PGroover (PHI or Pearson Education)
2	Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.
Reference Books	
1	Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India
2	Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.
3	Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Prof.S.M.Gidaveer	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

23UGPEC1-ME5043- ADDITIVE MANUFACTURING

Lectures: 3 hrs / week
Credits: 2

Evaluation Scheme:
ESE: 60 marks
ISE: 40 marks

Course Objectives: The objective of the course is to

1) To develop a design for additive manufacturing skill set for CAD and CAM methodologies to produce successful 3D prints
2) To provide knowledge of additive manufacturing processes, materials, and capabilities, and to understand the software tools and techniques used

Course Outcomes:

Co's	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Understand the basic principles and significance of additive manufacturing and CAD in modern manufacturing.	Understanding
CO2	Understand the entire data preparation process for 3D printing, including the importance of the STL file format, the effects of part orientation and support generation on print quality, and the steps involved in slicing and deposition path generation to ensure successful 3D printing.	Understanding
CO3	Students will be able to select and operate appropriate 3D printing software to configure and manage 3D printers	Apply
CO4	Students will be able to choose and utilize appropriate 3D printing materials for various applications	Apply
CO5	analyze different solid-based 3D printing processes, such as Fused Deposition Modeling (FDM) and Selective Laser Sintering (SLS), to determine their suitability for various applications	Analyse
CO6	analyze different liquid-based 3D printing processes, such as Stereolithography (SLA) and Digital Light Processing (DLP)	Analyse

Description:		
Additive Manufacturing (AM), commonly known as 3D Printing, is a process of creating three-dimensional objects from a digital model by sequentially adding material layer by layer.AM builds up parts directly from raw materials, which can include plastics, metals, ceramics, and composites. This technology enables the production of complex geometries, reduces material waste, and allows for customization and rapid prototyping, making it highly valuable in industries such as aerospace, healthcare, automotive, and consumer goods.		
Prerequisites:	1:	3D CAD Modeling
	2:	Materials and Applications
	3:	GDT Techniques in Engineering

Section - I		
Unit 1	**Additive Manufacturing Introduction and CAD**	
	Introduction, Additive v/s Conventional Manufacturing processes, Overview of Additive Manufacturing Processes, Introduction Solid Modeling, CAD Modeling example using SOLID Works Software, Process Chain for 3D Printing, Reverse Engineering for 3D Printing	**08 Hrs**
Unit 2	**Data Preparation for 3D Printing**	
	STL file format and Associated Operations, Part orientation and Support Generation, Slicing and Deposition Path Generation	**06 Hrs**
Unit 3	**3D Printers and Software**	
	Constructional Details of a 3D Printer, Understanding Accuracy, Precision, and Tolerance in 3D Printing,3D Printer software	**06 Hrs**
Section - II		
Unit 4	**3D Printing Materials**	
	Materials: The building block for 3D printing, Solid-based materials for 3D printing, Powder-based materials for 3D printing, Liquid based materials for 3D printing	**08 Hrs**
Unit 5	**Solid based 3D Printing Processes**	
	Basic principle of Solid based 3D printing processes; Constructional details, Basic Principle and working of fused deposition modeling (FDM) process; Post Processing of FDM and other Solid based 3D Printed components. Troubleshooting Common Issues, Applications of FDM, DED and SL	**06 Hrs**
Unit 6	**Liquid based 3D Printing Processes**	
	Basic principle of Liquid based 3D printing processes; Photo Polymerization-Principle and working of stereo lithography apparatus-SLA based 3D printing processes-Curing processes; Applications; Post Processing	**06 Hrs**

Mapping of POs & COs:

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

Books and References:

1	Gebhardt, A. (2011). *Understanding additive manufacturing: Rapid prototyping, rapid tooling, rapid manufacturing*. Hanser Publishers.
2	Soloman, Sabrie. n.d. *3D Printing and Design*. Delhi: Khanna Publishing House.
3	Chua, C. K., & Leong, K. F. (2017). *3D printing and rapid prototyping: Principles and applications* (4th ed.). World Scientific.
4	Kloski, L. W., & Kloski, N. (2021). *Getting started with 3D printing: A hands-on guide to the hardware, software, and services behind the new manufacturing revolution* (2nd ed.). Make Community, LLC.
5	**Bandyopadhyay, A., & Bose, S. (2015).** *Additive manufacturing* (1st ed.). CRC Press.

Sr. No.	Description	Signature
1	Name of Faculty Dr. M. R. Jadhav	Mrjadhav.
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING
T.K.I.E.T Warananagar

23UGMDM3-ME505 – MACHINING PROCESSES WITH CNC

Lectures : 03 Hrs/Week
Credits : 04
Tutorial : 2 Hrs/Week

Evaluation Scheme-
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	Understand turning and milling operations
2	Introduce basics of CNC lathe
3	Study the Components of CNC Vertical Machining Centre
4	Introduction to tool setting
5	Know selection of tools
6	Train students into Basic CNC Turning Programming

Course Outcomes:	
Co's	At the end of successful completion of the course, the student will be able to
CO1	Demonstration of Lathe machine and Milling Machine.
CO2	Explain applications and advantages of CNC machines and technology.
CO3	Demonstration of CNC and VMC with elements, power drives and spindle drives.
CO4	Prepare programs, demonstrate, simulate and operate CNC lathe machines for various machining operations.
CO5	Prepare programs, demonstrate, simulate and operate CNC milling machines for various machining operations.
CO6	Demonstration of tooling and work holding devices.

Description
Today's manufacturing utilizes innovative technologies, including sophisticated Computer numerical control (CNC), Computer Aided Manufacturing (CAM) software and specialty industry materials to develop and build the products of tomorrow. Students will be walked through all aspects of CNC machining, how to import a CAD model in to CAM software, how to get it ready for machining and how to apply machining techniques to machine that part. At the end students will spend some time on the machine learning how to machine a part on a CNC milling machining center. This last step is critical to put together pieces of the puzzle, so that one can understand the whole process. Students will be applying machining techniques in the virtual world and then apply and see how a virtual object comes in to reality on a CNC machine.

Prerequisites	1.	Workshop Technology
	2.	Manufacturing Processes
	3.	Tool Engineering
	4.	Auto CAD

Unit No.	Course Contents	Hours
Unit 1	**Lathe and Milling Machine Basics:** a) **Lathe:** Introduction, Working principle, types, specifications, principle parts, accessories, attachments, and various lathe operations. b) **Milling Machine:** Types- Horizontal, Vertical milling machines, Milling cutters, construction and working of column and knee type, milling operations, simple and compound indexing.	5
Unit 2	**Introduction to CNC Machine Tools** :Conventional Vs. non-conventional machine tool, History & development of CNC technology, Classification of NC & CNC Machine Tools, CNC Machine Components, Co-ordinate systems, Working Principle of Various CNC Systems, Direct Numerical Control, Adaptive Control, Concept of ATC & APC, Advantages of CNC machine tools, Limitations of CNC , CNC Safety Practices .	7
Unit 3	**Drives and Control:** **Spindle drives** – DC shunt motor, 3 phase AC induction motor, **Feed drives** –Stepper motor, servo principle, DC and AC servomotors, **Control system**- Types of encoders, absolute and incremental optical encoders, synchro, synchro-resolver, gratings, moire fringe gratings, inductosyn, and laser interferometer.	7
Unit 4	**CNC Machining -Lathe:** Basics of CNC Programming, Plan and optimize programs for CNC turning operations, Implementation of 'G' codes & 'M' codes of Turning, Calculate parameters like speed, feed, depth of cut etc. and set a references for the various operations. Prepare operation and operation sequence for the lathe operations like turning, grooving etc. Modern CNC Systems.	7
Unit 5	**CNC Machining -Milling:** Basics of CNC Programming on Milling. Plan and optimize programs for CNC milling operation, Implementation of G codes & M codes of milling	7
Unit 6	**Tooling and Work Holding Devices:** Introduction to cutting tool materials – Carbides, Ceramics, CBN, PCD–inserts classification, qualified, semi qualified and pre-set tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, modular fixtures, economics of CNC, maintenance of CNC machines.	7

Practical

Sr. No.	Topic	Hrs.
1.	CNC Programming and Simulation.	2 Hrs
2.	Demonstration on Setting up of work piece zero position.	2 Hrs
3.	Study and demonstration of drives and controls of CNC.	2 Hrs
4.	A Demonstration on a CNC lathe.	2 Hrs
5.	A Demonstration on a CNC Milling.	2 Hrs
6.	Study and demonstration of tooling and work holding devices in CNC.	2 Hrs

References	
Text Books	
1	Rao, P.N. (2013). Manufacturing Technology: Metal Cutting and Machine Tools (Vol. 2). New Delhi: McGraw Hill Education. ISBN: 978-1259029561.
2	Hajra Choudhury, S.K., & Hajra Choudhury, A.K. (2009). Elements of Workshop Technology: Volume II (Machine Tools). New Delhi: Media Promoters & Publishers Pvt. Ltd. ISBN: 978-8174092328.
3	Pabla, B.S., & Adithan, M. (2008). CNC Machines. New Delhi: New Age International Publishers. ISBN: 978-8122427180.

Reference Books	
1	Ghosh, A., & Mallik, A.K. (2010). Manufacturing Science. New Delhi: East-West Press Pvt. Ltd. ISBN: 978-8185938795.
2	Kundra, T.K., Rao, P.N., & Tewari, N.K. (1987). Numerical Control and Computer-Aided Manufacturing. New Delhi: Tata McGraw-Hill. ISBN: 978-0070087477.

Mapping of POs & COs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	If applicable		
													PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	--	--	1	---	--	--	--	--	--	1	--
CO 2	3	3	2	1	--	--	2	--	--	--	--	--	--	2	--
CO 3	3	2	2	1	--	--	2	--	--	--	--	--	--	3	--
CO 4	2	2	3	1	--	--	2	--	--	--	--	--	--	3	--
CO 5	2	2	2	1	--	--	2	--	--	--	--	--	--	3	--
CO 6	1	3	2	1	--	--	1	--	--	--	--	--	--	2	--

Sr. No.	Description	Signature
1	Name of Faculty : M.V.Jadhav:-	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING
Vidya Vikas Pratishthan's
Kolegaon,
Warananagar,
Tal. Panhala
T.K.I.E.T Warananagar

23UGOE2-ME5061 - Product design and development

Lectures : 03 Hrs/Week
Credits : 03

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	Study the various parameters in product design and development like a) Finding Customer Needs b) Creativity , Innovation , Invention and Patenting c) Doing Market Research in various parameters for product
2	d) Product Specifications criteria e) Product Architecture and Prototyping
3	f) Cost and Value Engineering g) Design for Manufacturing and Assembly h) Standards in Ergonomics and Industrial Safety
4	Practice exposure to Case Studies and CAD Software with a product case.

Course Outcomes:		
Co's	At the end of successful completion of the course, the student will be able to	**Blooms Taxonomy**
CO1	Identify the customer needs for a quality product through market research.	Understand
CO2	Product conceptualization selection and testing.	Create Evaluate
CO3	Elaborate Product Architecture.	Understand
CO4	Explain various principle and technologies used for the preparation of prototype.	Evaluate Analyze
CO5	Design products with improved function ergonomics and aesthetics.	Apply
CO6	Build and implement industry safety parameters in Product Design Development.	Understand Apply

Description		
Product design focuses on the visual and user experience aspects of a product, ensuring it is aesthetically pleasing and meets user needs. Product development, on the other hand, concentrates on the technical aspects of creating and launching a product, including engineering, manufacturing, and testing.		
Prerequisites	**1.**	Machine Design
	2.	Manufacturing Engineering
	3.	Marketing

Unit No.	Course Contents	Hours
Unit 1	**Introduction** Challenges to product development, Identify customer needs, Successful product development, Quality aspect of product design, Market Research, Survey.	6 Hrs
Unit 2	**Product Development Process and Planning** Innovation and Creativity in Product Design, Product Planning Processes, Product specifications: Process of setting specifications, Invention and Introduction to Patenting (Concept Generation–Selection–Testing)	7 Hrs
Unit 3	**Product Architecture** Product Architecture: Implication of architecture, Establishing the architecture, Related system level design issue, Product Data Management, Use of Computerized Data Management and `Process, Industrial Design: Overview.	7 Hrs
Unit 4	**Design for Manufacturing and Assembly** Tolerance, Design of Gauges, Design for Environment, Prototyping, Engineering Materials, Concurrent Engineering, Product Costing, Value Engineering.	7 Hrs
Unit 5	**Aesthetics:** Aesthetic Considerations, Visual Effects of Form and Color in Product Design. Ergonomics: Ergonomics and product design and automated systems, anthropomorphic data and its applications in ergonomic design, Limitations of Anthropomorphic data, General approach to the Man-Machine Relationship Work station Design and environment (working Position and posture). Control and Displays: Configurations and sizes of various controls and displays, Design of controls in automobiles, machine tools etc., Design of Instruments and controls.	8 Hrs
Unit 6	**Industrial Safety:** An approach to Industrial Design, Elements of Design, Structure for Industrial Design in engineering applications in manufacturing systems. Personal protective Equipment and Environment Control, Prevention and specific safety measures for manufacturing and processing industry and Chemical industry.	5 Hrs

References	
Text Books	
1	"Product Design and Development", Karl T. Ulrich, Steven G. Eppinger ; Irwin Tata McGraw Hill, 3rdEdition.
2	"Product Design and Manufacturing", A. C. Chitale and R.C.Gupta, Prentice Hall of India, 3rdEdition.
3	"Product Design", Otto and Wood, Pearson education.
4	"Human Factor Engineering", L P Singh ,Galgotia Publication Pvt.Ltd,1st Edition.

Reference Books	
1	"New Product Development", Tim Jones, Butterworth, Heinemann, Oxford,(1997).
2	"Assembly Automation and Product Design", Geoffrey Boothroyd, Marcel Dekker, CRC Press.
3	"Industrial Product Design", C W Flureshem.
4	"Industrial Design for Engineers", Mayall W.H, London, Hiffee books Ltd.
5	"Introduction to Ergonomics" ,R.C. Bridger, Tata McGraw Hill Publication

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Dr. Amol Subhash Todkar	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING
TK.I.E.T Warananagar

23UGOE2-ME5062- Hybrid and Electric Vehicles

Lectures : 03 Hrs/Week
Credits : 03

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	Understand the fundamentals of hybrid and electric vehicle technologies.
2	Learn about different configurations and components of electric and hybrid vehicles.
3	Study the energy storage systems, energy management system, power electronics and electric motors used in EVs/HEVs.
4	Study different charging technologies and safety aspects of EVs

Course Outcomes:

CO'S	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Understand basic terminologies of Vehicle dynamics and analyze the performance curves for HEVs and EVs	Understand Analyze
CO2	Classify Hybrid and Electric Vehicles.	Understand
CO3	Differentiate between various types of hybrid and electric vehicle architectures.	Understand
CO4	Explain the operation of electric motors, power electronics and energy storage and energy management systems.	Understand
CO5	Evaluate the performance of electric motors and batteries and Select the motors and batteries for EVs.	Evaluate Apply
CO6	Understand charging infrastructure and safety aspects for EVs.	Understand

Description:

This course provides a comprehensive introduction to the principles, design, and operation of Hybrid and Electric Vehicles (HEVs and EVs). It covers fundamental concepts of vehicle dynamics, classification and architecture of hybrid and electric drivetrains, electric motor technologies, power electronics, energy storage systems, and energy management strategies. The course also addresses practical considerations such as motor and battery selection, charging infrastructure, safety standards, and environmental implications. With a focus on both theoretical understanding and real-world applications, this course aims to equip students with the knowledge and analytical skills needed to contribute to the growing field of sustainable transportation.

Prerequisites:
Basic Electrical and Electronics Engineering, Internal Combustion Engines

Unit No.	Course Contents	Hours
Unit 1	Introduction to Hybrid Electric Vehicles: Historical Review Evolution: HEVs and EVs, History of EVs in India, Hybrid Electric Vehicles, Introduction and Basic Terminologies related to vehicle dynamics, Indian and Foreign Driving Cycles, Regenerative braking, Classification of Hybrid Vehicles and EVs, EVs- Need, Advantages, Disadvantages, Benefits of HEVs and EVs over conventional vehicles.	06
Unit 2	Vehicle Architecture: Introduction, Classification of Vehicle Architecture, Energy consumption of conventional I.C.Engines, Major components of EVs, Architecture of EVs- Pure EVs powertrain, Concept of Hybrid Electric Vehicle, HEV powertrain architecture, Power flow in Hybrid EVs	05
Unit 3	Electric Propulsion System: Introduction, Selection of EPS, key components during selection of EPS, Characteristic curves and Modes of operation for Electrical machines, Electrical machines for EV drives- Classification, DC Electric motor, AC motor, Synchronous motor, Switched reluctance motor, Electrical machines challenges in EVs, BLDC motor drives, Sizing of DC motor, Sizing of AC motor.	09
Unit 4	Energy Storage and Energy Management System: Introduction of Energy storage and energy generation devices, Performance requirement of battery, Main selection parameter of battery, Common type of batteries: Lead Acid, Nickel Cadmium, Nickel Metal Hydride, Lithium Ion, Battery comparisons, Energy Management Systems: Need, Key functions, Components, Classification, State of Charge energy management, Optimal energy management, Battery Thermal Management System: Air based, Liquid based.	09
Unit 5	Power Electronics: Fundamentals of Electronics-Semiconductors, Transistors, Integrated Circuits, Microcomputer, Introduction of power electronic systems, relation of power electronics with other disciplines, power semiconductor devices, application of power electronics, Concept of power electronics in terms of EVs, Advantages and Disadvantages of power electronics Converters, Electric Vehicle Controller: Uncontrolled and Controlled Rectifier (AC-DC Converter), DC-AC Converter or Inverter, DC- DC Converter.	08
Unit 6	Charging Technologies and Safety aspects for EVs: Introduction, Charger classification and Standards, Swap station, Vehicle to Grid Interface/Infrastructure, Designing a converter for EVs charging station, High Voltage components in EVs, Failure and Hazards in EVs.	03

References	
Text Books	
1	*A.K.Babu*, Electric and Hybrid Vehicles, 2nd Edition, Khanna Publishing House
2	*K.C.Jain, Amit R.Patil, Arvind J.Bhosale, S.S.Raghuvanshi*, Fundamentals of Hybrid and Electric Vehicles, Khanna Publishers
3	*Meenu Gibi*, EE469 Electric & Hybrid Vehicles, Digital notes
4	*Dr. N.Kamalamoorthy*, Digital Notes for Electrical Hybrid Vehicles (R17A0231)
Reference Books	
1	*Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi*, Modern Electric Hybrid Electric & Fuel Cell Vehicles, CRC Press, 3rd Edition, e-library
2	*Iqbal Husain*, Electric and Hybrid Vehicles: Design Fundamental. CRC Press, 3rd Edition, e-library
3	*James Larmine and John Lowry*, Electrical Vehicle Technology Explained, John Wiely and Sons Ltd., 2nd Edition WSE 2015.

Mapping of POs & COs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	2	2	2	2	-	-	-	-	-	-	2	-	2	-
CO2	2	1	-	-	1	-	-	-	-	-	-	2	-	2	-
CO3	2	2	2	-	2	-	-	-	-	-	-	2	-	3	-
CO4	3	2	2	2	3	-	-	-	-	-	-	2	-	3	-
CO5	3	3	3	2	3	-	-	-	-	-	-	2	-	3	-
CO6	2	-	-	-	2	2	2	2	-	-	-	2	-	3	-

Sr. No.	Description	Signature
1	**Name of Faculty :** Prof. Milind R.Todkar	
2	**Syllabus Structure and Content of Course Verified**	
3	**Approval of Board of Studies Chairman**	

DEPARTMENT OF MECH. ENGINEERING
T.K.I.E.T Warananagar

23UGPCC-ME501LP - THEORY OF MACHINE LAB– II

Practicals : 02 Hrs/Week
Credits : 01

Evaluation Scheme
ISA : 25 Marks
POE : 25 Marks

Course Objectives: The objective of the course is to	
1	Learn about various elements used in mechanism such as gears, gyroscope etc.
2	Identify and make different types of gear trains required in machines.
3	Recommend particular mechanism as per the specified applications.
4	Study the balancing of rotating masses

Course Outcomes:		**Bloom's Taxonomy**
Co's	At the end of successful completion of the course, the student will be able to	
CO1	Understand classification, construction, working of different types of gears and gear trains used in machines.	Create
CO2	Identify the effect of gyroscopic couple in machines.	Understand
CO3	Know the Problems of balancing in rotary machines and provide the appropriate solution for the same.	Apply
CO4	Estimate and determine forces in simple mechanism.	Analyze Evaluate

Description		
The Theory of machine laboratory consists of a number of models of gears, gears trains, and various mechanisms and experimental set up. Students will be able to enhance their basic and fundamental knowledge of Theory of machine by effective use of these experimental set up and models.		
Prerequisites	**1.**	Applied Mechanics
	2.	Applied Mathematics

Practical : Any 06

Sr. No.	Practical Topic	Hrs.
01	Generation of involute profile using rack cutter method .	01
02	Experiment on Gyroscope.	01
03	Numerical on epicyclic gear train.	01
04	Determination of M.I. using bifilar suspension system.	01
05	Determination of M.I. using Trifilar Suspension system.	01
06	Balancing of rotary masses .	01
07	Problems on balancing of reciprocating masses. (Minimum 3)	01

References	
Text Books	
1	Theory of Machines, Rattan S.S. ,Tata McGraw Hill, Publications.
2	Mechanism and Machine Theory, Rao, Dukkipati , New Age International
3	Theory of Machines , J. K. Gupta & R. S. Khurmi , S. Chand Publications

Reference Books	
1	Theory Of Machines And Mechanisms, John J. Uicker, Gordon R. Pennock & Joseph E. Shigley, Oxford University Press, 4th Edition.
2	Theory of Machines, Thomas Beven, Pearson Publisher, 3 rd Edition.
3	Theory of Mechanisms & Machines, Jagdish Lal, Publisher, Metropolitan Book Company.

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Dr. N.S. Dharashivkar	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING

23UGPCC- ME502LP – HEAT AND MASS TRANSFER LAB

Practicals : 02 Hrs/Week
Credits : 01

Evaluation Scheme
ISA : 25 Marks
POE : 25 Marks

Course Objectives: The objective of the course is to	
1	Students will study the experiments to determine the thermal conductivity of metal and insulating materials
2	Students will experimentally calculate heat transfer performance parameters for natural convection, forced convection and radiation modes
3	Students will calculate the emissivity of surface which is required for radiation heat transfer analysis

Course Outcomes:

Co's	At the end of successful completion of the course, the student will be able to	**Blooms Taxonomy**
CO1	Apply heat transfer principles to determine the thermal conductivity of metal and insulating materials	Apply Analyze
CO2	Calculate heat transfer coefficient for natural and forced convection by performing experiments.	Apply Analyze
CO3	Estimate emissivity of given surface and Stefan Boltzmann constant in radiation mode.	Apply Analyze
CO4	Demonstrate and analysis the performance heat exchangers	Apply Analyze

Experiment No.	**Course Contents**	**Hours**
1	Determination of thermal conductivity of insulating powder	2
2	Determination of thermal conductivity of a Metal rod	2
3	Determination of thermal conductivity of insulating material in Lagged pipe	2
4	Determination of local and average heat transfer coefficient in Natural convection heat transfer from a vertical cylinder	2
5	Determination of Heat Transfer Coefficient under forced convection to air through pipe.	2
6	Determination of emissivity of a Nonblack surface.	2
7	Determination of Stefan Boltzmann Constant.	2
8	Determination of overall heat transfer coefficient and effectiveness for a Parallel Flow and Counter Flow Heat Exchanger	2

References	
Text Books	
1	"Heat and Mass Transfer", R.K.Rajput, S. Chand and Company Ltd., New Delhi., 5th Edition
2	"Heat Transfer", J.P. Holman, Tata McGraw Hill Book Company, New York, 2nd Edition
3	"Fundamentals of Heat and Mass Transfer", R.C. Sachdeva, Willey Eastern Ltd., New York, 2nd Edition
4	"Heat and Mass transfer", M.M.Rathod, Laxmi Publications

Reference Books	
1	"Heat Transfer – A Practical approach" ,Yunus. A .Cengel, Tata McGraw Hill
2	"Heat Transfer" Chapman A.J., Tata McGraw Hill Book Company, NewYork
3	"Fundamentals of Heat and Mass Transfer", Frank P.Incropera, David P.Dewitt,Wisley India. 5th Edition
4	"A Text Book on Heat Transfer", Dr. S. P. Sukhatme, Orient Longman Publication Hyderabad
5	"Heat and Mass Transfer", S.C.Arora and S. Domkundwar, Dhanpat Rai and Sons, Delhi

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Kamble Gautam S.	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

23UGPCC-ME503L – DESIGN OF MACHINE ELEMENTS– I LAB

Practicals : 02 Hrs/Week
Credits : 01

Evaluation Scheme
ISA : 25 Marks
POE : NA

Course Objectives: The objective of the course is to	
1	Study basic principles of machine design.
2	Understand the methods involved in evaluating the dimensions of a component to satisfy functional and strength requirements.
3	Learn use of catalogues and design data book to extract required design information
4	Develop detail drawings of mechanical components

Course Outcomes:		**Bloom's Taxonomy**
Co's	At the end of successful completion of the course, the student will be able to	
CO 1	Identify and apply basic principles of machine design.	Knowledge
CO 2	Design machine elements on the basis of strength concept.	Apply Analyze Evaluate
CO 3	Formulate and solve the problems of various machine elements used in industries.	Analyze Evaluate
CO 4	Prepare assembly and detail drawings for different machine elements	Knowledge Analyze Create

Description

The main task of mechanical engineer is to design the mechanical elements as per the requirement to accomplish the objective of task. It is done by the study of this course. It covers principles, theory, and mathematical expressions regarding the design process. By applying the basic principles of machine design students should be able to design the Machine Elements like Knuckle Joint, Turn Buckle, lever, Shaft, Couplings, Welded & Bolted joints, Springs and Belts.

Prerequisites	**1.**	Applied Mechanics
	2.	Analysis of Mechanical Elements
	3.	Theory of Machines –I

Practicals

Sr. No.	Practical Topic	Hrs.
1	Assignments on selection of materials for various components showing their IS codes, composition and properties	2
2	Design and Drawing of Knuckle joint.	2
3	Design and Drawing of flexible bushed pin type flanged coupling.	2
4	Assignments on Problems on Bolted Joint.	2
5	Assignments on Problems on Design of helical compression spring subjected to static load.	2
6	Assignments on Problems on Selection of Belts as per the manufacturer's catalogue	2

References	
Text Books	
1	"Design of Machine Elements", V.B.Bhandari., Tata McGraw Hill Publication, 3rd Edition
2	"A Text Book of Machine Design", R.S. Khurmi and J.K.Gupta.
3	"Machine Design", Pandya Shah, Charotar Publication.
4	"Machine Design", U.C.Jindal, Pearson Education.

Reference Books	
1	"Design of Machine Element", J.F. Shigley, Tata McGraw Hill Publication.
2	"Design of Machine Element" M.F.Spotts, Pearson Education Publication, 6th Edition.
3	"Machine Component Design",Robert C. Juvniall, Willey Ltd, 5th Edition.

Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO1 0	PO1 1	PO1 2	If applicable		
													PSO 1	PSO2	PSO 3
CO 1	3	2	2	2	--	--	--	---	--	1	--	--	2	--	--
CO 2	2	2	2	2	--	--	--	--	--	1	--	--	2	--	--
CO 3	2	2	3	2	--	--	--	--	--	1	--	--	2	--	--
CO 4	2	2	2	2	--	--	--	--	--	1	--	--	2	--	--

Sr. No.	Description	Signature
1	Name of Faculty : 1. Prof. R.T.Salunkhe, 2.Dr. S.V.Lingraju, 3.Prof. P.N.Deshmukh	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING
TK.I.E.T Warananagar

23UGPCC-ME507LP-CNC & CMM Lab.

Practicals : 02 Hrs/Week
Credits : 01

Evaluation Scheme
ISA : 25 Marks
POE :50 Marks

Course Objectives: The objective of the course is to	
1	Understand different parts of a CNC machine.
2	Write a CNC part program for turning and milling operation.
3	Study the use of coordinate measuring machine and its application.
4	Study the use of various measurement features of the component.

Course Outcomes:		
Co's	At the end of successful completion of the course, the student will be able to	**Blooms Taxonomy**
CO1	Translate the part program into actual working on CNC Lathe machine.	Understand Knowedge
CO2	Write a CNC part program for turning and milling operation.	Understand Apply
CO3	Understand the various components and probing systems of a CMM.	Understand Apply
CO4	Use theCMM to measure a wide variety of dimensional and geometrical features of a component.	Analysis Evaluate

Description		
The CNC and CMM Lab provides hands-on training in modern manufacturing and precision measurement. The **CNC section** focuses on programming and operating CNC milling and turning machines for accurate part production. The **CMM section** teaches the use of coordinate measuring machines for inspecting component dimensions and tolerances. This lab helps students understand both fabrication and quality control processes essential in advanced engineering and industry.		
Prerequisites	**1**	Machine Drawing and Geometric Modeling Lab
	2	Machining Processes

Practicals

Sr. No.	PracticalTopic	Hrs.	Bloom's Taxonomy
Part A: Experiments			
1	Introduction to CNC Machine and Part programming	02	Knowledge Understand
2.	Writing and execution of part programs for CNC Lathe Machine	02	Understand Apply
3	Writing and execution of part programs for CNC Milling Machine	02	Understand Apply
4	Study of CMM,its construction and probing system.	02	Understand Apply
5	Measurement of linear dimensions (length, diameter) and geometric features of components (parallelism, roundness and concentricity) using CMM	02	Apply Analyze
6	Measurement of angular dimensions,centre distance and PCD using CMM.	02	Apply Analyze
7	A case study on measurement of an industrial component using CMM.	02	Understand Apply

References

Text Books

1	Gupta, K.K., & Ghosh, A. (2017). Manufacturing Technology: CNC and Robotics. New Delhi: Narosa Publishing House. ISBN: 978-8184871925.
2	Pabla, B.S., & Adithan, M. (2008). CNC Machines. New Delhi: New Age International Publishers. ISBN: 978-8122427180.
3	"Engineering Metrology", I.C. Gupta, Dhanpat Rai Publications.
4	Hocken R.J., Pereira P.H., Coordinate Measuring Machines and Systems

Reference Books

1	Rao, P. Nageswara. (2015). CNC Technology and Programming. New Delhi: McGraw Hill Education. ISBN: 978-8123926033.
2	Singh, R. (2009). Computer Numerical Control: Machines and Computer AidedManufacture. New Delhi: Narosa Publishing House. ISBN: 978-8184870713.
3	Sladek J.A., Coordinate Metrology, 2016, Springer Verlag

Mapping of POs & COs

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

Video Lectures / Practicals:

1. https://nptel.ac.in/courses/112106179
2. https://archive.nptel.ac.in/courses/112/105/112105211/

Sr. No.	Description	Signature
1	Name of Faculty :Prof.M.V.Jadhav / Prof.A.R.Shinge:	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING ★ T.K.I.E.T Warananagar

Member Secretary
Board of Studies

Chairman
Board of Studies

Academic Dean
T.K.I.E.T., Warananagar

Principal
T.K.I.E.T., Warananagar

Chairman
Board of Studies
MECHANICAL ENGG. DEPT.
Institute of Engg.
Technology (Autonomous)
Warananagar, Dist. Kolhapur

23UGPCC-ME601–Metrology and Quality Control

Lectures : 03 Hrs/Week
Credits : 02

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	Understand the use of standards in measurement, gauges and tolerances.
2	Study the use of various comparators and angle measuring instruments.
3	Study the advanced methods in metrology and measurement of surface roughness.
4	Study the methods used for the measurement of screw threads and gears.
5	Study the concept of quality control and quality assurance and QC tools.
6	Understand the various SQC techniques.

Course Outcomes:		**Bloom's Taxonomy**
Co's	At the end of successful completion of the course, the student will be able to	
CO1	Identify the use of linear measuring instruments and select appropriate instrument for particular feature measurement.	Knowledge Evaluate
CO2	Understand the principles, construction, working and use of comparators and angle measuring instruments.	Understand Apply
CO3	Learn surface roughnessand advanced techniques of metrology in various industrial applications.	Understand Evaluate
CO4	Apply the methods of measurement of screw threads and gears.	Understand Apply
CO5	Distinguish and understand the quality control and different QC tools.	Understand Apply
CO6	Interpret various control charts and their applications in process control.	Analysis Evaluate

Description

The Metrology and Quality Control subject consists of a number of measuring instruments, gauges and their use to check the dimensional features and physical dimensions of various components. Students are able to enhance their basic and fundamental knowledge of machine drawing to study the dimensional features and physical dimensions of the components and by selecting the appropriate measuring instrument they should able to check these dimensional features and physical dimensions of the various components used in the industry.

Prerequisites	**1**	Computer Aided Engineering Drawing
	2	Machine Drawing & Geometric Modeling

Unit No.	Course Contents	Hours
Unit 1	**Linear measurement and Limits fits and tolerances:** Need of measurement, line and end measurement, types and sources of errors in measurement, slip gauges, Maximum metal limit and least metal limit, Unilateral and bilateral tolerances, Types of Fits, Gauges and their classification, Taylor's principle of gauge design, Numerical treatment on design of gauges.	8
Unit 2	**Comparators and Angle Measurement:** Classification of comparators and their uses, advantages and disadvantages of various types of comparators. Mechanical comparator (Dial indicator, Sigma and Johansson Mikrokator. Pneumatic comparator (Solex and Differential), Use of Bevel protractor, spirit level, clinometers, angle gauges, sine bar, sine center, angle dekkor and auto collimator for angle measurement.	6
Unit 3	**Surface roughness and advancements in Metrology:** Surface roughness terminology, Direction of lay, textures, symbols, Numerical assessment of surface roughness, Instruments used in surface roughness assessment (Tomlinson and Talysurf surface testers), Indication of surface roughness symbol on drawing. Introduction & application of Coordinate Measuring Machine, introduction and use of machine vision system. Applications of machine vision systems for the measurement of surface roughness, tool wear, lengths and diameters.	6
Unit 4	**Metrology of Screw Threads and Gears:** Different errors in screw threads, Measurement of forms of thread with profile projector, Pitch measurement, Measurement of thread diameters with standard wire, screw thread micrometer. Classification of measurement for spur gears Tooth thickness measurement, Run out checking, Pitch measurement, Profile checking, Backlash checking, Contact area testing.	7
Unit 5	**Quality Control:** Concept of Quality, Quality control and quality assurance, Specification of quality, Factors controlling quality of design and conformance, Cost of quality, Balance between cost and quality and value of quality, Seven QC tools. Introduction to in process quality, quality circles, quality management.	6
Unit 6	**Statistical Quality Control and Acceptance Sampling:** Statistical quality control - Basic statistics, Mean, Mode, Median, Standard deviation, Frequency distribution, Control chart for variables and attributes, Different types of control chartsX Bar, R, P and C charts (Numerical treatment), Process capability. Acceptance sampling - Sampling inspection, Operational characteristics curve, Consumer's risk, Producer's risk, AQL, LTPD, AOQL.	7

References	
Text Books	
1	"Engineering Metrology", I.C. Gupta, Dhanpat Rai Publications.
2	"Engineering Metrology", R. K. Jain, Khanna Publisher.
3	"Engineering Metrology", M. Mahajan, Dhanpat Rai and Sons.
4	"Understanding and Applying Machine Vision" - Nello Zuech,Marcel Dekker.

Reference Books	
1	"Practical Engineering Metrology", Sharp K.W.B. Pitman, London.
2	"Metrology and Measurements", A. K. Bewoor, Tata McGraw Hill Publication
3	"Statistical Quality Control", A.L. Grant, Tata McGraw Hill International, New York. 6th Edition.

Web Links/ Video Lectures

1. https://nptel.ac.in/courses/112106179
2. https://nptel.ac.in/courses/112107259

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : A R Shinge	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING

23UGPCC-ME602 Fluid and Turbo Machinery

Lectures : 03 Hrs/Week
Credits : 02

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	Make students understand the construction, working principles, performance evaluation of water turbines & centrifugal pump.
2	Discuss theory of various types of compressors, its applications and performance evaluation
3	Impart the information and explain the construction and working of gas turbine using thermodynamic cycle.

Course Outcomes:		
Co's	At the end of successful completion of the course, the student will be able to	**Bloom's Levels**
CO1	Define basic terminologies and state the applications of pumps, compressors, water turbines, and gas turbines.	Remember
CO2	Explain the construction, working principles, and classifications of water turbines and pumps.	Understand
CO3	Apply standard equations to calculate work, power, and efficiency of impulse and reaction water turbines.	Apply
CO4	Explain the construction, working principles, and classifications of air compressors and gas turbines.	Understand
CO5	Apply standard equations to calculate work, power, and efficiency of air compressors and gas turbines.	Apply
CO6	Compare various turbomachines based on their principles, construction, and performance characteristics.	Analyze

Description		
This course provides a comprehensive understanding of hydraulic machines and air compressors, emphasizing their principles, design, performance, and applications. Students will explore the working and construction of various water turbines and pumps, as well as air compression systems. Key topics include Euler's equation, velocity triangles, efficiency calculations, and governing mechanisms.		
Prerequisites	**1.**	Basic Mechanical Engineering
	2.	Basic knowledge of fluid mechanics
	3.	Thermodynamic laws & processes

Unit No.	Course Contents	Hours
Unit 1	**Impulse Water Turbines** Euler's equation for work done in rotodynamic machine, definition of hydraulic turbine, classification of water turbines, Impulse turbine: Pelton wheel turbine - construction and working of Pelton wheel turbine , application of impulse water turbine, velocity triangles, calculations of work done, different efficiencies, power, discharge etc., Pelton wheel design, Governing of Pelton wheel.	6
Unit 2	**Reaction Water Turbines** Reaction turbine: Construction and working of Francis and Kaplan turbine, application of reaction water turbine, comparison between impulse and reaction water turbine, velocity triangles, degree of reaction, calculation of work done, various efficiencies, power, discharge, etc. Introduction of draft tube, cavitation in reaction turbine.	7
Unit 3	**Centrifugal Pump** Classification of pumps, principle, construction and working of centrifugal pump, applications, different heads & efficiencies, velocity triangles, calculations of work done, power, efficiencies etc. Minimum starting speed, multistaging of centrifugal pump, priming of pump, NPSH(Net Positive Suction Head), cavitation of centrifugal pump	7
Unit 4	**Reciprocating Air Compressor** Compressor definition, applications of air compressors, classification of compressors, air compressor terminology, construction and working, calculation of work done, power and different efficiencies, etc. for polytropic, isothermal & isentropic compression for single stage reciprocating air compressor. Effect of clearance volume and expression for volumetric efficiency, Introduction of multistage compressor.	7
Unit 5	**Rotary Air Compressor** Construction and working of centrifugal compressor, velocity triangle, calculations of work done, power etc. Difference between centrifugal and axial flow compressor, difference between reciprocating and rotary compressor. Introduction of roots blower, vane blower and axial flow compressor.	7
Unit 6	**Gas turbines** Classification of gas turbine, applications, Standard Brayton's cycle, actual Brayton's cycle, calculation of work done, power & thermal efficiency etc. Construction and working of gas turbine with reheating, regeneration and inter cooling, Introduction of jet engine.	6

References

Text Books

1. A text book of Fluid Mechanics and Hydraulic Machines by R. K. Bansal, Laxmi Publicaton
2. A text book of Thermal Engineering by R.S. Khurmi, S Chands Publicatuon
3. Hydraulics and Fluid Mechanics including Hydraulic Machine by Dr. P. N. Modi and Dr. S. M. Seth, Standard Book House .
4. Fluid mechanics and Hydraulic Machinery by R.K. Rajput, Laxmi Publicaton

Reference Books	
1	Turbomachines by S.M.Yahya
2	Steam and Gas Turbines by R. Yadav
3	Thermodynamics – An Engineering Approach by Cengel & Boles

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Patil S.S.	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

23UGPCC-ME603–DESIGN OF MACHINE ELEMENTS- II

Lectures : 03 Hrs/Week
Credits : 02

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to .	
1	Apply Advanced Design Principles
2	Analyze and Design Mechanical Elements
3	Use Design Standards and Codes
4	Integrate Design for Real-world Applications

Course Outcomes:

Co's	At the end of successful completion of the course, the student will be able to	**Bloom's Taxonomy**
CO1	Identify the stresses in machine components due to various types of fluctuating loads and failure of components according to theories of failures.	Understand Apply
CO2	Develop capability to analyze rolling contact bearing and its selection from manufacturer's catalogue	Analyze Evaluate
CO3	Achieve an expertise in design of sliding contact bearing in industrial applications.	Apply Evaluate
CO4	Apply principles of spur gear design during design of gear boxes	Apply Evaluate
CO5	Evaluate and design helical and bevel gear systems for application	Apply Evaluate Create
CO6	Design worm gear for various industrial applications.	Create

Description

Design of Machine Elements –II course is offered as professional course. This course has six units namely, Design for Fluctuating Loads, Design of Rolling Contact Bearings, Design of Sliding Contact Bearings, Design of Spur Gear, Design of Helical and Bevel Gears and Design of Worm Gears.

Prerequisites	**1.**	Applied Mechanics
	2.	Analysis of Mechanical Elements
	3.	Design of Machine Elements –I

Unit No.	Course Contents	Hours
Unit 1	**Design For Fluctuating Loads:** Stress concentration - causes and remedies, Fluctuating stresses, S-N. diagram under fatigue load, Endurance limit, Notch sensitivity, Endurance strength modifying factors, Design for finite and infinite life under reversed stresses, Cumulative damage in fatigue failure, Goodman diagram, Modified Goodman diagram, Fatigue design for components under combined stress.	7
Unit 2	**Rolling Contact Bearings:** Types, Static and dynamic load capacities, Stribeck's equation (No Derivation), Equivalent bearing load, Load-life relationship, Bearing life, Load factor, Selection of bearing from manufactures catalogue, Ball and Roller bearing, Design for variable load and speed, Bearings with probability of survival other than 90 %. Lubrication and mountings, Dismounting and preloading of bearings, Oil seal and packing.	6
Unit 3	**Design of Sliding Contact Bearings :** Introduction to Tribological consideration in design Friction, Wear, Lubrication., Sliding Contact Bearing: Bearing material and their properties: Sintered bearing materials, bearing types and their construction details., Hydro-Dynamic Lubrication: Basic theory, Thick and thin film lubrication, Somerfield Number, Design consideration in hydrodynamic bearings, Raimondi and Boyd method relating bearing variables, Heat balance in journal bearings, Temperature rise.	7
Unit 4	Design of Spur Gear: Introduction to Gears: Gear terminology, Material selection, Types of gear failure. Spur Gear: Tooth loads, No. of teeth, Face width, Strength of gear teeth, Static beam strength (Lewis equation) Barth equation, Dynamic tooth load (spot's equation and Buckingham equation), Wear strength (Buckingham's Equation), Estimation of module based on beam strength and wear strength. Gear design for maximum power transmission capacity, Methods of gear lubrication	7
Unit 5	**Design of Helical and Bevel Gears :** Helical Gears: Formative number of teeth in helical gears, Force analysis, Beam and wear strength of helical gears, Effective load and design of helical gear. Bevel Gear: Straight tooth bevel gear terminology and geometrical relations, Guidelines for selection of dimensions and minimum number of teeth, Force analysis, Mounting of bevel gear and bearing reactions, Beam and wear strength, Dynamic tooth load, Design of straight tooth bevel gears based on beam and wear strength.	7
Unit 6	**Design of Worm Gears:** Terminology and geometrical relations. Standard dimensions and recommendation of worm gearing, Force analysis, Friction, Efficiency of worm gear drive, Design of worm drive as per IS 7443-1974 based on beam strength and wear strength rating, Thermal consideration in worm drive.	6

References	
Text Books	
1	"Design of Machine Elements", V. B. Bhandari., Tata McGraw Hill Publication, 4th Edition
2	"Machine Design", R. K. Jain, Khanna Publication
3	"Machine Design A Basic Approach", Dr. S. S. Wadhwa, S S Jolly, DhanapatRai and Sons.
4	"A Text Book of Machine Design", R. S. Khurmi and J. K. Gupta.
Reference Books	
1	"Design of Machine Element", J. F. Shigley, Tata McGraw Hill Publication.
2	"Design of Machine Element" M. F. Spotts, Pearson Education Publication, 6th Edition
3	"Machine Component Design", Robert C. Juvniall, Willey Ltd, 5th Edition.
4	"Design Data: Data Book of Engineers by PSG College"-KalaikathirAchchagam - Coimbatore
5	SKF Bearings Catalogue

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Dr. Lingaraju. S.V.	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECHANICAL ENGINEERING

23UGPEC2-ME6041- Industrial Fluid Power

Practicals : 02 Hrs/Week
Credits : 03

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	To impart knowledge about the fundamentals of Hydraulic and pneumatic system.
2	To prepare the students to study different pumps and compressors in hydraulic and pneumatic system.
3	To educate the students about hydraulic fluids and characteristics of fluids.
4	To impart knowledge about various control valves and its functions.

Course Outcomes:		**Blooms Taxonomy**
Co's	At the end of successful completion of the course, the student will be able to	Apply Analyze
CO1	Do analysis of performance of Hydraulic and pneumatic system.	Understand Apply
CO2	Demonstrate Hydraulic and pneumatic system.	Apply
CO3	Apply Hydraulic and pneumatic system fundamentals to industrial applications.	Knowledge
CO4	Demonstrate about the fundamentals of Hydraulic and pneumatic circuits	Application
CO5	Relate different types of valves with actuators.	Analysis
CO6	Select different types of motors and pumps for different applications.	Apply Analyze

Description

Industrial Fluid Power is offered as the program elective course. This course contains basic principles and applications in Hydraulics and Pneumatics in Mechanical Engineering. In this course students will learn about fundamentals, properties, principles and applications of different hydraulic components. Students will get knowledge of designing different hydraulic circuits used in industrial applications. This course has six units namely i) Introduction to Fluid Power ii) Hydraulic System Elements iii) Control of Fluid Power Elements iv) Elements of Pneumatic System v) Hydraulic Circuits and its Application vi) Pneumatic Circuits and its Application

Prerequisites	**1.**	Engineering Physics
	2.	Basic Mechanical Engineering
	3.	Fluid Mechanics

Unit No.	Course Contents	Hours
Unit 1	**Introduction to Fluid Power** a) Classification, general features, applications in various fields of engineering, various hydraulic and pneumatic ISO/JIC Symbols, transmission of power at static and dynamic states, advantages and disadvantages b) Principle of hydraulic system, Types of hydraulic fluids and their properties, selection of fluid, effect of temperature on fluids c) Introduction and Application of pneumatics, Physical properties, Principles, basic requirements of pneumatic system, comparison with hydraulic system	08
Unit 2	**Hydraulic System Elements** a) Classification, types of seals, sealing material, pipes, hoses, compatibility of seal with fluid, sources of contamination and its control, strainer, filter, heat-exchanger, reservoir. b) Pumps-types, selection of pumps from Gear, vane, piston, screw, ball pump etc. for various applications. c) Actuators-linear and rotary, hydraulic motors, types of hydraulic cylinders and their mountings. d) Accumulators, intensifier and their applications.	08
Unit 3	**Control of Fluid Power Elements** a) Requirements of Pressure control, direction control and flow control valves. b) Principle of pressure control valves directly operated and pilot operated pressure relief valve, pressure reducing valve, sequence valves, counter balance valve. c) Principles and Types of direction Control valves-2/2, 3/2, 4/2, 4/3, 5/2. Open center, close center, tandem center, manual operated, mechanical operated solenoid, pilot operated direction control valves, check valves. d) Principles of flow control valves, temperature compensated, pressure compensated, temperature and pressure compensated flow control valve. e) Hydraulic servo system for linear and rotary motion.	08
Unit 4	**Elements of Pneumatic System** a) Air compressor- Types, selection criteria, capacity control, piping layout, fitting and connectors, Pneumatic controls, Direction control valves (two way, three way, four way), check valves, flow control valves, pressure control valves, speed regulators, quick exhaust valves, time delay valve, shuttle valve and twin pressure valve. Solenoid operated, pilot operated valves, Pneumatic actuators, Rotary and reciprocating cylinders–types and their mountings, Air motor – types, Comparison with hydraulic and electric motor. b) Serving of compressed air – types of filters, regulators, lubricators (FRL unit), mufflers, dryers. c) Maintenance, troubleshooting and safety of hydraulic and pneumatic system.	08
Unit 5	**Hydraulic Circuits and its Application** a) Speed control circuits – Meter-in, Meter-out, Bleed off, Regenerative, Fast approach and slow traverse. b) Sequence circuits – Travel dependent and Pressure dependent c) Synchronizing circuit.	04
Unit 6	**Pneumatic Circuits and its Application.** a) Speed control circuits b) Impulse operation circuit. c) Sequence circuits.	04

23UGPEC2-ME6042 – POWER AND ENERGY ENGINEERING

Evaluation Scheme

Lectures : 02 Hrs/Week
Tutorial 01 Hrs/Week
Credits: 03

ESE: 60 Marks
ISE: 40 Marks

Course Objectives: The objective of the course is to	
1	To understand the scenario of the Indian and global power sector, various types of power plants, their working principles, and the role of major organizations like NTPC, NHPC, and NPCIL in India's power development.
2	To develop knowledge of energy management and conservation techniques, including energy auditing, co-generation, waste heat utilization, and to assess the environmental impact of conventional energy sources.
3	To study the fundamentals of power plant economics, including load analysis, cost of energy production, tariff methods, and the performance characteristics of different power plants.
4	To explore renewable and green energy technologies, including solar, wind, tidal, biomass, hydrogen energy systems, fuel cells, and the concept of the Internet of Energy (IoE) for future sustainable power generation.

Course Outcomes:

COs	**At the end of successful completion of the course, the student will be able to**	**Blooms Taxonomy**
CO1	**Understand the scenario of the power sector, types of power plants, and alternate energy sources.**	**Knowledge Understand**
CO2	**Analyze the performance and economics of different power plants.**	**Analyze**
CO3	**Apply energy management and conservation techniques in power systems.**	**Apply**
CO4	**Evaluate the use of renewable and green energy technologies for sustainable power generation.**	**Evaluate**

Description:

This course covers the fundamentals of power generation in India and globally, including conventional and renewable sources. It introduces various types of power plants, energy management practices, power plant economics, and emerging green energy technologies such as solar, hydrogen, and fuel cells.

Unit No.	Course Contents	Hours
Unit 1	**Introduction** to Indian and global power scenario, fossil fuels, India power production, consumption and demand of power, NTPC, NHPC, NPCIL and their role in Power development in India, Power generation from Private sector, Power grids. Role of alternate energy sources for worlds power generation in future.	6
Unit 2	**Power Plants and Energy Management** Different types of power plants – Thermal, Hydro, IC Engine, Gas Turbine, Nuclear, Combined Cycle and their characteristics, Pumped storage, Compressed Air storage power plants and their characteristics, Comparison of power plants with respect to various parameters. Energy conservation and management, energy audit, co-generation systems, waste heat utilization, impact of conventional energy use on environment.	7
Unit 3	**Power Plant Economics** Introduction to Terms and definitions related to electrical load, Load Curves and Load duration curves, cost of energy production, selection of plant, Peak load, Intermediate load and Base load plants and their performance and operating characteristics, Input output characteristics of power plants, tariffs methods. **(Numerical treatment).**	7
Unit 4	**Renewable energy** Introduction to renewable energy sources and their potential, Global and Indian renewable energy scenario. Brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, Introduction to Internet of energy (IOE).	6
Unit 5	**Solar energy** Introduction to Solar Radiation, Solar geometry, Solar radiation Measurements-Pyrheliometers, Pyrometer, Sunshine Recorder, application of solar energy. Solar Photovoltaic: Solar PV system stand alone and grid connected, Photo cell materials, Maximum power point tracking system. Solar energy collector: Classification, evacuated tube collector, Concentrating collectors and comparison between them.	7
Unit 6	**Green Energy:** Fuel cell: Introduction, Principle of operation, classification, applications advantages and disadvantages. Introduction to fuel cell electric vehicles (FCEV'S). Hydrogen Energy: Properties of Hydrogen with respect to its utilization as a renewable form of energy, types, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.	7

References	
Text Books	
1	Power Plant Engineering By P. K. Nag McGraw Hill Education 4th Edition (2017)
2	Non-Conventional Energy Resources B.H. Khan McGraw Hill Education 3rd Edition (2017)
3	Solar Energy: Principles of Thermal Collection and Storage S.P. Sukhatme, J. K. Nayak McGraw Hill Education 3rd Edition (2017)

Reference Books	
1	Power Plant Technology M.M. El-Wakil McGraw Hill Education 1st Edition, 1984
2	Renewable Energy Resources John Twidell, Tony Weir Taylor & Francis 3rd Edition (2015)
3	Solar Engineering of Thermal Processes John A. Duffie, William A. Beckman Wiley 4th Edition (2013)
4	Introduction to Hydrogen Technology Alec Grodzinski Wiley 1st Edition (2007)
5	Fuel Cell Fundamentals Ryan O'Hayre, Suk-Won Cha, Whitney Colella, Fritz B. Prinz Wiley 3rd Edition (2016)

Mapping of POs & COs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	If applicable		
													PSO 1	PSO 2	PSO 3
CO 1	2	2	-	-	-	2	2	-	-	2	-	2	--	3	--
CO 2	2	3	2	2	-	2	3	-	2	-	-	2	--	3	--
CO 3	2	2	2	3	2	2	3	2	2	2	2	3	--	3	--
CO 4	2	2	2	-	2	2	3	-	-	-	-	3	--	3	--

No.	Link
1	NPTEL Course on POWER PLANT ENGINEERING, Department of Mechanical Engineering IIT Roorkee - https://nptel.ac.in/courses/112/107/112107291/
2	NPTEL Course on Physics of Renewable Energy Systems, IIT Kharagpur https://nptel.ac.in/courses/115105127
3	SWAYAM Course Renewable Energy Engineering: Solar, Wind and Biomass Energy Systems IIT Guwahati https://nptel.ac.in/courses/103103206
4	https://mnre.gov.in/
5	https://beeindia.gov.in/
6	https://ascelibrary.org/journal/jleed9

Sr. No.	Description	Signature
1	Name of Faculty : Prahlad Vithal Kamble	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING

23UGPEC2-ME6043 - Production Management

Lectures : 03 Hrs/Week
Credits : 03

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	Understand the product design and development procedure.
2	Study and Analyze different sales forecasting techniques.
3	Study of modern production management tools

Course Outcomes:		
Co's	At the end of successful completion of the course, the student will be able to	**Blooms Taxonomy**
CO1	Prepare the product design procedure of an existing product and judge it on the basis of other products	Remember
CO2	Analyze and point out different sales forecasting techniques.	Understand
CO3	Identify meaning of quality by inferring different parameters to prioritize product value to adopt new changes in a changing circumstance.	Apply
CO4	Anticipate use of modern production management tools.	Understand
CO5	Identify different pillars of TPM in manufacturing industry.	Remember
CO6	Prepare product demand and supply curve.	Understand

Unit No.	Course Contents	Hours
Unit 1	**Introduction to Production Management** Production types, Objectives and scope of Production Management, Production Planning and Control (PPC) - Definition and elements and activities of production planning and production control Relevance, Strategy formulation process, Order qualifiers and order winners.	5
Unit 2	**Product and Process Design** Determinants of process characteristics- Volume, Variety, Flow, Types of processes, Choice of Process, Equipment selection, Use of BEP in selection process- Product matrix. Estimation of Demand- Time series Analysis and causal forecasting techniques, Least square method, Moving average and exponential smoothing forecasting method Role of Product Development in competitiveness, Product Life Cycle (PLC)	4

Unit 3	**Capacity and Scheduling of Operations** Capacity- Definition, Measure of Capacity, Capacity strategies, Estimation of number of machines, Overcapacity and under capacity factors, Aggregate Planning, Aggregate Planning Strategies, Use of transportation model approach to aggregate planning Loading, scheduling and sequencing, Priority sequencing rules. Sequencing problems, n job 2 machines, n Job '3'machines.	**4**
Unit 4	**Supply Chain Management and Advanced Manufacturing Techniques** Concept of supply chain and supply chain management, Manufacturing supply chain, SCM activities, Supply chain strategies, Managing supply chain, Measuring supply chain performance, JIT Philosophy, Origin and core logic of JIT, Elements of JIT, Kanban System-Design of Kanban containers, JIT .Implementation issues and performance.	**5**
Unit 5	**Total Productive Maintenance and Replacement** Introduction, Definition, Six big losses, Stages of maintenance, Pillars stages of TPM Development, Overall Equipment Effectiveness (OEE) Computation Replacement - need, Replacement of items whose maintenance cost increases with time (with and without considering time value of money).	**5**
Unit 6	**Production Economics** Demand and supply, Demand curve and supply curve, Equilibrium of supply and demand, Elasticity of demand Production function, Factors of production, Review - Time value of money, Cash flows, Evaluation criteria for capital projects.	**4**

Practicals:

Sr. No.	Practical Topic	Hrs.
1.	Presentation on Product Design and Development	2
2.	Problems on Sales Forecasting Techniques	2
3.	Presentation on Case study on "Design for Manufacturing and Assembly".	2
4.	Problems on Job sequencing- Single Machine Scheduling, Priority Sequence and Johnson's Algorithm.	2
5.	Presentation on Case study on "Implementation of JIT in a small/ medium company".	2
6.	Problems on Estimate OEE and Replacement Analysis.	2
7.	Exercises on Analyzing tools in Project preparation	2
8.	Case Study On TPM	2

References

Text Books

1. "Industrial Engineering and Production Management", Martand Telsang, S Chand and Company New Delhi,(2009).
2. "Production and Operation Management", S. N. Chary, Tata Mcg Graw Hill, 5thEdition.

Reference Books	
1	"Production and Operation Management", Everett E. Adam and Ebert, PHI Publication, ISBN no.9788120308381.
2	"Production and Operations Management", Buffa. Elwood modern Wiley India, 8thEdition.
3	"Techniques of Value Analysis and Engineering", Miles Lawrence.
4	"Operation Management Theory and Practice", Mahadevan B Pearson Education,(2007)

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Prof. Vivek V. Patil	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

23UGPEC3-ME6051– Internal Combustion Engines

Lectures : 03 Hrs/Week
Credits : 03

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	Study constructional details and various types of internal combustion engine.
2	Understand and analyze thermodynamic cycles of I C Engines.
3	Understand combustion phenomenon in SI engine and CI engines.
4	Impart knowledge about various fuel supply systems on the I C Engines.
5	Impart knowledge about various engine performance characteristics

Course Outcomes:		
Co's	At the end of successful completion of the course, the student will be able to	**Bloom's Taxonomy**
CO1	Explain the working and classification of IC engines and air standard cycles.	Understand
CO2	Explain the functional requirements of a fuel supply system in SI and CI engine system.	Understand
CO3	Solve numerical problems related to simple carburetors and fuel Nozzles	Apply
CO4	Compare normal and abnormal combustion phenomenon in SI engine and CI engine	Understand
CO5	Calculate performance metrics such as torque, power, specific fuel consumption and efficiencies	Apply
CO6	Discuss engine emissions, their control methods, emission norms, and the role of alternative fuels and boosting techniques.	Understand

Description		
This course studies the fundamentals of how the design and operation of internal combustion engines affect their performance, efficiency, fuel requirements, and environmental impact.		
Prerequisites	1.	Engineering Thermodynamics
	2.	Fluid Mechanics
	3.	Fluid and Turbo Machinery

Unit No.	Course Contents	Hours
Unit 1	**Introduction to I.C. Engines** Engine, Internal combustion Engine & External combustion Engine, Classification of Internal Combustion Engines, Applications of IC Engines, Air Standard cycles Otto cycle Diesel Cycle Air standard cycle efficiency Numerical on Otto cycle and Diesel Cycle ,Valve timing diagram and port timing Diagram	8
Unit 2	**A) Fuel supply system in SI Engines** General layout of fuel supply system, Carburetion, Simple Carburetor Inexact analysis Air fuel ratio requirement for SI engine limitations of simple carburetor Complete Carburetor Numerical treatment on Simple carburetor. **B) Fuel supply system in CI Engines** General layout of fuel supply system, Requirements of injection system, Types of injection systems – Individual pump, Common rail and Distributor systems, Unit injector, Types of fuel nozzles- single hole, multi hole, pintle, and pintaux,	8
Unit 3	**Combustion in S.I Engine** Stages of combustion, Ignition lag, Flame propagation, Factors affecting flame speed, Abnormal combustion, Influence of engine design and operating variables on detonation, Fuel rating, Octane number, Fuel additives, HUCR, Requirements of combustion chambers of S.I. Engines and its types	5
Unit 4	**Combustion in C.I Engine** Stages of combustion, Delay period, Factors affecting delay period, Abnormal combustion- Diesel knock, Influence of engine design and operating variables on diesel knock, Comparison of abnormal combustion in S.I. and C.I. Engines, Cetane number, Additives. Swirl and its types	5
Unit 5	**Performance Testing of Engines** Performance parameters, Measurement of performance parameters like torque, power, and Volumetric Efficiency, Mechanical Efficiency, BSFC, Brake and Indicated Thermal efficiencies. Numerical on Heat Balance Sheet and engine performance, Performance curves	7
Unit 6	**Engine Emission and Control** Introduction to Supercharging and Turbo-charging, S.I. engine emission (HC, CO, NOx) Control methods- Thermal, Catalytic converters, C.I. Engines Emission (CO, NOx, Smog, Particulate), , Control methods- Chemical, EGR Pollution norms like Bharat stage IV and Bharat stage VI Introductions to **Alternative Fuels** for IC Engines	7

References

Text Books

1	"Internal Combustion Engines", V. Ganesan Tata McGraw Hill
2	"A Course in Internal Combustion Engines", Mathur & Sharma, R. P. Dhanapat Rai Publications.
3	"Course in Internal Combustion Engines", V. M Domkundwar, Dhanpat RaiPublication
4	"Advanced Internal Combustion Engines" R.K. Agarwal, PHI Learning Pvt. Ltd.

Reference Books	
1	"Internal Combustion Engines",Maleev, CBS Publication andDistributors.
2	"Internal Combustion Engines", J. B. Heywood,Tata McGraw Hill Publication
3	"Internal Combustion Engines",Gills and Smith , Oxford and IBH PublishingCompany
4	"Internal Combustion Engines Fundamentals", E. F. Obert, Harper and Row Publication ,New York
5	"Engine Combustion and Emissions" M. R. W. M. R. Bradley, Butterworth-Heinemann

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Prof. A.S.Chavan	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING

23UGPEC3-ME6052–TRIBOLOGY

Lectures : 03 Hrs/Week
Credits : 03

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	Understand the Fundamentals of Tribology
2	Analyze Surface Interactions and Material Behavior
3	Apply Lubrication Theory to Practical Systems
4	Evaluate Wear Mechanisms and Select Suitable Materials and Lubricants

Course Outcomes:

Co's	At the end of successful completion of the course, the student will be able to	Bloom's Taxonomy
CO1	Understand the fundamentals of tribology and associated parameters	Understand
CO2	Identify and explain various friction and wear mechanisms	Remember Understand
CO3	Select proper lubricants and lubricant methods for different applications	Apply
CO4	Suggest compatible materials to machineries to reduce wear and friction	Apply Analyze
CO5	Study the surfaces coating techniques for reduction of wear	Understand
CO6	Apply the principles of surface engineering for different applications of tribology.	Apply

Description		
Majority of mechanical equipment / mechanisms involve relative motion of links or parts. The course intends to impart concepts of friction, wear and lubrication and application of tribology in design of mechanical components is also introduced.		
Prerequisites	**1.**	Fluid Mechanics
	2.	Applied Mechanics

Unit No.	Course Contents	Hours
Unit 1	**Introduction :** 1. Introduction to tribology 2. History of tribology 3. Interdisciplinary Approach 4. Economic Benefits.	5
Unit 2	**Lubrication and Lubricants:** Introduction to tribology, tribology in industry, basics modes of lubrication, oil viscosity, temperature and pressure dependence of viscosity, Viscosity index, viscosity measurement, properties of lubricants, temperature characteristics of lubricants, lubricant impurities and contaminants, mineral oils based lubricants, synthetic oils based lubricants, emulsions and aqueous lubricants, greases, and lubricant additives.	8
Unit 3	**Friction and Wear:** Friction causes of friction, theories of dry friction; adhesion theory, abrasive theory, junction growth theory, laws of rolling friction, friction measurement, friction instabilities. Wear classification; abrasive wear, erosive wear, cavitation wear, adhesive wear, corrosive wear, oxidative wear, fatigue wear, factors affecting wear, measurement of wear, theories of wear, approaches to friction control and wear prevention.	7
Unit 4	**Lubrication of Bearings :** Theory of hydrodynamic lubrication, mechanism of pressure development in oil film, jet lubrication, mist lubrication, lubrication utilizing under race passage, concept of journal bearing, minimum oil film thickness, porous bearings, flat plate thrust bearing, tilting pad bearings, hydrostatic lubrication, squeeze film lubrication, elasto-hydrodynamic lubrication, rolling element bearings, gas lubricated bearings, and hybrid bearings.	7
Unit 5	**Solid Lubrication and Surface Treatment :** Lubrication by solids, friction and wear characteristics of lamellar solids, reduction of friction by soft metallic films, deposition methods of solid lubricants, techniques for producing wear resistant coatings, characteristics of wear resistant coatings.	7
Unit 6	**Industrial Case Studies:** Selection of bearing and lubricant; bearing maintenance, diagnostic maintenance of Tribological components and considerations in IC engines and automobile parts, roller chains and wire rope, lubrication systems; Filters and filtration.	6

References

Text Books

1	Principles and Application of Tribology, B. Bhushan, Wiley.
2	Fundamentals of Tribology, S. K. Basu, S. N.Sengupatha and D. B.Ahuja, PHI.
3	"Engineering Tribology ",SahooPrasanta , PHI Learning Pvt.Ltd.
4	"Tribology in Industries"by Shushil Kumar Srivastava by S.Chand Publications

Reference Books

1	Applied Tribology (Bearing Design and Lubrication), by Michael M Khonsari, John Wiley & Sons (2001).
2	Principles of Tribology, by J Halling, The Macmillan Press Ltd,London, (1975).
3	Friction, Wear, Lubrication:A textbook in Tribology, by Ludema K C, CRC Press, (2010)
4	Fundamentals of Engineering Tribology with Applications by Harish Hirani, Cambridge English (2017)

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Dr. Lingaraju. S.V.	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING

23UGPEC3-ME6053–Piping Design

Lectures : 03Hrs/Week
Credits : 03

Evaluation Scheme
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to	
1	To equip engineering graduates with the basic knowledge of piping design.
2	To meet the requirements of the EPC (Engineering, Procurement, and Construction) industry
3	To familiarize engineering graduates with comprehensive understanding of pipe manufacturing processes and selection of piping materials
4	To enable engineering graduates with Process Flow Diagram, Piping & Instrumentation Diagram

Course Outcomes:		**Bloom's Taxonomy**
Co's	At the end of successful completion of the course, the student will be able to	
CO1	Define and describe the basic components and terminology in piping design.	Remember
CO2	Classify pipes and explain their manufacturing methods and applicable standards.	Remember Understand
CO3	Identify and evaluate piping materials using ASME/ASTM specifications.	Understand Apply
CO4	Explain the functions and types of flanges and valves used in piping systems	Remember Understand
CO5	Describe the structure and function of various mechanical and process equipment in piping layouts.	Remember Understand
CO6	Interpret and create basic process flow diagrams, piping and instrumentation diagrams, and utility flow diagrams.	Understand Apply

Description		
As per the requirements of EPC industry, engineering graduates are expected to have the knowledge about piping design and plant design software. This course will equip the students with basic knowledge of piping design.		
Prerequisites	**1.**	Basic knowledge of Fluid Mechanics
	2.	Basic knowledge of Strength of Material
	3.	

Unit No.	Course Contents	Hours
Unit 1	**Introduction to Piping:** Definition, Basic Piping, Pipe & Tubes, Pipe size, Pipe thickness	4
Unit 2	**Pipe Manufacturing:** Classification of pipe, Applications & uses, Manufacturing methods, Weight & size -- Standards STD , Extra Strong XS , Double Extra Strong XXS etc., Pressure Temperature Rating System	8
Unit 3	**Piping Material:** Ferrous & Non-ferrous material specifications (ASME / ASTM), examples of identifying properties of commercial piping materials	8
Unit 4	**Flanges & Valves:** Definition of Flange, Types of Flanges, Gaskets, Definition & basic function of Valve, Types of Valves	7
Unit 5	**Mechanical and Process Equipment:** Static Equipment – Horizontal Vessels, Vertical Vessels, Storage Tanks, Heat Exchanger , Reboiler, Towers and Columns Rotary Equipment – Pumps, Compressor, Fans, & Steam Turbines.	8
Unit 6	**Flow Diagrams:** Process Flow Diagram (PFD), Piping & Instrumentation Diagram (P & ID), Utility Flow Diagram, P& ID Requirements, Symbols & Abbreviations	5

References	
Text Books	
1	Mohanta, D. (2010). *Piping engineering*. Tata McGraw-Hill Education.
2	Ghate, D. K. (2010). *Process equipment design*. Nirali Prakashan
3	Austin, D. E. (2011). *Chemical engineering process design and economics*. John Wiley & Sons.
4	Rao, S. (1996). *Piping design and engineering*. Jaico Publishing House.

Reference Books	
1	Nayyar, M. L. (Ed.). (2000). *Piping handbook* (7th ed.). McGraw-Hill
2	Towler, G., & Sinnott, R. K. (2013). *Chemical engineering design: Principles, practice and economics of plant and process design*. Butterworth-Heinemann.
3	American Society of Mechanical Engineers. (Most recent edition). *ASME B31.3 Process piping*. ASME.

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Dr. M. S. Dhuttargaon	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING

23UGMDM4-ME606LGD&T Techniques in Engineering

Lectures:2 hrs/ week
Credits:2

Evaluation Scheme:
ISA:50Marks

CourseObjectives: Theobjectiveofthiscourseisto

1. Understand GD&T principlesincluding the importance of tolerances, datum references, and geometric controls.
2. Learn to interpret engineering drawings that utilize GD&T symbols and annotations accurately.
3. Apply GD&T Symbols and Concepts: Develop proficiency in applying GD&T symbols and concepts to engineering drawings.

CourseOutcomes:

COs	At the end of successful completion of the course the student will beable to	Blooms Taxonomy
CO1	Identify different GD&T symbols.	Understand
CO2	Understand limits fits and tolerance and Taylor's principle of gauging	Understand
CO3	UnderstandMMC, LMC and RFS concepts	Understand
CO4	Assess the significance and selection of datum & datum features	Apply Analyze
CO5	ApplyGeometric characteristics of feature	Understand Apply
CO6	Interpret the geometrical features using different measuring instruments.	Analyze Apply

Description:

Geometric Dimensioning and Tolerancing (GD&T) is a comprehensive system used in engineering and manufacturing to define and communicate the allowable variations in the geometry of parts and assemblies. It uses symbols, terms, and definitions to provide a clear and precise description of a component's design and its allowable deviations.

Students will become familiar with the various GD&T symbols used to represent different geometric characteristics, such as straightness, flatness, circularity, cylindricity, profile, orientation, and runout.

They will develop the skills to read and interpret GD&T annotations on engineering drawings, enabling them to accurately understand design requirements.

Prerequisites:	1:	Computer Aided Engineering Drawing
	2:	Machine Drawing & Geometric Modeling

	Section-1	
Unit1	**Introduction to GD&T** Introduction to dimensioning and tolerancing, Terms and symbols used in GD&T,Benefits of GD&T, advantages of GD&T, applications of GD&T	**6 Hrs.**
Unit2	**Measurement and Limits fits and tolerances** Introductiontomeasurement, International standards of length, line and end measurement, IS specifications of limits, Unilateral and bilateral tolerances, Types of Fits, Taylor's principle of gauging.	**6 Hrs.**
Unit 3	**MMC, LMC & RFS** Maximum Material Condition (meaning & use); Least Material Condition (meaning & use); Regardless of Feature Size How to read a Feature Control Frame, Rules, concepts, characteristics, and untoleranced dimensions: types of datums individual or related datum's, material Conditions; untoleranced dimensions.	**6 Hrs.**
	Section-II	
Unit 4	**Size Control Form and datum** Rules, concepts, characteristics, and untoleranced dimensions: types of datums individual or related datum's, material Conditions; untoleranced dimensions.	**6 Hrs.**
Unit5	**Geometric characteristics of feature** **Form** (straightness, flatness, circularity,cylindricity) **Orientation** (parallelism, perpendicularity, angularity) **Location** (position,concentricity,symmetry) **Profile** (profile of line, profile of surface) **Runout**(circular runout, total runout)	**7 Hrs.**
Unit6	**Measuring Instruments for Checking Geometric Features** Use of measuring instruments to check the geometrical features of the component like dial indicator, Pneumatic gauge. Use of CMM for the measurement of Geometric characteristics of industrial component.	**6 Hrs.**

MappingofPos&COs:

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

References:

Text Books	
1	Fundamentals of GD&T, 3rd edition by Krulikowski
2	Advanced Geometric Dimensioning and Tolerancing (GD&T) by Bipinkumar Singh
3	P S Gill, "Geometric Dimensioning and Tolerancing", S K Kataria & sons
ReferenceBooks	
1	Dimensioning and Tolerancing: Applications and Techniques for Use in Design: Manufacturing, and Inspection, by James D. Meadows, CRC Press
2	& T: Based on ASME-Y 14.5-2009 by Ashok Kumar, Azuko Publishing

VideoLectures

1. **https://nptel.ac.in/courses/112106179**
2. **https://nptel.ac.in/courses/112104250**
3. **https://www.youtube.com/watch?v=rbk28swIiHU**
4. **https://www.youtube.com/watch?v=flsTBgNgNhQ**

Sr. No.	Description	Signature
1	Name of Faculty: Prof. A.R.Shinge	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING
At./Post. Walchandnagar
Tal. Indapur
Dist. Pune
T.K.I.E.T. Warananagar

23UGVSEC-ME607L – COMPUTATIONAL TECHNIQUES & PROGRAMMING

Lectures	: 02 Hrs./Week	**Evaluation Scheme**	
Credits	: 02	**ESE**	: 60 Marks
Tutorials	: 01 Hr. /Week	**ISE**	: 40 Marks

Course Objectives: The objective of the course is to

1. Provide the knowledge of Numerical methods used and solve various types of problems in Mechanical Engineering.
2. Identify specific method to solve a specific engineering problem.
3. Enable students to write computer program in C++ for aforementioned numerical methods.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Bloom's Taxonomy
CO1	Differentiate between direct methods and numerical methods with their significance	Knowledge
CO2	State different numerical methods used to solve engineering problems	Knowledge
CO3	Describe mathematical process of various Numerical methods to solve problems	Understand
CO4	Relate a specific method to solve an engineering specific problem with greater emphasis on mechanical Engineering.	Analysis
CO5	Develop the logic behind a method for its coding through flowcharts.	Synthesis
CO6	Prepare computer program for these numerical methods using C++	Synthesis Create

Description:

The course, Computational Techniques and Programming is offered as the Skill course. There are some situations in engineering, where the direct methods fail or do not provide correct solution to mathematical problems. These situations may be critical and need a solution. Engineer should have knowledge of Numerical methods to cope up with these situations. This course contains Numerical Methods to solve various Engineering Problems which has six units along with Assignments through Tutorials.

i) Roots of Equations ii) Linear Algebraic Equations iii) Curve Fitting & Interpolation iv) Numerical Differentiation & Integration v) Ordinary Differential Equations and vi) Ordinary Differential Equations.

Prerequisites:	1.	Basics in Algebra: Roots of equations, Simultaneous equations.
	2.	Basics of Matrices and determinants
	3.	Basic knowledge of derivative and integration
	4.	Basic Knowledge of C++ Programming

Unit No.	Course Contents	Hours
Unit 1	**Roots of equation:** Bracketing Methods: Bisection method & Regula falsi method Open Methods: Muller method, Newton Raphson method for single root **A C++ Program on Regula falsi method**	06 Hrs.
Unit 2	**Linear algebraic equations:** Direct Methods: Gauss elimination method, LU Decomposition method Iterative Methods: Gauss-Siedel method. **A C++ Program on Gauss elimination method**	04 Hrs.
Unit 3	**Curve Fitting & Interpolation** Curve Fitting: Straight line fit, Parabolic fit Interpolation: Newton's Divided difference method **A C++ Program on Straight Line fit**	04 Hrs.
Unit 4	**Numerical Differentiation & Integration:** Num. Differentiation: Newton's Forward, Backward methods Newton's Divided difference method for unequal intervals Num. Integration: Trapezoidal method, Simpson's methods, Gauss quadrature **A C++ Program on Simpson's 3/8th rule**	07 Hrs.
Unit 5	**Ordinary Differential Equations:** Taylor's series method, Euler's method, Modified Euler's method, **A C++ Program on Modified Euler's method**	04 Hrs.
Unit 6	**Partial Differential Equations:** Liebmann's method for Laplace equation, Crank-Nicholson method (Descriptive treatment only)	03 Hrs.

TUTORIALS: SIX assignments on SIX Units with at least one problem on each method along with a C++ program as mentioned in the curriculum.

Text Books

1	Dr. P. Kandasamy, Dr. K. Thilagavathy, Dr. K. Gunavathi, Numerical Methods, S. Chand Pub.
2	S. S. Patil, Applied Numerical Methods. Electrotech Publication.(Engineering Series)

Reference Books

1	E. Balagurusamy, Numerical Methods, McGraw Hill Education
2	S. Arumugam, A. Thangapandi Isaac, A. Somasundaram, Numerical Methods, SciTech Publications

Mapping of POs & COs

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

Link for Video Lectures:

https://nptel.ac.in/courses/111/107/111107105/

https://nptel.ac.in/courses/106/106/106106212/

Sr. No.	Description	Signature
1	Name of Faculty : Prof. Krishnakumar D Joshi	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING

23UGPCC-ME601LP -METROLOGY AND QUALITY CONTROL LAB

Practicals : 02 Hrs/Week
Credits : 01

Evaluation Scheme
ISA : 25 Marks
POE :25 Marks

Course Objectives: The objective of the course is to	
1	Study the use of various linear measuring instruments, comparators and angle measuring instruments.
2	Learn the use of floating carriage micrometer and optical profile projector for measurement of the different features of the screw thread.
3	Study the use of optical flat for the measurement of flatness of the component and use of Coordinate Measuring Machine to check the geometrical dimensions.
4	Study the capability of the process by using various control charts.

Course Outcomes:		
Co's	At the end of successful completion of the course, the student will be able to	**Blooms Taxonomy**
CO1	Use various linear and angular measuring instruments and comparatorsand select appropriate instruments for specific feature measurements.	Understand Knowedge
CO2	Understand the working and use of measuring instruments for screw threads and gear teeth.	Understand Apply
CO3	Apply knowledge of Coordinate Measuring Machines (CMM) to inspect geometrical dimensions.	Understand Apply
CO4	Understand and evaluate the capability of the process by using various control charts	Analysis Evaluate

Description		
The Metrology and Quality Control laboratory consists of a number of measuring instruments, gauges and their use to check the dimensional features and physical dimensions of various components. Students are able to enhance their basic and fundamental knowledge of machine drawing to study the dimensional features and physical dimensions of the components and by selecting the appropriate measuring instrument they should able to check these dimensional features and physical dimensions of the various components used in the industry.		
Prerequisites	1	Computer Aided Engineering Drawing
	2	Machine Drawing & Geometric Modeling

Practicals

Sr. No.	Practical Topic	Hrs.	Bloom's Taxonomy
Part A: Experiments			
1	Study and use of linear measuring instruments.	02	Understand Apply
2	Study and use of comparators. (Use of pneumatic/mechanical comparator)	02	Understand Apply
3	Study and use of bevel protractor and sine bar for angle measurement.	02	Understand Apply
4	Study and use of floating carriage micrometer for screw thread measurement.	02	Understand Apply
5	Study and use of gear tooth Vernier caliper for spur gear measurement.	02	Understand Apply
6	Study and use of optical flat.	02	Knowledge Understand
7	Study and use of use of optical profile projector.	02	Understand Apply
8	Study and use of CMM to check the geometrical dimensions.	02	Knowledge Understand
*Perform any 6 from above experiments.			
Part B: Assignments			
9	Assignment on control charts.	02	Analysis Evaluate
10	Assignment on Operating characteristic curve and Quality control tools.	02	Knowledge Understand

References

Text Books

1	"Engineering Metrology", I.C. Gupta, Dhanpat Rai Publications.
2	"Engineering Metrology", R. K. Jain, Khanna Publisher.
3	"Engineering Metrology", M. Mahajan, Dhanpat Rai and Sons.

Reference Books

1	"Practical Engineering Metrology", Sharp K.W.B. Pitman, London.
2	"Metrology and Measurements", A. K. Bewoor, Tata McGraw Hill Publication
3	"Statistical Quality Control", A.L. Grant, Tata McGraw Hill International, New York, 6th Edition.

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Prof. A. R. Shinge	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING

23UGPCC-ME602L Fluid and Turbo Machinery Lab

Practicals : 02 Hrs/Week
Credits : 01

Evaluation Scheme
ISA : 25 Marks

Course Objectives: The objective of the course is to	
1	Understand the construction and working of pumps, turbines, and compressors.
2	Conduct performance tests and plot characteristic curves.
3	Evaluate and select suitable pumps and compressors for applications.

Course Outcomes:		
Co's	At the end of successful completion of the course, the student will be able to	**Bloom's Levels**
CO1	Identify and demonstrate the construction and working of various types of pumps, turbines, and compressors.	Understand
CO2	Conduct performance tests on Pelton wheel, Francis turbine, centrifugal pump, and reciprocating compressor	Apply
CO3	Analyze experimental data and plot characteristic curves for different fluid machines to assess performance.	Analyze
CO4	Evaluate and justify the selection of appropriate pumps and compressors for specific engineering applications	Evaluate

Description		
This laboratory course complements the theoretical study of hydraulic machines and compressors through hands-on experiments and demonstrations. It aims to develop practical understanding of the construction, operation, and performance evaluation of pumps, turbines, and compressors, while also emphasizing industrial relevance through equipment selection and exposure to real-world applications		
Prerequisites	**1.**	Basic Mechanical Engineering
	2.	Basic knowledge of fluid mechanics
	3.	Thermodynamic laws & processes

Expt. No.	Course Contents	Hours
1	Trial on Pelton wheel and to plot characteristics curve.	2
2	Trial on Francis turbine and to plot characteristics curve.	2
3	Study and demonstration of various types of pumps.	2
4	Trial on centrifugal pump and to plot characteristics curve.	2
5	Study and demonstration of various types of compressors	2
6	Trial on reciprocating compressor	2
7	Selection Criteria for Pumps and Compressors	2
8	Industrial visit to pump/turbine manufacturing industry or hydro power plant	-

References	
Text Books	
1	A text book of Fluid Mechanics and Hydraulic Machines by R. K. Bansal, Laxmi Publicaton
2	A text book of Thermal Engineering by R.S. Khurmi, S Chands Publicatuon
3	Hydraulics and Fluid Mechanics including Hydraulic Machine by Dr. P. N. Modi and Dr. S. M. Seth, Standard Book House .
4	Fluid mechanics and Hydraulic Machinery by R.K. Rajput, Laxmi Publicaton

Reference Books	
1	Turbomachines by S.M.Yahya
2	Steam and Gas Turbines by R. Yadav
3	Thermodynamics – An Engineering Approach by Cengel & Boles

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Pabl S.S.	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING

23UGPCC-ME603LP–DESIGN OF MACHINE ELEMENTS- II

Practicals : 02 Hrs/Week
Credits : 01

Evaluation Scheme
ISA : 25 Marks

Course Objectives: The objective of the course is to	
1	Apply Advanced Design Principles
2	Analyze and Design Mechanical Elements
3	Use Design Standards and Codes
4	Integrate Design for Real-world Applications

Course Outcomes:		
Co's	At the end of successful completion of the course, the student will be able to	Bloom's Taxonomy
CO1	Identify the stresses in machine components due to various types of fluctuating loads and failure of components according to theories of failures.	Understand Apply
CO2	Develop capability to analyze rolling contact bearing and its selection from manufacturer's catalogue	Analyze Evaluate
CO3	Apply principles of spur gear design and worm gear during design of gear boxes	Apply Evaluate Create
CO4	Evaluate and design helical and bevel gear systems for application	Apply Evaluate Create

Description		
The Design of Machine Elements-II laboratory syllabus consists of Design of components subjected to fluctuating loads and also design of gear box using Spur gears, Helical gears, Bevel Gears, Worm Gears for various gear box selections as per the requirement and also selection of rolling contact bearings.		
Prerequisites	**1.**	Applied Mechanics
	2.	Analysis of Mechanical Elements
	3.	Design of Machine Elements –I

Sr.No.	Name of Practical	Hours
1	Assignments based on Design for Fluctuating loads	2
2	Construction of gears such as hub, web, arm, rim type etc. Design considerations of gear box	2
3	A detail design report and two sheets containing working drawing of details and assembly i) Spur gear/ Helical gear	2
4	A detail design report and two sheets containing working drawing of details and assembly ii) Bevel gear / Worm and Worm Wheel.	2
5	Assignments based on study of ball bearing mountings and its selection preloading of bearings.	2
6	Industrial visit based on above syllabus	2

References

Text Books

1	"Design of Machine Elements", V. B. Bhandari., Tata McGraw Hill Publication, 4th Edition
2	"Machine Design", R. K. Jain, Khanna Publication
3.	"Machine Design A Basic Approach", Dr. S. S. Wadhwa, S S Jolly, DhanapatRai and Sons.
4	"A Text Book of Machine Design", R. S. Khurmi and J. K. Gupta.

Reference Books

1	"Design of Machine Element", J. F. Shigley, Tata McGraw Hill Publication.
2	"Design of Machine Element" M. F. Spotts, Pearson Education Publication, 6th Edition
3	"Machine Component Design", Robert C. Juvniall, Willey Ltd, 5th Edition.
4	"Design Data: Data Book of Engineers by PSG College"-KalaikathirAchchagam - Coimbatore
5	SKF Bearings Catalogue

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Dr. Lingaraju. S.V.	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGG.

23UGPCC-ME608L– 3D Printer LAB

Evaluation Scheme
ISA : 50 Marks

Practicals : 02 Hrs/Week
Credits : 01

Course Objectives: The objective of the course is to	
1	To introduce the fundamentals and workflows of 3D Printing.
2	To provide hands-on experience in 3D modeling and printing using different techniques and materials.
3	To understand Cura software and machine settings for optimized prints.
4	To encourage creativity and design thinking through prototype fabrication.

Course Outcomes:		
Co's	At the end of successful completion of the course, the student will be able to	Bloom's Taxonomy
CO1	Demonstrate understanding of 3D printing technologies and their applications	**Understand**
CO2	Operate and troubleshoot common 3D printers.	**Apply**
CO3	Perform set of instructions, setting printer parameters, and managing print jobs.	**Apply**
CO4	Develop rapid prototypes for real-world applications.	**Create**

Description		
The **3D Printing Laboratory** is designed to provide students with comprehensive knowledge and practical skills in additive manufacturing technologies. The lab equips students with the ability to design, model, and fabricate three-dimensional objects using various 3D printing techniques and materials.		
Prerequisites	**1.**	Basic knowledge of Computer-Aided Design (CAD) tools
	2.	Familiarity with mechanical systems and materials
	3.	Fundamental understanding of manufacturing processes

Practicals

Sr. No.	Practical Topic	Hrs.
1	Introduction to Additive Manufacturing (History, types of 3D printing, applications)	4
2	3D Modeling using TinkerCAD/Fusion 360 (Designing printable models, exporting .STL)	2
3	Ultimaker Cura Software and Printer Setup (Print settings, material selection)	2
4	Hands-on 3D Printing and Troubleshooting (Calibration, test prints, fault fixing)	4
5	Post-processing and Evaluation (Cleaning, finishing, dimensional testing)	2
6	Prototype Design and Fabrication (Develop functional prototype and document process)	4

References

Text Books

1. *Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing* – Ian Gibson, David Rosen, Brent Stucker
2. *3D Printing: A Practical Guide for Librarians* – Sara Russell Gonzalez, Denise Beaubien Bennett

Reference Books

1. *3D Printing and Additive Manufacturing: Principles and Applications* – Chee Kai Chua, Kah Fai Leong
2. *Mastering 3D Printing* – Joan Horvath
3. *Fusion 360 for Makers* – Lydia Sloan Cline

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Mahadik Sachinkumar Shashikant	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING

23UGPEC3-ME6051LP- INTERNAL COMBUSTION ENGINE LAB

Practicals : 02 Hrs/Week
Credits : 01

Evaluation Scheme
ISA : 25 Marks
POE : 25 Marks

Course Objectives: The objective of the course is to	
1	Learn different parts of reciprocating IC engines and their functions
2	Study of modern fuel supply system in S. I Engine
3	Study of Diesel injection system in C. I Engine
4	Test the performance of IC engines with help of engine test rig.
Course Outcomes:	
Co's	At the end of successful completion of the course, the student will be able to
CO1	Describe and explain the constructional features and functions of various components of internal combustion engines.
CO2	Understand functional details of Fuel supply systems in SI Engine
CO3	Understand functional details of engine systems in CI Engine
CO4	Evaluate the IC engines performance parameters by conducting experiments.

Description		
IC engines lab consists of a practical study of whole IC engines (different parts and systems) with help of demonstrative engines. The course also covers the testing of SI and CI engines and evaluation of performance of these engines for different performance parameters.		
Prerequisites	**1.**	Engineering Thermodynamics
	2.	Fluid Mechanics
	3.	Fluid and Turbo Machinery

Sr. No	Practical Topic	Hours
1	Constructional details of Internal Combustion Engine	02
2	Study and Demonstration of fuel supply system in SI Engine	02
3	Study and Demonstration of fuel supply system in CI Engine	02
4	Test on four stroke Diesel Engine	02
5	Test on computerized IC engine.	02
6	Test on variable compression ratio engine.	02
7	Morse Test on Multi Cylinder Engine.	02
8	Visit PUC center and submit PUC certificate photocopy of your own vehicle Or Visit to an engine manufacturing company / repairing unit.	02

References

Text Books

1	"Internal Combustion Engines", V. Ganesan Tata McGraw Hill
2	"A Course in Internal Combustion Engines", Mathur & Sharma, R. P. Dhanapat Rai Publications.
3	"Course in Internal Combustion Engines", V. M Domkundwar, Dhanpat RaiPublication
4	"Advanced Internal Combustion Engines" R.K. Agarwal, PHI Learning Pvt. Ltd.

Reference Books

1	"Internal Combustion Engines",Maleev, CBS Publication andDistributors.
2	"Internal Combustion Engines", J. B. Heywood,Tata McGraw Hill Publication
3	"Internal Combustion Engines",Gills and Smith , Oxford and IBH PublishingCompany
4	"Internal Combustion Engines Fundamentals", E. F. Obert, Harper and Row Publication ,New York
5	"Engine Combustion and Emissions" M. R. W. M. R. Bradley, Butterworth-Heinemann

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Prof. A. S. Chavan	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING

23UGPEC3-ME6052LP–TRIBOLOGY

Practical : 02 Hrs/Week
Credits : 01

Evaluation Scheme
ISA : 25 Marks
POE :25 Marks

Course Objectives: The objective of the course is to	
1	Understand the Fundamentals of Tribology
2	Analyze Surface Interactions and Material Behavior
3	Apply Lubrication Theory to Practical Systems
4	Evaluate Wear Mechanisms and Select Suitable Materials and Lubricants

Course Outcomes:

Co's	At the end of successful completion of the course, the student will be able to	Bloom's Taxonomy
CO1	Understand the fundamentals of tribology and associated parameters	Understand
CO2	Identify and explain various friction and wear mechanisms	Remember Understand
CO3	Select proper lubricants and lubricant methods for different applications	Apply
CO4	Suggest compatible materials to machineries to reduce wear and friction	Apply Analyze

Description

Majority of mechanical equipment / mechanisms involve relative motion of links or parts. The course intends to impart concepts of friction, wear and lubrication and application of tribology in design of mechanical components is also introduced.

Prerequisites		
	1.	Fluid Mechanics
	2.	Applied Mechanics

Sr.No.	**Name of Practical**	**Hours**
1	Determine the coefficient of friction for different conditions and different material pairs.	2
2	Assess rolling type abrasion resisting life for various types of industrial materials	2
3	Experiments on wear measurement	2
4	Study effect of lubricants and their properties on friction and wear.	2
5	Study effect of additives on lubricant performance.	2
6	Experimental study on Journal bearing performance.	2
7	Experiment on gas lubricated bearing.	2

References

Text Books

1	Principles and Application of Tribology, B. Bhushan, Wiley.
2	Fundamentals of Tribology, S. K. Basu, S. N.Sengupatha and D. B.Ahuja, PHI.
3	"Engineering Tribology ",SahooPrasanta , PHI Learning Pvt.Ltd.
4	"Tribology in Industries"by Shushil Kumar Srivastava by S.Chand Publications

Reference Books

1	Applied Tribology (Bearing Design and Lubrication), by Michael M Khonsari, John Wiley & Sons (2001).
2	Principles of Tribology, by J Halling, The Macmillan Press Ltd,London, (1975).
3	Friction, Wear, Lubrication: A textbook in Tribology, by Ludema K C, CRC Press, (2010).
4	Fundamentals of Engineering Tribology with Applications by Harish Hirani, Cambridge English (2017)

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Dr. Lingaraju S.V	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING

23UGPEC3-ME6053LP–Piping Design Lab

Practicals : 02 Hrs/Week
Credits : 01

Evaluation Scheme
ISA : 25 Marks
POE :25 Marks

Course Objectives: The objective of the course is to	
1	Introduce students to the fundamentals of plant design using 3D software.
2	Develop students' skills in 3D modeling of equipment, piping, and structures.
3	Enable students to create and modify various components in 3D software.
4	Familiarize students with drafting, dimensioning, labeling, and clash checking in a plant design environment.

Course Outcomes:		**Bloom's Taxonomy**
Co's	At the end of successful completion of the course, the student will be able to	
CO1	Understand the basic concepts and applications of 3D software in piping engineering	Remember Understand
CO2	Model equipment, piping, and structures using AVEVA E3D.	Apply Analyze
CO3	Modify equipment, pipe work, and structural elements using AVEVA E3D	Apply Analyze
CO4	Generate drafts with dimensions, labels, and tags, and perform clash checks.	Apply Analyze

Description		
• This course provides basic introduction to Plant design by using AVEVA E3D software and its use in EPC industry. • AVEVA E3D as it is known in the 3D CAD industry, is a customizable, multi-user and multi-discipline, engineer controlled design software package for engineering, procurement and construction projects in offshore and onshore		
Prerequisites	**1.**	Basic Mechanical Equipment design concepts
	2.	Strength of material concepts
	3.	Basic information of any CAD tool

Practicals

Sr. No.	PracticalTopic	Hrs.
1	**Introduction to Piping and AVEVA E3D**: E3D database, E3D login, E3D Modules, E3D usage and application, History of E3D, GUI Introduction, E3D Mouse button operations and shortcut Keys, Advantages E3D.	2
2	**Equipment Modelling:** Creating Primitives/Nozzles, Orienting and Dimensioning Primitives / Nozzles, Modifying Primitives/Nozzles.	6
3	**Pipe work Modeling:** Pipe Routing,Adding/Modifying Components Supports.	6
4	**Structural Modeling:** Creating/Modifying Columns & Beams Adding walls and floors, Adding panels.	6
5	**Introduction to Drafting:** Dimensioning, Labeling, Tagging, Clash checking.	4

References	
Text Books	
1	
2	

Reference Books	
1	
2	
3	

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty: Dr. M. S. Dhuttargaon	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

Member Secretary
Board of Studies

Chairman
Board of Studies

Academic Dean
T.K.I.E.T., Warananagar

Principal
T.K.I.E.T., Warananagar

Chairman
Board of Studies
MECHANICAL ENGG. DEPT.
...ra Institute of Engg.
... Technology (Autonomous)
...nagar, Dist. Kolhapur

DEPARTMENT OF MECH. ENGINEERING
T.K.I.E.T Warananagar

23UGVSEC-ME609L – AVEVA E3D Design Lab

Practicals : 02 Hrs/Week
Credits : 01

Evaluation Scheme
ISA : 25 Marks
POE : 25 Marks

Course Objectives: The objective of the course is to	
1	Introduce students to the fundamentals of plant design using AVEVA E3D software.
2	Develop students' skills in 3D modeling of equipment, piping, and structures.
3	Enable students to create and modify various components in AVEVA E3D.
4	Familiarize students with drafting, dimensioning, labeling, and clash checking in a plant design environment.

Course Outcomes:		**Bloom's Taxonomy**
Co's	At the end of successful completion of the course, the student will be able to	
CO1	Understand the basic concepts and applications of AVEVA E3D software in process engineering	**Remember Understand**
CO2	Model equipment, piping, and structures using AVEVA E3D.	**Apply Analyze**
CO3	Modify equipment, pipe work, and structural elements using AVEVA E3D	**Apply Analyze**
CO4	Generate drafts with dimensions, labels, and tags, and perform clash checks.	**Apply Analyze**

Description

- This course provides basic introduction to Plant design by using AVEVA E3D software and its use in EPC industry.
- AVEVA E3D as it is known in the 3D CAD industry, is a customizable, multi-user and multi-discipline, engineer controlled design software package for engineering, procurement and construction projects in offshore and onshore

Prerequisites	**1.**	Basic Mechanical Equipment design concepts
	2.	Strength of material concepts
	3.	Basic information of any CAD tool

Practicals

Sr. No.	Practical Topic	Hrs.
1	**Introduction to Piping and AVEVA E3D**: E3D database, E3D login, E3D Modules, E3D usage and application, History of E3D, GUI Introduction, E3D Mouse button operations and shortcut Keys, Advantages E3D.	2
2	**Equipment Modelling:** Creating Primitives/Nozzles, Orienting and Dimensioning Primitives / Nozzles, Modifying Primitives/Nozzles.	6
3	**Pipe work Modeling:** Pipe Routing, Adding/Modifying Components Supports.	6
4	**Structural Modeling:** Creating/Modifying Columns & Beams Adding walls and floors, Adding panels.	6
5	**Introduction to Drafting:** Dimensioning, Labeling, Tagging, Clash checking.	4

References	
Text Books	
1	
2	

Reference Books	
1	
2	
3	

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty: Dr. M. S. Dhuttargaon	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

23UGELC-ME610L – MINI PROJECT

Lectures : 01
Practicals : 04 Hrs/Week
Credits : 03

Evaluation Scheme
ISA : 50 Marks
POE : NA

Course Objectives: The objective of the course is to	
1	To provide students hands on experience on, troubleshooting, maintenance, fabrication, innovation, record keeping, documentation etc. thereby enhancing the skill and competency part of technical education
2	To inculcate innovative thinking and thereby preparing students for main project.
3	To familiarize the process of solving the problem in a group.
4	Enhance teamwork, collaboration, and communication abilities

Course Outcomes:		**Blooms Taxonomy**
Co's	At the end of successful completion of the course, the student will be able to	
CO1	Identify small real engineering and societal problems through different types of surveys (Literature survey, Industrial survey etc.)	Understand Knowledge
CO2	Solve and analyze these problems by using software / analytical / computational tools and techniques by applying engineering principles.	Apply Analyze
CO3	Develop model / technical reports with presenting skills to defend their work in front of technically qualified audience.	Evaluate Create
CO4	Develop problem solving capabilities by self-learning in a team as well as an individual, which leads to lifelong learning.	Analyze

Practical:

Guidelines and Activities for Mini Project	
Allotment of Guide	Department will provide you project guide. Allotted guide takes care of the progress and completion of project work. He will entirely guide you, starting from the selection of topic to the completion.
Topic Selection	By doing the discussion along with your concerned guide decide the topic of the mini project. Project work shall be based on any of following 1. Design and development/fabrication of small setup/model 2. Theoretical/Software analysis of any small mechanical system/subsystem of large system 3. Testing and analysis of small mechanical system 4. Software program for any mechanical system design or analysis 5. Industrial survey of any mechanical systems, data collection and analysis

Literature review	After selection of topic student should collect related information by searching and xeroxing/ downloading the journal paper from various sources. Xeroxing the reference books pages related to their topic.
Review of Progress	In the middle of the activity, guide must take review of progress of mini project work for in time completion.
Fabrication and testing of model/Theoretical analysis /Surveying analysis/Testing of software program	Complete core part of your project under the instructions of guide.
Presentation of your work in the form of project report	Writing the Project report of 30 to 40 pages in standard format given by department.
Presentation of Mini Project	At the end, students have to give presentation in front of guide and one more faculty from department. This presentation will be assessed for 50 Marks internal term work. Student should have to submit two hard copies of good quality project reports to the department along with submission of the project diary and literature review file.
Files/Reports to submit as a Term Work	
Project Diary	It is simple note book in which students should keep the record of meetings, along with guide and their discussion about mini project. Also, you have to maintain the record of rough calculations, drawings and observations of your project.
Literature file	Collect all the information or material related to your topic (Xerox or printout of journal papers, reference books, Hand books, internet materials etc.) in one file.
Project Report	Project report should be of 30 to 40 pages (typed on A4 size sheets). For standardization of the project reports the following format should be strictly followed. 1. Page Size: Trimmed A4 2. Top Margin: 1.00 Inch 3. Bottom Margin: 1.00 Inches 4. Left Margin: 1.5 Inches 5. Right Margin: 1.0 Inch 6. Para Text: Times New Roman 12 Point Font 7. Line Spacing: 1.5 Lines 8. Page Numbers: Right Aligned at Footer. Font 12 point, Times New Roman 9. Headings: Times New Roman, 14 Point and Bold

	10. Certificate: Student should attach standard format of Certificate as described by the department. Certificate should have signatures of Guide, Head of Department and Principal/Director. 11. References: References should have the following format. a. For books: "Title of Book", Authors, Publisher, Edition b. For Papers: "Title of Paper", Authors, Journal/Conference Details, Year

Mapping of POs & COs

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

Video Lectures / Practicals

https://www.youtube.com/watch?v=-lIEzaKE_I

https://www.youtube.com/watch?v=Hj15c7Jog4k

https://www.youtube.com/watch?v=0oSDa2kf5I8

Sr. No.	Description	Signature
1	Name of Faculty: Prof. **M. S. Sawant**	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING
At./Post. Warananagar

23UGELC-ME611L – INDUSTRIAL INTERNSHIP

Practical : 2 weeks
Credits : 2

Evaluation Scheme
ISA: 50Marks

Course Objectives: The objective of this course is to

1. Provide students with practical exposure to industrial environments and real-world applications of engineering concepts.
2. Familiarize students with modern tools, equipment, technologies, and industrial practices.
3. Bridge the gap between theoretical knowledge and practical implementation.
4. Enhance problem-solving abilities, decision-making skills, and critical thinking in industrial scenarios.

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Understand the organizational structure, culture, and operations of a real-world industrial environment.	Understand
CO2	Apply theoretical knowledge of mechanical engineering to practical tasks, processes, or problems in an industrial setting.	Apply
CO3	Identify gaps between academic learning and industrial practices, and suggest ways to bridge them.	Understand Analyze
CO4	Prepare detailed report and presentation based on industrial tasks and experiences.	Analyze Apply

Description:

The students have to undergo an industrial training of minimum two weeks in an industry preferably dealing with mechanical engineering during the semester break after Fifth semester and complete within 15 calendar days before the start of sixth semester. The students have to submit a report of the training undergone and present the contents of the report before the evaluation committee constituted by the department. An internal evaluation will be conducted for examining the quality and authenticity of contents of the report and award the marks at the end of the sixth semester.
Report is based on compilation of work carried out by the students during their 15 days of industrial training.

Prerequisites:	1.	Domain knowledge of Mechanical Engineering.
	2.	Engineering Drawing and Design Skills.
	3.	Workshop, Practical Skills, Software and Simulation Tools (basic level).

Industrial Training Report Format	The **Industrial Internship Report** with 30 to 35 pages must be **handwritten** and submitted in **proper sequence** as per the prescribed format. Typed or printed reports will **not be accepted** under any circumstances. Students must ensure the following: • The report is neatly handwritten. • All sections are arranged in the correct sequence. • The report is properly bound and submitted on or before the deadline. Certificate: All students should attach standard format of Certificate as prescribed by the department. The report written by the students should be as per the following sequence. **Company Profile:** • Name, location, history. • Type of industry and products/services. • Organizational structure. • Major clients or markets served. **Internship Work Details:** • Department(s) assigned. • Daily/weekly activities. • Machines, processes, or software worked with. • Observations made. • Problems identified and solved (if any). **Technical Details:** • Description of mechanical systems, processes, or designs studied. • Diagrams, charts, photographs (if allowed). • Details of any mini-project or task completed. **Learning Outcomes:** • Skills and knowledge gained. • Industry practices observed. • Safety procedures followed. • Use of engineering principles in real-world settings. **Conclusion:** • Summary of experience. • Benefits of the internship. • Suggestions for future interns.

Mapping of POs & COs

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

Sr. No.	Description	Signature
1	Name of Faculty : Prof. P. B. Kadam	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

Member Secretary
Board of Studies

Chairman
Board of Studies

Academic Dean
T.K.I.E.T., Warananagar

Principal
T.K.I.E.T., Warananagar

Chairman
Board of Studies
MECHANICAL ENGG. DEPT.
Tatyasaheb Kore Institute of Engg.
& Technology (Autonomous)
Warananagar, Dist. Kolhapur

DEPARTMENT OF MECH. ENGINEERING