



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPC0501	L	T	P	Credit
Course Name:	Design of Machine Elements	3			3

Course Pre-Requisites:	1. Analysis of Mechanical Elements, 2. Kinematics of Mechanics, 3. Engineering Mathematics
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Course Description:	Design of Machine Elements course aims to design the mechanical elements as per the requirement to accomplish the objective of task. The design Engineer requires selecting standard components such as rolling contact bearings and sliding contact bearings. The knowledge of Machine design will enable students to understand the procedures of selection of bearings, design the mechanical components against fluctuating load. By applying the basic principles of machine design students should be able to design the Machine Elements like Shaft, Gears, Couplings, Welded and Bolted joints.
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Course Objectives:

1	To study fundamental principles in design of machine elements.
2	To learn to use of design data book for design of machine elements.
3	To learn to select machine elements from manufacturer's catalogue.
4	To design of components subjected to dynamic load and static loading.
5	To analyze the gears with respect to strength point of view.
6	To measure design parameters of mechanical systems.

Course Outcomes:	After the completion of the course the student will be able to
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COs	CO Statement	Blooms Level	Descriptor
CO1	Explain fundamental principles of fatigue and stress concentration in design of components.	II	Understand
CO2	Identify parameters required for design of mechanical Components.	III	Apply
CO3	Analyze the design parameters of mechanical components.	IV	Analyze
CO4	Develop elements of power transmission	IV	Analyze

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10% (10 marks)	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30% (30 marks)	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10% (10 marks)	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50% (50 marks)	100% course contents

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Theories of failure and Design against fluctuating load. Introduction on material designation as per standards, Theories of failure, Stress concentration, 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, Soderberg and Goodman diagrams, modified Goodman diagram.	8
2	Design of Shafts, Keys and Couplings Design of shafts on the basis of strength, Torsional rigidity and A.S.M.E. code, Design of keys and Splines, Design of Muff and Flange Couplings.	7
3	Design of Bolted and Welded Joints Design of bolted joints subjected to Eccentric Loading- 1) In a plane containing bolts, 2) Perpendicular to the axis of bolt. Welding symbols, Stresses in butt and fillet welds, Strength of butt, parallel and transverse fillet welds, Eccentric load in plane of welds, Welded joints subjected to bending moment.	7

4	Design of bearings Classification of bearings, static and dynamic load capacities, Stribeck's equation, equivalent bearing load, load- life relationship, Bearing life, 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, Introduction on Sliding contact bearing.	7
5	Design of Spur Gear and Helical Gear Spur Gear: Gear tooth loads, No. of teeth, face width, strength of gear teeth, static beam strength (Lewis equation), dynamic tooth load, wear strength (Buckingham's equation), Estimation of module based on beam strength and wear strength. Methods of gear lubrication. Terminology, Formative number of teeth in helical gears, force analysis, beam & wear strength of helical gears, effective load & design of helical gear.	10
6	Design of Worm and worm wheel Gear 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

Text Books:

Sr. No.	
1	Design of Machine Elements, Bhandari V. B Tata McGraw Hill New edition
2	Mechanical Engineering Design, Shigley J.E. and Mischke C.R. – McGraw Hill Publ. Co. Ltd.
3	Machine Design, R.K.Jain, Khanna Publication.
4	Machine Design, Pandya Shah, Charotar Publication.
5	Machine Design, U.C.Jindal, Pearson Education.
6	Introduction to Machine design, V.B. Bhandari, Tata McGraw Hill Publication, 2 nd Edition

Reference Books:

Sr. No.	
1	Machine Design – Black P.H. and O. Eugene Adams – McGraw Hill Book Co. Ltd.
2	Mechanical Design of Machine, Maleev V.L., Hartman J.B, CBS Pub. & Distributors,
3	Design Data Handbook – P.S.G. College of Technology, Coimbatore.
4	Hall A.S.; Holowenko A.R. and Laughlin H.G.Theory and Problems of Machine DesignI Schaum's outline series.
5	Machine Design, Hall, Holowenko Laughlin, Tata McGraw Hill Pub. Schaums Outline Series
6	Design of Machine Element, M.F.Spotts, Pearson Education Publication, 6 th Edition.
7	Machine Component Design, Robert C. Juvniail, Willey Ltd, 5th Edition.
8	Mechanical Design of Machine Elements and Machines, Jack A Collis Henry Busby, George StaabWiley Ltd., 2nd Edition.
9	Machine Design, P. Kannaiyah, Scitech Publication, 2 nd Edition.
10	Design Data Book, Mahadevan, CBS Publishers and Distributors Pvt Ltd, 4 th Edition.



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPC0502	L	T	P	Credit
Course Name:	MECHANICAL VIBRATIONS	2			2
Course Pre-Requisites:	Basics of mathematics, Physics, Analysis of Mechanical Elements, Dynamics of Machines				
Course Description:	Many practical applications need investigation of Vibration such as machines, engines, turbines, structures, etc. Study of causes and effects of vibrations and analysis which is necessary to improve performance of system and to optimize the system at both design stage and application stage. The subject contains - Introduction to vibrations, Single Degree of freedom Free and Forced Vibrations, Vibration Measurement along with its Applications.				

Course Objectives:

1	To carry out study of causes and effects of unbalance on Vibrations
2	To take overview of basic concepts of vibration analysis.
3	To study vibration analysis of Single degree of freedom systems
4	To acquaint students with the principles of vibration measuring instruments.

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Explain fundamentals of Balancing and Vibration of Mechanical systems.	II	Understand
CO2	Solve numerical of natural frequency of mechanical system	III	Apply
CO3	Analyze vibratory response of mechanical system.	IV	Analyze
CO4	Evaluate mathematical model to represent dynamic system	V	Evaluate

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Unit 1:--- Balancing Static and Dynamic balancing of rotary and reciprocating masses. Primary and Secondary forces and couples. Balancing of Single cylinder, Multi cylinder-Inline Engines. Function of flywheel and Study of turning moment diagram.	08 Hrs
2	Unit 2:---Free Vibrations (SDOF) Basic concepts and definitions, vibration measuring parameters- Displacement, Velocity and acceleration, Free and forced vibrations, Equivalent Springs. Types of damping. Free vibrations with and without damping (Rectilinear, Torsional & Transverse), Degree of damping. Logarithmic decrement, equivalent viscous damping, Coulomb damping.	08 Hrs
3	Unit 3:---Forced Vibrations (SDOF) Forced vibrations with viscous damping, magnification factor, frequency response curves, vibration isolation and transmissibility, forced vibrations due to support excitation. Critical speed of shafts.	07 Hrs
4	Unit 4:- Vibration Measurement and Applications : Instruments for measurement of displacement, velocity, acceleration and frequency of vibration, Sensors and Actuators, signal conditioners, Time and frequency domain plot, Spectral analyzers, Exciters, FFT analyzer.	07 Hrs

Text Books:

Sr. No.	
1	Ratan S.S., "Theory of Machines", Tata McGraw Hill, New Delhi, 3rd Edition, 2011.
2	Sadhu Singh, "Theory of Machines", Pearson Education, 2nd Edition, 2009
3	H. G. Phakatkar, "Theory of Machines I", Edition 2009, Nirali Publication, 5th Edition 2009
4	Mechanical Vibrations by Grover G.K., Nemchand Publications.

Reference Books:	
Sr. No.	
1	Hamilton H Mabie and Charles F Reinholtz, (1987), “Mechanisms and Dynamics of Machinery”, Fourth Edition, John-Wiley and Sons, Inc., New York.
2	Ghosh A. and Mallick A.K., (1988), “Theory of Mechanisms and Machines”, Affiliated East-West Press Pvt. Ltd., New Delhi.
3	William T Thomson, Marie Dillon Dahleh and Chandramouli Padmanabhan, (2004), “Theory of Vibration with applications”, Fifth Edition, Pearson Education Publishers
4	Theory of Machines by Dr. V.P.Singh, Dhanpat Rai Publications.
5	Theory of Machines by Ballaney, Khanna Publications



Kolhapur Institute of Technology's College of Engineering Kolhapur (Autonomous)

Department of Mechanical Engineering

Course Code:	UMEPC0503	L	T	P	Credit
Course Name:	HEAT TRANSFER	3			3
Course Pre-Requisites:	Differential calculus, integral calculus, Fluid mechanics				
Course Description:	The course deals with fundamentals aspects of heat transfer. The knowledge of heat transfer is necessary for design of thermal equipments in the industry and simulation using Computational Fluid dynamics and Heat transfer.				

Course Objectives:

1	To prepare students of Mechanical Engineering to excel in heat transfer problems related to thermal Engineering so as to succeed in careers in industry, technical professions or entrepreneurship.
2	To provide students with a solid foundation in mathematics, science and engineering fundamentals required to solve engineering problems in heat transfer and also to pursue higher studies.
3	To train students with good scientific and engineering breadth in the areas of heat transfer so as to comprehend, analyze, design and create novel products and solutions for the real life problems.

Course Outcomes: After the completion of the course the student will be able to

COs	Upon completion of the course, students shall have ability to	Blooms Level	Descriptor
CO1	Explain fundamentals of Heat Transfer mechanisms.	II	Understand
CO2	Develop differential equations for Heat Transfer mechanisms .	III	Apply
CO3	Analyze the performance of heat transfer devices.	IV	Analyze
CO4	Estimate the rate of heat transfer at specified temperature difference.	V	Evaluate

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	BASICS OF HEAT TRANSFER AND ONE DIMENSIONAL STEADY STATE HEAT CONDUCTION 1.1 Basics of Heat Transfer: Thermodynamics and Heat Transfer, Heat Transfer Mechanisms and Basic Laws Simultaneous Heat Transfer Mechanisms. Problem Solving Techniques in Heat Transfer. 1.2 Heat Conduction Equation: General Heat Conduction Equation: Rectangular Coordinates, Cylindrical Coordinates and Spherical Coordinates. 1.2.1 One Dimensional Steady State Heat Conduction Without Heat Generation: Plane Wall, Cylinder, Sphere. Boundary and Initial Conditions. Variable Thermal Conductivity. Concept of Thermal Resistance Thermal Contact Resistance, Overall Heat Transfer Coefficient. Critical Radius of Insulation. 1.2.2 One Dimensional Steady State Heat Conduction With Heat Generation: Plane Wall, Cylinder and Sphere.	6
2	ONE DIMENSIONAL UNSTEADY STATE HEAT CONDUCTION AND EXTENDED SURFACES 1.2.2: Transient Heat Conduction: Lumped System Analysis, Significance of Biot and Fourier Number. Transient Heat Conduction in Large Plane Walls, Long Cylinders, and Spheres With Spatial Effects Transient Heat Conduction in Semi-Infinite Solids. 1.2.3 Extended Surfaces (Finned Surfaces): Types of fins, applications, Expression for Heat Transfer, Temperature Distribution, fin efficiency and Fin effectiveness based fin tip condition, Error estimation in Thermowell.	8

3	CONVECTION 3.1 Fundamentals of Convection: Physical Mechanism of Convection, Velocity and Thermal Boundary Layer, Differential Convection Equations (Mass, Momentum and Energy Equations), Solution of Convection Equations for a Flat Plate. Reynolds and Chilton-Colburn Analogy. Buckingham's Pi Theorem applied to Forced and Free Convection, Physical Significance of dimensionless numbers. 3.2 External Forced Convection: Local and Average Heat Transfer Coefficient, Parallel Flow over Flat Plates, Flow Across Cylinders and Spheres, Flow Across Tube Banks. 3.3 Internal Forced Convection: Mean Velocity and Mean Temperature, Laminar Flow in tubes, Turbulent Flow in Tubes. 3.4 Natural Convection: Physical Mechanism of natural Convection, Natural Convection Over surfaces. Natural Convection inside enclosures. Combined Natural Convection and Radiation. Combined Natural and Forced Convection.	8
4	THERMAL RADIATION 4.1 Fundamentals of Thermal Radiation: Nature of radiation, electromagnetic wave spectrum, Black Body Radiation, Laws of Radiation, Radiation Intensity, Irradiation,Radiosity, Spectral Quantities, Radiative Properties, The Greenhouse Effect. 4.2 Radiation Heat Transfer: View Factor, Radiation Heat Transfer Between Black Surfaces, Radiation Heat Transfer Between Non-Black Surfaces, Radiation Shields, Problem Solving using Electrical Analogy, Radiation Effect on Temperature Measurements.	7
5	HEAT EXCHANGERS Types of Heat Exchangers, Overall Heat Transfer Coefficient, Effect of Fouling, Analysis of Heat Exchangers (Parallel and Counter Flow); LMTD and Effectiveness NTU Methods, Multi pass and Cross Flow Heat Exchangers. Selection of Heat Exchangers.	8
6	COOLING OF ELECTRONIC EQUIPMENT Introduction and History, Importance of Heat Transfer in Electronics, Cooling Load of Electronic Equipment, Conduction Cooling, Air Cooling, Liquid Cooling, Immersion Cooling, Heat Pipes, Thermoelectric Coolers, Electrohydrodynamic Flow, Synthetic Jet, Microchannel Cooling, Cooling by nano fluids.	8
Text Books:		
Sr. No.		
1	Heat Transfer: A Practical Approach, Yunus A. Cengel , McGraw-Hill Higher Education; 2 edition	
2	Fundamentals of Heat & Mass Transfer ,7th Edition, Frank P. Incropera, Wiley.	
3	A Course in Heat and Mass Transfer,: S. C. Arora (Author), S. Domkundwar (Author), Anand V. Domkundwar	
4	Heat and Mass transfer: J Holman (Author), Souvik Bhattacharyya , McGraw Hill Education; 10 edition	
5	Heat Transfer- Thermal Management of Electronics, Younes Shabany, CRC Press, Indian Edition.	
Reference Books:		
Sr. No.		
1	Fundamentals of Engineering Heat and mass transfer, R C Sachdeva, NEW AGE; Fourth edition	
2	Heat And Mass Transfer, Data Book, C.P. Kothandaraman, New Age International Private Limited; Ninth edition.	



Kolhapur Institute of Technology's College of Engineering Kolhapur (Autonomous)

Department of Mechanical Engineering

Course Code:	UMEPC0531	L	T	P	Credit
Course Name:	HEAT TRANSFER LAB			2	1
Course Pre-Requisites:	Differential calculus, Integral calculus, Fluid mechanics				
Course Description:	The course deals with various experiments related to conduction, convection and radiation mode of heat transfer so as to understand the fundamentals and application of governing equations used in heat transfer.				

Course Objectives:

1	To provide the students the fundamentals of conduction, convection and radiation.
2	To train students with good scientific and engineering breadth in the areas of heat transfer, so as to comprehend, analyze, design and create novel products and solutions for the real life problems

Course Outcomes: After the completion of the course the student will be able to

COs	Upon completion of the course, students shall have ability to	Blooms Level	Descriptor
CO1	Explain fundamentals of Heat Transfer mechanisms.	II	Understand
CO2	Develop differential equations for Heat Transfer mechanisms .	III	Apply
CO3	Analyze the performance of heat transfer devices.	IV	Analyze
CO4	Estimate the rate of heat transfer at specified temperature difference.	V	Evaluate

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (ISE)	100%	Experiments conducted and Journal
2	End Semester Examination (ESE)	100%	Experiments conducted and Journal

Course Contents:

Expt No.	Experiment Name	No. of Hours
1	Heat transfer through composite wall	2
2	Thermal conductivity of metal rod	2
3	Heat transfer through lagged pipe	2
4	Thermal conductivity of insulating powder	2
5	Heat transfer by natural convection	2
6	Heat transfer by forced convection	2
7	Stefan -Boltzmann apparatus	2
8	Emissivity measurement apparatus	2
9	Heat transfer through pin fin	2
10	Parallel and counter flow heat exchanger	2

Text Books:

Sr. No.	
1	Heat Transfer: A Practical Approach, Yunus A. Cengel , McGraw-Hill Higher Education; 2 edition
2	Fundamentals of Heat & Mass Transfer ,7th Edition, Frank P. Incropera, Wiley.
3	A Course in Heat and Mass Transfer,; S. C. Arora (Author), S. Domkundwar (Author), Anand V. Domkundwar
4	Heat and Mass transfer: J Holman (Author), Souvik Bhattacharyya , McGraw Hill Education; 10 edition
5	Heat Transfer- Thermal Management of Electronics, Younes Shabany, CRC Press, Indian Edition.

Reference Books:

Sr. No.	
1	Fundamentals of Engineering Heat and mass transfer, R C Sachdeva, NEW AGE; Fourth edition
2	Heat And Mass Transfer, Data Book, C.P. Kothandaraman, New Age International Private Limited; Ninth edition.



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPC0532	L	T	P	Credit
Course Name:	MECHANICAL VIBRATIONS Lab			2	1
Course Pre-Requisites:	Basics of mathematics, Physics, Analysis of Mechanical Elements, Dynamics of Machines				
Course Description:	Many practical applications need investigation of Vibration such as machines, engines, turbines, structures, etc. Study of causes and effects of vibrations and analysis which is necessary to improve performance of system and to optimize the system at both design stage and application stage. The subject contains - Introduction to vibrations, Single Degree of freedom Free and Forced Vibrations, Vibration Measurement along with its Applications.				

Course Objectives:

- 1 To carry out study of causes and effects of unbalance on Vibrations
- 2 To take overview of basic concepts of vibration analysis.
- 3 To study vibration analysis of Single degree of freedom systems
- 4 To acquaint students with the principles of vibration measuring instruments.

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Explain fundamentals of Balancing and Vibration of Mechanical systems.	II	Understand
CO2	Solve numerical of natural frequency of mechanical system	III	Apply
CO3	Analyze vibratory response of mechanical system.	IV	Analyze
CO4	Evaluate mathematical model to represent dynamic system	V	Evaluate

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (ISE)	25	Practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group
2	End Semester Examination (ESE)	25	100% course contents

Course Contents:

Unit No.	Unit Content	No. of Sessions
1	Experiment No. 1:- Experiment on Balancing of rotary masses (Static and Dynamic). Aim & Objectives: To observe the principles of static and dynamic balancing . Outcomes: Able to analyze rotary system for static and dynamic balancing. Experimentation: To arrange the given masses in Angular and linear positions for complete static and Dynamic balance. Results and Discussions: To find Angular and linear positions of masses analytically and to verify the results.	02 Hrs
2	Experiment No. 2:- Experiment on equivalent spring mass system. Aim & Objectives: To determine Natural Frequency of equivalent spring mass system. Outcomes: Able to determine Natural frequency experimentally. Experimentation: Determination of time period and natural frequency. Results and Discussions: Comparison between Analytical and Experimental natural Frequency.	02 Hrs
3	Experiment No.3 :-Determination of logarithmic decrement for single DOF damped system Aim & Objectives: To determine logarithmic decrement for Torsionally vibratory system. Outcomes: Able to analyze effect of damping on vibratory system Experimentation: Plotting the logarithmic decrement of Torsionally vibratory system. Results and Discussions: Calculation of damping coefficient for vibrating systems.	02 Hrs
4	Experiment No. 4:- Experiment on study of forced vibration characteristics Aim & Objectives: To study effect of exciting force on characteristics of vibrations Outcomes: Able to determine forced vibration characteristics like Amplitude and Frequency. Experimentation: To plot the graph Amplitude vs Time for forced vibrations Results and Discussions: Determination of Maximum Amplitude and Natural Frequency for the Systems subjected to forced vibrations.	02 Hrs

5	Experiment No. 5:- Experiment on Whirling of Shaft Aim & Objectives: To study whirling of shafts Outcomes: Able to measure speed of shaft at which whirling takes place Experimentation: To measure speed of rotating shaft which is whirling. Results and Discussions: To measure critical speed of whirling.	02 Hrs
6	Experiment No. 6: Study and demonstration of vibration measuring instruments. Aim & Objectives: To study various Vibration measuring instruments. Outcomes: Able to select suitable vibration measuring instrument for specific application. Experimentation: To measure vibration parameters of machineries. Results and Discussions: To measure vibration parameters and its significance.	02 Hrs
7	Experiment No.7: Study of signal analysis, filtering and data acquisition. Aim & Objectives: To study techniques of signal analysis, filtering and data acquisition. Outcomes: Able to select suitable techniques of signal analysis, filtering and data acquisition for suitable application. Experimentation: Able to select suitable techniques of signal analysis, filtering and data acquisition. Results and Discussions: To process the signal analysis, filtering and data acquisition for mechanical systems.	02 Hrs
8	Experiment No.8: Case study of Bearing fault analysis using vibration measurement. Aim & Objectives: To analyze various bearing faults and its signals. Outcomes: To identify bearing faults with vibration signals .	02 Hrs
9	Experiment No.9 : Case study of Gear box fault analysis using vibration measurement. Aim & Objectives: To analyze various gear faults and its signals. Outcomes: To identify gear faults with vibration signals.	02 Hrs
10	Experiment No 10:- Industrial visit based on above syllabus. Aim & Objectives : To make students acquainted to balancing of components like Gears, Pulleys used in Industry. Outcomes: Able to understand industrial procedure for Static and Dynamic Balancing. Experimentation: Demonstration of Measurement and removal of unbalance of Pulley using Balancing Machine.	02 Hrs

Text Books:

Sr. No.	
1	Ratan S.S, “Theory of Machines”, Tata McGraw Hill, New Delhi, 3rd Edition, 2011.
2	Sadhu Singh, “Theory of Machines”, Pearson Education, 2nd Edition, 2009
3	H. G. Phakatkar, “Theory of Machines I”, Edition 2009.Nirali Publication, 5th Edition 2009
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1	Hamilton H Mabie and Charles F Reinholtz, (1987), “Mechanisms and Dynamics of Machinery”, Fourth Edition, John-Wiley and Sons, Inc., New York.
2	Ghosh A. and Mallick A.K., (1988), “Theory of Mechanisms and Machines”, Affiliated East-West Press Pvt. Ltd., New Delhi.
3	William T Thomson, Marie Dillon Dahleh and Chandramouli Padmanabhan, (2004), “Theory of Vibration with applications”, Fifth Edition, Pearson Education Publishers
4	Theory of Machines by Dr. V.P.Singh, Dhanpat Rai Publications.
5	Theory of Machines by Ballaney, Khanna Publications

Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:			UMEPE0511								L		T		P		Credit	
Course Name:			Automobile & EV Technology								3		-		-		3	
Course Pre-Requisites:			Basic Mechanical Engineering, I. C Engine, Basic knowledge about electric motors.															
Course Description:			This course discusses the fundamental concepts, principles and analysis of hybrid and electric vehicles. This course discusses the various EV subsystems such as electric motors, motor controllers, energy storage devices, battery management system, charging technology etc.															
Course Objectives:																		
1		To make students familiar with various basic systems of a modern automobile.																
2		To introduce the mathematical treatments required for vehicle performance																
3		To make students aware about latest trends in transportation towards a safe, pollution free and fully automatic vehicle.																
4		To empower students to face the real life automotive usage with greater confidence.																
Course Outcomes:				After the completion of the course the student will be able to														
COs		CO Statement										Blooms Level			Descriptor			
CO1		Explain different automobile systems and components.										II			Understand			
CO2		Show the impact of EV on environment and sustainability.										II			Understand			
CO3		Demonstrate the structure of electric vehicle.										II			Understand			
CO4		Identify design parameters of Electric vehicles for a given requirement.										III			Apply			
CO-PO Mapping:																		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3				
CO1	2										1	2	1	1				
CO2	2					2					1	2	1	1				
CO3	2					1					1	2	1	1				
CO4	2	1	2	1		1					1	2	1	1				
Assessment Scheme:																		
SN	Assessment					Weightage			Remark									
1	In Semester Evaluation 1 (ISE1)					10%			Assignment, Test, Quiz, Seminar, Presentation, etc.									
2	Mid Semester Examination (MSE)					30%			50% of course contents									
3	In Semester Evaluation 2 (ISE2)					10%			Assignment, Test, Quiz, Seminar, Presentation, etc.									
4	End Semester Examination (ESE)					50%			100% course contents									
Course Contents:																		
Unit No.	Unit Content													No. of Lectures				
1	Introduction to Electric Vehicles History of electric vehicles, Development towards 21st century, Automobile history and development, Classification, vehicle layouts- engine location and drive arrangement, specifications of vehicles, Type of vehicle bodies, Environmental impact, Social and environmental importance of hybrid and electric vehicles, Fuel Cell EV.													6				
2	Transmission System Clutch – Function and requirements, Classification, Construction and working of Single-plate, Multi-plate, Diaphragm spring and centrifugal clutches, Fluid flywheel. Gear Box – Necessity, classification, construction of manual gear boxes like Sliding mesh, constant mesh, Synchromesh, Epicyclic gear train, Automatic transmission, Overdrive. Propeller shaft, Differential and final drive.													8				
3	Vehicle Systems Steering system - function, principle of steering, Types of steering gearbox, power steering. Suspension system - Functions, Types of suspension systems, types of springs. Braking system - Need, principle, types, Mechanical, hydraulic and pneumatic brakes, disc and drum types, air brakes, Anti-lock braking system. Electrical Systems - Automotive batteries, battery charging system, alternators, lighting and electrical accessories, automobile air conditioning													8				
4	Vehicle Performance Resistance to vehicle motion, Air, Rolling and Gradient resistance, Acceleration, Gradeability and draw bar pull, Traction and Tractive effort, Distribution of weight, Power required for vehicle propulsion, Selection of gear ratio, Rear axle ratio. (Numerical)													9				
5	Electric vehicles – technology and design Configuration of EVs, Electric motor characteristics, design process and issue, modelling and performance estimation, energy consumption, regenerative breaking.													7				
6	Hybrid electric vehicle technology Concepts, modes and operation patterns, architectures of hybrid drive trains, series hybrid drive train, parallel hybrid drive train.													7				
Text Books:																		
Sr. No.																		

1	“Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, C. Mi, M. A. Masrur and D. W. Gao, John Wiley & Sons, 2011
2	“Hybrid Electric Vehicles: Energy Management Strategies”, S. Onori, L. Serrao and G. Rizzoni , Springer, 2015
3	Kripal Singh, Automobile Engineering Vol II, Standard Publishers Distributors, Tenth Edition , 2007
4	P S Gill, Automobile Engineering II, S K Kataria and Sons, Second Edition, 2012
5	R K Rajput, Automobile Engineering, Laxmi Publications, First Edition, 2007
Reference Books:	
Sr. No.	
1	James Larminie, J. Lowry, “Electric Vehicle Technology Explained”, John Wiley & Sons Ltd. 2003.
2	M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
3	S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”,Springer, 2015.
4	Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.
5	Newton, Steeds and Garrett, The Motor Vehicle, Butterworths International Edition, 11th Edition, 1989



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPE0512	L	T	P	Credit
Course Name:	Tribology	3			3

Course Pre-Requisites:	Engineering Mathematics, Fluid Mechanics, Machine Design, Manufacturing Process
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Course Description:	Tribology is the study of friction, wear and lubrication, and design of Tribological Components, science of interacting surfaces in relative motion.
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Course Objectives:

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

Course Outcomes:	After the completion of the course the student will be able to
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COs	CO Statement	Blooms Level	Descriptor
CO1	Explain industrial and practical objectives of tribology Considering parameters of tribology triangle.	II	Understand
CO2	Explain mechanisms of friction and wear for metals, alloys,	II	Understand
CO3	Illustrate different types of lubrication system and methods.	II	Understand
CO4	Apply friction/lubrication mechanism to the practical engineering problem.	III	Apply

CO-PO Mapping:														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2										2	2	
CO2	2	2	1	1								2	2	
CO3	3	2	2	2								2	2	
CO4	2	1	2	2								2	2	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10% (10 marks)	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30% (30 marks)	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10% (10 marks)	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50% (50 marks)	100% course contents

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	INTRODUCTION OF TRIBOLOGY Tribology definition, Need of Tribology, Tribology in design, Tribology in industry (Maintenance), Lubrication- Definition, Lubricant properties, Viscosity, its measurements- Numerical, basic modes of lubrication, types of lubricants, Standard Grades of lubricants, selection of lubricants, commonly used lubricants and Hazards, Recycling of used oil, Disposal of used oil, bearing materials, Fundamentals of surface engineering, GreenTribology, Bearing Terminology-Types of Sliding contact, rolling contact bearings.	8
2	FRICTION Introduction, Laws of friction, kinds of friction, causes of friction, area of contact, friction measurement, theories of friction.	7
3	WEAR Types of wear, various factors affecting wear, measurement of wear, theories of wear, Wear debris analysis; Wear reduction methods.	7
4	HYDRODYNAMIC LUBRICATION Theory of hydrodynamic lubrication, mechanism of pressure development in an oil film. Two dimensional Reynolds equation, Petroff's equation, pressure distribution in journal bearings - long & short, Load Carrying capacity, Somerfield number and its importance- Numerical. Introduction to Hydrodynamic Thrust Bearing	8
5	HYDROSTATIC LUBRICATION Introduction to hydrostatic lubrication, hydrostatic step bearing, load carrying capacity and oil flow through the hydrostatic step bearing- Numerical. Hydrostatic squeeze film : basic concept, circular and rectangular plate approaching a plane-Numerical	7

6	DIAGNOSTIC MAINTENANCE AND CONDITION MONITORING Types of maintenance; Preventive and corrective Maintenance; Condition Based Maintenance and Condition Monitoring; Cost effectiveness. Different condition monitoring Techniques; Visual, performance, fluid and vibration monitoring. Fluid condition and particle monitoring; Fluid degradation and its identification methods; Chemical tests, infrared spectroscopy, calorimeter. Wear debris analysis; SOAP, Ferrography and other spectrometric analysis techniques for wear rate evaluation and interpretation. Vibration monitoring methods; Vibration data collection; Techniques; Instruments; Transducers; Commonly witnessed machinery faults diagnosed by vibration analysis.	8
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Text Books:

Sr. No.	
1	Engineering Tribology – Prasanta Sahoo – Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
2	Fundamentals of Tribology – S.K. Basu, S.N. Sengupta, B.B. Ahuja – PHI Learning Pvt. Ltd., 2010.
3	Tribology in Industries – S.K. Shrivastava – S. Chand & Company Ltd., New Delhi, 2001
4	Bearing Design in Machinery, Engineering Tribology and Lubrication - A. Harnoy- Marcel Dekker Inc., 2003
5	Bharat Bhushan, Principles and Applications of Tribology 2nd Edition, Wiley India
6	Mujumdar B. C., Introduction to Tribology and Bearings, S. Chand and Company Ltd. New Delhi.

Reference Books:

Sr. No.	
1	Cameron A., Basic Lubrication Theory, Wiley Eastern Ltd.
2	Bharat Bhushan, Principles and Applications of Tribology 2nd Edition, Wiley India
3	Mujumdar B. C., Introduction to Tribology and Bearings, S. Chand and Company Ltd. New Delhi.
4	Fuller D. D., Theory and Practice of Lubrication for Engineers, John Wiley and Sons.
5	Halling J., Principles of Tribology, McMillan Press Ltd.
6	Bhushan B. and Gupta B. K., Handbook of Tribology: Material, Coatings and Surface Treatments, McGraw Hill Ltd.
7	Davis J., Surface Engineering for Corrosion and Wear Resistance, Woodhead Publishing, 2001.
8	Tadausz Burakowski, Surface Engineering of Metals: Principles, Equipments and Technologies, Taylor and Francis.
9	Tribology in machine design- By -T. A. Stolarski
10	Tribology & design-edited by M. Hadfield, C. A. Brebbia, J. Seabra
11	Tribological Design of Machine Elements by D. Dowson, C.M. Taylor, M. Godet, D. Berthe



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPE0513	L	T	P	Credit
Course Name:	Machine Tool Design	3			3
Course Pre-Requisites:	Knowledge of basic mechanical engineering, analysis of mechanical elements				
Course Description:	This course aims to impart knowledge of machine tools and various operations performed on to it, using different cutting tools. Design of machine tool structures and drives, Design and analysis of systems for specified speeds and feeds and selection of subsystems for achieving high accuracy in machining.				

Course Objectives:

1	To understand all the traditional and basic machine tools used on these machines for varied applications.
2	To make the students understand the concepts & broad principles of machine tool design, regulation of speed and speed regulation, design of machine tool structure, dynamics of machine tools.
3	To study design procedure of guide ways, hoists, power screws and spindles
4	To understand design procedure of gear boxes for stepped drives

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Explain the fundamentals & basic concepts of metal removal process tools.	II	Understand
CO2	Identify the basic needs of machine tool components	III	Apply
CO3	Analyze design parameters of guide ways, power screws and spindles	IV	Analyze
CO4	Design the gear boxes for stepped drives.	VI	Create

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Unit 1: Principles of Machine Tool Design Introduction to machine tool, General requirements of machine tool design, Specifications and layout of machine tools, Machining rangediagram, Interference diagram, Parameter defining working motions of a machine tool. Working and auxiliary motion in machine, Machine tool drives, Hydraulic transmission, Mechanical transmission.	7
2	Unit 2: Design of Machine Tool Structure Fundamentals of machine tool structures and their requirements, Design criteria of machine tool structure, Materials for machine tool structure, Static and dynamic stiffness, Structure profiles, Design of beds and columns, Design of housing models, bases and tables, Design of saddle, carriages and rams	8
3	Unit 3: Stepped Drives of Machine Tools Gear drive, gear box design, graphical representation of gear box operation with ray diagram, structure diagram and deviation diagram. Gear Teeth Calculations. Basic introduction of any component of the gearbox on suitable analysis software.	8
4	Unit 4: Design of Guide-Ways And Power Screws Function and type of guide-ways, design of slide-ways, Protecting devices for slide-ways, Design of power screws.	8
5	Unit 5: Design of Spindles And Spindle Supports Materials for spindles, Design principles of spindles, selection of antifriction bearings, Sliding bearings for machines like lathe, CNC, VMC etc.	7
6	Unit 6: Design of Hoists Drives for hoisting, components, and hoisting mechanisms; rail traveling components and mechanisms; hoisting gear operation during transient motion; selecting the motor rating and determining breaking torque for hoisting mechanisms	7

Text Books:

Sr. No.	
1	Machine Tool Design- N.K. Mehta Tata McGraw Hill.
2	Design Principles of Metal Cutting Machine tool- F. Koenigsberger - Pergamon press
3	Machine Tool design Handbook CMTI Bangalore, McGraw-Hill

4	Sen and Bhattacharya,, “Principles of Machine Tools”, New Central Book Agencies
Reference Books:	
Sr. No.	
1	Manufacturing Science – Amit abha Ghosh and Mallik, Affiliated East West press, 2010, 2nd edition
2	Modern machining Process – Pandey and Shah, Tata McGraw Hill – 2009.
3	Manufacturing processes for Engineering Materials by Seropekalkpakijian and Steven R.Schimidpearson education 2009, 5th edition
4	Materials and Processes in Manufacturing by E. Paul De Garmo, J T Black, Ronald A Kohser, 8th Edition, Prentice Hall of India Private limited, 2004
5	Machine Tool Design, S.K. Basu, Oxford and IBH Publishing



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPE0514	L	T	P	Credit
Course Name:	Design Thinking	3			3
Course Pre-Requisites:	Innovative and Creative Mindset, Genuine interest towards Entrepreneurship Development and Product design and Development.				
Course Description:	This course introduces engineering students to the Design Thinking process—Empathize, Define, Ideate, Prototype, and Test. Learners will explore creativity techniques, prototyping methods, and modern tools like Figma and Miro. Through case studies and a group project, students apply Design Thinking to real-world engineering, business, and social challenges, building practical innovation skills.				

Course Objectives:

- CO1** To understand the Design Thinking process and its applications.
- CO2** To develop creative and critical thinking skills.
- CO3** To apply Design Thinking methodologies to solve complex problems.
- CO4** To enhance team collaboration and communication skills.

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Define the principles of Design Thinking and its application in engineering contexts.	I	Remember
CO2	Explain the Design Thinking process, including empathizing, defining, ideating, prototyping, and testing.	II	Understand
CO3	Classify prototypes and conduct user testing to iterate and improve design solutions.	IV	Analyze

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit No	Unit Content	No. of Lectures
1	Introduction to Design Thinking: Design Thinking Process: Empathize, Define, Ideate, Prototype, Test Historical Evolution and Importance Case Studies in Design Thinking	6
2	Empathizing and Problem Definition: Techniques for User Research and Empathy Mapping Defining Problem Statements Framing Design Challenges	7
3	Ideation Techniques: Brainstorming, Mind Mapping, and SCAMPER. Encouraging Creativity and Breaking Assumptions. Idea Evaluation and Selection	8
4	Prototyping and Testing: Types of Prototypes: Low-Fidelity to High-Fidelity. User Testing and Feedback Collection. Iterative Design and Improvements	8
5	Design Tools and Methodologies: Introduction to Tools like Canva, Figma, Miro. Methodologies: Design Sprints, Lean Design. Applying Tools to Develop Prototypes	8
6	Design Thinking in Practice: Real-Life Applications in Engineering, Business, and Social Impact Group Project: End-to-End Design Thinking Project Presentation and Reflection	8

Text Books:

Sr. No.	Books
1	Brown, Tim. Change by Design: How Design Thinking Creates New Alternatives for Business and Society. Harper Business, 2009.
2	Gupta, Praveen. Design Thinking for Startups. Notion Press, 2019.
3	Lewrick, Michael, Patrick Link, and Larry Leifer. The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems. Wiley, 2018.
4	Kelley, T., & Kelley, D. (2013). Creative confidence: Unleashing the creative potential within us all. Crown Business.
5	Soni, Pavan. Design Thinking: A Guide to Creative Problem Solving for Everyone. Penguin Random House India, 2020.
6	Curedale, R. A. (2013). Design thinking: Process and methods manual. Design Community College Inc.

7	Liedtka, Jeanne, and Tim Ogilvie. Designing for Growth: A Design Thinking Toolkit for Managers. Columbia Business School Publishing, 2011.
Reference Books:	
S.No.	
1	Mootee, I. (2013). Design thinking for strategic innovation: What they can't teach you at business or design school. Wiley.
2	Knapp, Jake, John Zeratsky, and Braden Kowitz. Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days. Simon &
3	Kelley, Tom. The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm. Currency /Doubleday, 2001.
4	Kaipa, Prasad. Design Thinking for Innovation. Rupa Publications, 2016.
5	Balaram, S. Thinking Design. National Institute of Design, 1998.
6	Ranjan, M. P. Design Thinking and Innovation in Business. National Institute of Design, 2009.
7	Deshmukh, Amit. Design Thinking: The Handbook. Notion Press, 2021.



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEVS0533	L	T	P	Credit
Course Name:	Advance Automobile Engineering Lab	-	-	2	1
Course Pre-Requisites:	Basic Mechanical Engineering, I. C Engine, Basic knowledge about electric motors.				
Course Description:	This course discusses the fundamental concepts, principles and analysis of hybrid and electric vehicles. This course discusses the various EV subsystems such as electric motors, motor controllers, energy storage devices, battery management system, charging technology etc.				

Course Objectives:

1	To make students familiar with various basic systems of a modern automobile technology.
2	To introduce the mathematical treatments required for vehicle performance
3	To make students aware about latest trends in transportation towards a safe, pollution free and fully automatic vehicle.
4	To empower students to face the real life automotive usage with greater confidence.

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Illustrate the basic concepts of electric vehicles.	II	Understand
CO2	Explain the different vehicle systems and components.	II	Understand
CO3	Identify electric vehicle troubleshooting and remedies.	III	Apply

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (ISE)	100%	25 Marks (based on experiments)

Course Contents:

Unit No.	Course Contents:	No. of sessions
1	Experiment No. 1:--- Study and demonstration of four-wheeler chassis layout and vehicle body parts and its materials.	1
2	Experiment No. 2:--- Study and Demonstration of working of single plate automobile clutch and synchromesh gearbox.	1
3	Experiment No. 3:--- Study and demonstration of final drive and differential.	1
4	Experiment No. 4:--- Study and Demonstration of Control systems – Braking system, steering system.	1
5	Experiment No. 5:--- Study and Demonstration of automobile systems –Suspension system, Electrical System.	1
6	Experiment No. 6:--- Demonstration of typical hybrid vehicle construction and operation.	1
7	Experiment No. 7:--- Regenerative braking with BLDC motor using bidirectional converter.	1
8	Experiment No. 8:--- Study of AC charger for electric vehicle.	1
9	Experiment No. 9:-- Experiment on wheel balancing and front wheel alignment.	1
10	Experiment No. 10:-- Visit to EV servicing station for study of vehicle maintenance, repairs and report.	1

Text Books:

Sr. No.	
1	Kripal Singh, Automobile Engineering Vol II, Standard Publishers Distributors, Tenth Edition , 2007
2	“Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, C. Mi, M. A. Masrur and D. W. Gao, John Wiley & Sons, 2011
3	“Hybrid Electric Vehicles: Energy Management Strategies”, S. Onori, L. Serrao and G. Rizzoni , Springer, 2015
4	P S Gill, Automobile Engineering II, S K Kataria and Sons, Second Edition, 2012
5	R K Rajput, Automobile Engineering, Laxmi Publications, First Edition, 2007

Reference Books:	
Sr. No.	
1	James Larminie, J. Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd. 2003.
2	M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
3	S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
4	Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003.
5	Newton, Steeds and Garrett, The Motor Vehicle, Butterworths International Edition, 11th Edition, 1989



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEEM0504	L	T	P	Credit
Course Name:	Supply Chain Management	2	0		2
Course Pre-Requisites:	Nil				
Course Description:	This course will outline various key concepts of supply chain management in a manufacturing or distribution firm. The course focuses on key concepts of Supply Chain Management, specifically Forecasting, Inventory, and Logistics Management.				

Course Objectives:

1	Introduce students to the basic principles and terminology of supply chain management.
2	Help students understand the role of supply chain management in mechanical engineering.
3	Provide an overview of key supply chain processes such as procurement, production, and distribution.
4	Familiarize students with basic tools and techniques used in supply chain analysis and optimization.

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Summarize the fundamental concepts, objectives, and decision phases of supply chain management.	II	Understand
CO2	Explain the role of integration and key drivers in achieving strategic fit and enhancing supply chain performance.	II	Understand
CO3	Apply forecasting and inventory control techniques to manage demand and optimize stock levels.	III	Apply
CO4	Explain the role of logistics and transportation in supply chain operations.	II	Understand

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	End Semester Examination (ESE)	100%	100% course contents (50 Marks)

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Unit-1:--- Supply Chain Concepts Introduction to Supply Chain Management, Objectives of a Supply Chain, Decision Phases in Supply Chain, Value Chain Process, Importance of Supply Chain Management, Cycle view of Supply Chain Process. Examples of Supply Chains.	7
2	Unit -2:--- Supply Chain Integration and Drivers Understanding the importance of integration in supply chain processes: Competitive and Supply Chain Strategies Achieving Strategic Fit. SCM drivers: Framework for Structuring Drivers Facilities, Inventory, Transportation Information, Sourcing, and Pricing, Supply Chain Performance: Bullwhip effect and reduction, Obstacles to Coordination in a supply chain, Performance measurement: Dimension, Tools of performance measurement.	8
3	Unit -3: Forecasting and Inventory Management Inventory Management: Basics of inventory management, Inventory control models (e.g., EOQ, safety stock), Estimating Cycle inventory costs, ABC analysis and inventory classification, Vendormanaged inventory (VMI), and Just-in-Time (JIT) inventory systems. Demand Forecasting in Supply Chain: Role of forecasting in the supply chain, components of forecast and forecasting methods, estimating forecasted demand using various methods, Measures of forecast errors. (Numerical Treatment is expected based on forecasting models and inventory management models)	8
4	Unit 4: Logistics Management: Logistics and transportation overview, the role of logistics/transportation in the supply chain, Warehouse design and management, Modes of transportation, and selection criteria for appropriate mode	7

Text Books:

Sr. No.	
1	Sunil Chopra & Peter Meindl – Supply Chain Management: Strategy, Planning, and Operation, Pearson Education.
2	R. Dan Reid & Nada R. Sanders – Operations Management: An Integrated Approach, Wiley.
3	R.P. Mohanty & S.G. Deshmukh – Supply Chain Management, Biztantra, New Delhi.
4	Ronald H. Ballou – Supply Chain Management, Pearson Education.
5	Daniel Stanton – Supply Chain Management For Dummies, Wiley.
Reference Books:	
Sr. No.	
1	Ronald H. Ballou – Business Logistics Management, Prentice-Hall Inc.
2	David Simchi-Levi, Philip Kaminsky, & Edith Simchi-Levi – Designing and Managing the Supply Chain, McGraw-Hill.
3	Martin Christopher – Logistics and Supply Chain Management, Pearson Education.
4	John T. Mentzer – Supply Chain Management, Sage Publications.
5	Chandra Mohan – Production and Operations Management, Himalaya Publishing House.



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEIL0571	L	T	P	Credit
Course Name:	Community Engagement Project	-	-	2	1
Course Pre-Requisites:	Basic sciences, mechanical engineering science				
Course Description:	New generation of students are increasingly unaware of local rural and peri-urban realities surrounding their HEIs, as rapid urbanization has been occurring in India. A large percentage of Indian population continues to live and work in rural and peri-urban areas of the country. While various schemes and programs of community service have been undertaken by HEIs, there is no singular provision of a well- designed community engagement course that provides opportunities for immersion in rural realities. Such a course will enable students to learn about challenges faced by vulnerable households and develop an understanding of local wisdom and lifestyle in a respectful manner.				

Course Objectives:

1	To make students more aware of the living conditions of those in their immediate vicinity and to assist them in realizing the harsh truths of society.
2	To help the students transform their mindset and cultivate societal awareness, sensitivity, accountability, and responsibility
3	To help students to initiate developmental activities in the community in coordination with public and government authorities.
4	To enable students to apply their knowledge to the betterment of their local communities.

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Identify the real-world problems and develop a suitable solution based on the fundamentals of mechanical engineering	VI	Create
CO2	Analyze the results and arrive at valid conclusions	IV	Analyse
CO3	Make use of technology in proposed work and demonstrate learning in oral and written form.	III	Apply
CO4	Develop ability to work as an individual and as a team member.	III	Apply

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (Lab ISE)	100%	25 Marks

Course Contents:

Preamble: To achieve the objectives of the socio-economic development of New India, HEIs can play an important role through active community engagement. This approach will also contribute to improve the quality of both teaching and research in HEIs in India. India is a signatory to the global commitment for achieving Sustainable Development Goals (SDGs) by 2030. Achieving these 17 SDG goals requires generating locally appropriate solutions. Community engagement should not be limited to a few social science disciplines alone. It should be practiced across all disciplines and faculties of HEIs. These can take the forms of enumerations, surveys, awareness camps and campaigns, training, learning manuals/films, maps, study reports, public hearings, policy briefs, cleanliness and hygiene teachings, legal aid clinics, etc. For example, students of chemistry can conduct water and soil testing in local areas and share the results with the local community. Students of science and engineering can undertake research in partnership with the community on solid and liquid waste disposal. Therefore, students are being encouraged to foster social responsibility and community engagement in their teaching and research.

The Community Engagement Project is an experiential learning approach that combines education, learning, community development, and meaningful community service.

- The Community Engagement Project involves students in community development and service activities and applies the experience to personal and academic development.
- The purpose of the Community Engagement Project is to establish a mutually beneficial relationship between the college and the community. The targeted contribution of college students to the village/local development will benefit the community. The college has an opportunity to help students become more socially conscious and responsible while simultaneously becoming a socially conscious organization.

Group Structure:

Working in supervisor/mentor –monitored groups. The students plan, manage and complete a task/project/activity which addresses the stated problem.

1. Create groups of 4-6 students in each class.
2. A supervisor/mentor teacher is assigned to 4-6 groups or one batch.

Procedure to implement community engagement project:

- A group of students or a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay, so as to enable them to commute from their residence and return back by evening or so.
- If required, students of the department will be divided into groups and each group is allotted to a faculty member of the department.
- The group of students will be associated with a government official / village authorities /NGOs etc. concerned, allotted by the district administration, during the duration of the project.
- The Community Engagement Project is a two-fold one –First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area.

Recommended field-based project activities (Tentative):

Community engagement field projects for mechanical engineering could include:

- ☐ Developing sustainable energy solutions like solar water pumps or wind turbine systems for rural communities,
- ☐ Designing accessible assistive devices for people with disabilities,
- ☐ Creating energy-efficient cooling systems for schools or public buildings,
- ☐ Building water filtration systems, or
- ☐ Developing educational workshops on basic mechanical concepts for local youth

Specific project ideas based on different mechanical engineering focuses:

- ☐ Renewable Energy:
 - ☐ Solar-powered water pumping system:
 - ☐ Design and build a solar-powered water pump for villages with limited access to clean water.
 - ☐ Small-scale wind turbine:
 - ☐ Develop a small-scale wind turbine to generate electricity for community centers or homes in windy areas.

- ☐ Solar cooker design:
 - ☐ Create efficient solar cookers to reduce reliance on firewood in rural communities.
- ☐ Accessibility and Assistive Technology:
 - ☐ Wheelchair accessible ramps: Design and build ramps for public buildings to improve accessibility.
 - ☐ Prosthetic limb modifications: Collaborate with local clinics to design and fabricate customized prosthetic limbs.
 - ☐ Adaptive tools for people with disabilities: Develop customized tools for individuals with physical limitations.

☐ Energy Efficiency:

- ☐ Building energy audit:
 - ☐ Conduct energy audits in schools or community centers to identify areas for improvement and suggest retrofitting solutions.
- ☐ Passive cooling systems:
 - ☐ Design and implement passive cooling systems (like natural ventilation) in buildings to reduce energy consumption.
- ☐ Efficient water heating systems:
 - ☐ Develop and install more efficient water heating systems in community facilities.
- ☐ Waste Management and Recycling:
 - ☐ Waste sorting and recycling system: Design a waste sorting and recycling system for schools or community centers.
 - ☐ Composting systems: Develop and implement community-scale composting systems to reduce organic waste.
 - ☐ Upcycling projects: Design and build useful items from recycled materials.

Evaluation & Continuous Assessment

The comprehensive and ongoing monitoring and evaluation of student achievement is key to the project concept's effectiveness. It is recommended that regular reporting of all actions be mandated. Students must maintain a project log book at the department with regular evaluations of their project work. The following should be recorded in the project log book:

1. Student guidance and information
2. The project guide's weekly oversight,
3. Evaluation form for the project guide to review the project work

Recommended parameters for assessment, evaluation and weightage:

1. Idea Inception (kind of survey). (10%)
2. Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents). (15%)
3. Attended reviews, poster presentation and model exhibition. (10%)
4. Demonstration (Poster Presentation, Model Exhibition etc). (10%).
5. Awareness /Consideration of - Environment/ Social /Ethics/ Safety measures/Legal aspects. (5%)
6. Outcome (physical model/prototype/ virtual model/ product development/ assembly & disassembly and analysis of standard mechanism or system, design and development of small application, design of control systems, development of various systems/ /Hackathon/ application development and similar activities/ System performance and analysis) (40%)
7. Participation in various competitions/ publication/ copyright/ patent) (10%)

The review/ progress monitoring committee shall be constituted by head of departments of each institute.

The progress of project to be evaluated on continuous basis, minimum two reviews in each semester.

- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

Project shall be assessed based on following points;

- ☐ Quality of problem and Clarity
- ☐ Innovativeness in solutions
- ☐ Cost effectiveness and Societal impact
- ☐ Full functioning of working model as per stated requirements
- ☐ Effective use of skill sets
- ☐ Effective use of standard engineering norms
- ☐ Contribution of an individual's as member or leader
- ☐ Clarity in written and oral communication

Report Format

1. Project introduction: Introduce the project and its objectives
2. Project details: Include the where, when, and how of the project
3. Participants: Describe who participated in the project
4. Outcomes: Share the outcomes of the project
5. Next steps: Provide recommendations and next steps for the project

Project Evaluation:

1. Activity book: 5 marks
2. Project implementation working model: 10 marks
3. Presentation: 5 marks
4. Report: 5 marks



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEMM0541	L	T	P	Credit
Course Name:	Python for Machine Learning and Data Science	3	0	0	3
Course Pre-Requisites:	This course requires the basic knowledge of the following: 1. Basics of Python Programming 2. Basics of Mathematics and Statistics				
Course Description:	Students need to develop the skills required for Machine Learning Technologies with use of Python to analyze data, create beautiful visualizations, and problem solving using powerful machine learning algorithms. Machine learning heavily relies on mathematics, statistics, and programming expertise to develop and fine-tune algorithms. Data science requires a multidisciplinary skill set that includes knowledge of statistics, programming, data manipulation, and subject matter expertise.				

Course Objectives:

1	To revise the basics of Python programming and learn the installation of various Python Libraries.
2	To explain the basics of machine Learning and Data Science.
3	To explain the basics of NumPy and Pandas.
4	To explain the applications of Machine Learning and Data Science using Python programming.

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Demonstrate the installation of various Python libraries.	II	Understand
CO2	Make use of NumPy and Pandas for data handling.	III	Apply
CO3	Apply the Data Cleaning and Regression techniques to various practical problems.	III	Apply
CO4	Illustrate the Machine learning process and its applications	II	Understand

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
	End Semester Examination (ESE)	100%	100% course contents with equal weightage for all units.

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Introduction Python for Data Analysis, essential python libraries, Installation and setup of different operating systems, important development environments (IDEs) and text editors, brief background of python, decision structures and Boolean logic, looping, built-in data types, and functions	7
2	Introduction to NumPy and Pandas Introduction to NumPy, What is NumPy, Key Features of NumPy, Array Operations, Random Number Generation Introduction to Pandas, what is Pandas, Overview of Pandas for data manipulation and analysis, Key Features of Pandas, Pandas Series, Pandas Data Frame, Data Manipulation with Pandas: Sorting, filtering, and grouping data.	8
3	Data Cleaning and Preparation Handling missing data-filtering out missing data, filling in missing data, data transformation-removing duplicates, transforming data using a function or mapping, replacing values, string manipulation Matplotlib and libraries, figures and subplots, colors, markers and line styles, ticks, labels, and legends, Annotations and drawing on a subplot, saving plots to file, plotting with pandas-line plot, bar plot, histogram and density plots, scatter and point plots	8

4	Introduction to Machine Learning Introduction to machine learning – definition, terminology. Types of machine learning – supervised learning, unsupervised learning, semi-supervised learning, reinforcement learning. Machine learning process. Performance metric in machine learning. Tools and frameworks.	7
5	Regression and Classification Regression –simple linear regression, multiple linear regression, Assumptions in regression analysis, other regression techniques, improving accuracy of the linear regression model, polynomial regression model, logistic regression. Support Vector Machines Decision trees – definition, terminology, the need, advantages, and limitations. Constructing and understanding decision trees. Common problems with decision trees. Decision tree algorithms – ID3 , random forest, examples, cross-validation, confusion matrix, precision recall.	9
6	Applications of Machine Learning Predictive Maintenance , Quality Control and Defect Detection, Design Optimization, Robotics and Automation, Research papers and journals on specific applications in Mechanical Engineering	6

Text Books:

Sr. No.	
1	Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly, 2nd Edition, 2018.
2	Wesley J. Chun, “Core Python Programming”, Second Edition, Pearson Education, 2010.
3	Machine Learning with Python - an approach to applied ML, by Abhishek Vijayvargia, BPB publications

Reference Books:

Sr. No.	
1	Aurelien Geron , “ Hands on Machine Learning with Scikit -learning , Keras & Tensorflow “, Concepts , Tools & Techniques to build Intelligent systems
2	Andreas Muller, “Introduction to Machine Learning with Python: A Guide for Data Scientists”, 1st Edition, O’Reilly Media, 2017.
3	Rajiv Chopra, Machine Learning, Khanna Book Publishing 2021
4	Practical Machine Learning by Sunila Gollapudi Packt Publishing Ltd
5	Machine Learning by Tom M. Mitchell, McGraw Hill Education; First edition



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEMM0542	L	T	P	Credit
Course Name:	Signal and Image Processing	3			3
Course Pre-Requisites:	Knowledge of basic Electronic Devices and Signal.				
Course Description:	Signal Image Processing deals with the processing of Digitized images. In image processing, there are two major categories of processing; the first is enhancing the quality of the image so that human beings will better visualize the image. The other applications associated with detecting and extracting information by machine may be to assist human decisions. In this course, we will introduce various image processing techniques, algorithms, and their applications for improvement in the visual quality of the image. Also, the curriculum includes an introduction to segmentation and object representation.				

Course Objectives:

1	Explain basic concepts of signal conditioning components and Image Formation.
2	Make Use of the fundamentals of image enhancement and restoration techniques in both spatial and frequency domains.
3	Demonstrate various image segmentation techniques and morphological operations used in image analysis.
4	Summarize key image compression techniques and their role in reducing redundancy and improving efficiency.

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Explain basic concepts of signal conditioning components and Image Formation.	II	Understand
CO2	Make Use of the fundamentals of image enhancement and restoration techniques in both spatial and frequency domains.	III	Apply
CO3	Demonstrate various image segmentation techniques and morphological operations used in image analysis.	II	Understand
CO4	Summarize key image compression techniques and their role in reducing redundancy and improving efficiency.	II	Understand

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
4	End Semester Examination (ESE)	100%	100% course contents (100 Marks)

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Unit 1: - Signal Conditioning Signal conditioning process, Operational amplifier (inverting amplifier, non-inverting amplifier, summing, subtractor), Filtering, Data acquisition, Multiplexer, Analog to Digital Converter (ADC), Digital to Analog Converter (DAC).	7
2	Unit 2: - Digital Image Fundamentals & Image Transforms: Digital Image Fundamentals, Sampling and quantization, Relationship between pixels. 08 08 Image Transforms: 2-D FFT, Properties. Walsh transforms, Hadamard Transform, Discrete cosine Transform, Discrete Wavelet Transform.	8
3	Unit 3: - Image Enhancement: Image enhancement (spatial domain): Introduction, Image Enhancement in Spatial Domain, Enhancement Through Point Operation, Types of Point Operation, Histogram Manipulation, gray level Transformation, local or neighborhood operation, median filter, spatial domain high- pass filtering. Image enhancement (Frequency domain): Filtering in Frequency Domain, Obtaining Frequency Domain Filters from Spatial Filters, Generating Filters Directly in the Frequency Domain, Low Pass (smoothing) and High Pass (sharpening) filters in Frequency Domain.	8
4	Unit 4: - Image Restoration: Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration.	7

5	Unit 5: - Image Segmentation and Processing: Detection of discontinuities. Edge linking and boundary detection, Thresholding, Region oriented segmentation. Morphological Image Processing: Dilation and Erosion, Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, the Hit or Miss Transformation.	8
6	Unit 6: - Image Compression: Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression, JPEG 2000 Standards.	7

Text Books:

Sr. No.	
1	Digital Image Processing- Rafeal C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson, 2008.
2	Digital Image Processing- S Jayaraman, S. Essakkirajan, T. Veerakumar-TMH,2010.
3	Pratt, William K., "Digital Image Processing", John Wiley & Sons, 2010

Reference Books:

Sr. No.	
1	Digital Image Processing and analysis-human and computer vision application with using CVIP Tools – Scotte Umbaugh,2ndEd, CRC Pr
2	Introduction to Digital Image Processing with Matlab, Alasdair McAndrew,Thomson Course Technology.
3	Fundamentals of Digital Image Processing-A.K. Jain,PHI,1989.
4	Introduction to Image Processing & Analysis-JohnC.Russ, J.ChristianRuss, CRCPress, 2010.
5	Digital Image Processing with MATLAB & Labview - Vipula Singh Elsevier, 2019



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEMM0543	L	T	P	Credit
Course Name:	Electrical & hybrid vehicle.	3	-	-	3
Course Pre-Requisites:	Basic knowledge about electric motor, Applied Thermodynamic, Basic Mechanical Engineering.				
Course Description:	This course discusses the fundamental concepts and analysis of hybrid and electric vehicles. This course discusses the various EV subsystems such as electric motors, energy storage devices, charging technology etc. Analytical exercises in vehicle dynamics, battery parameters and charging technology are included as a preparatory base for designing an EV.				

Course Objectives:

1	To make students familiar with various basic systems of a modern automobile technology.
2	To introduce the mathematical treatments required for vehicle performance
3	To make students aware about latest trends in transportation towards a safe, pollution free and fully automatic vehicle.
4	To empower students to face the real life automotive usage with greater confidence.

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Illustrate the basic concept of EV & HEV.	II	Understand
CO2	Explain the correlation between HEV, EV and environment, infrastructure and policies of a nation.	II	Understand
CO3	Identify various subsystems and components in EV and HEV.	III	Apply
CO4	Solve the performance parameters of EV subsystems.	III	Apply

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	End Semester Examination (ESE)	100%	100% course contents

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Introduction to Electric Vehicle History of electric vehicles, Development towards 21st century, Environment impact, Types of electric vehicles in use today – Battery Electric Vehicle, Hybrid, Fuel Cell EV, Solar powered Vehicle, Conventional drive train.	7
2	Vehicle Dynamics Calculation/modeling of traction power and energy consumption. Resistance to vehicle motion, Air, Rolling and Gradient resistance, Acceleration, Gradeability and draw bar pull, Traction and Tractive effort, Distribution of weight, Power required for vehicle propulsion, Selection of gear ratio, Rear axle ratio. (Numerical)	9
3	Electrical Vehicles – Technology and design Configuration of EV's, electric motor characteristics, design process and issues, modelling and performance estimation, electric motors used for EVs and HEVs, energy consumption, Regenerative brakes.	7
4	Hybrid electric vehicle technology Concept, Modes and operation patterns, Architectures of hybrid drive trains, series hybrid drive train, parallel hybrid drive train with torque coupling and speed coupling, Sizing of components, Introduction to electric components used in hybrid and electric vehicle.	8
5	Energy sources and storage system Introduction to energy storage requirements in Hybrid and electric vehicles, Battery based energy storage, Fuel Cell based energy storage, super capacitor based energy storage, flywheel based energy storage. Battery Management System (BSM)	7

6	Energy Management Strategies Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Introduction to various charging techniques and schematics of charging stations.	7
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Text Books:

Sr. No.	
1	“Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, C. Mi, M. A. Masrur and D. W. Gao, John Wiley & Sons, 2011
2	“Hybrid Electric Vehicles: Energy Management Strategies”, S. Onori, L. Serrao and G. Rizzoni , Springer, 2015
3	Kripal Singh, Automobile Engineering Vol II, Standard Publishers Distributors, Tenth Edition , 2007
4	“Electric and Hybrid Vehicles” by Tom Denton, Routledge, 2016
5	R K Rajput, Automobile Engineering, Laxmi Publications, First Edition, 2007

Reference Books:

Sr. No.	
1	James Larminie, J. Lowry, “Electric Vehicle Technology Explained”, John Wiley & Sons Ltd. 2003.
2	M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
3	S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”,Springer, 2015.
4	Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.
5	Newton, Steeds and Garrett, The Motor Vehicle, Butterworths International Edition, 11th Edition, 1989



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPC0601	T	P	Credit
Course Name:	Power Plant Engineering	-	-	3
Course Pre-Requisites:	Applied Thermodynamic, Basic Mechanical Engineering, Heat Mass Transfer.			
Course Description:	The aim of this course is to provide students with a working knowledge and application of the fundamentals of how the operation of power plant affect their working, performance, fuel requirements and environmental impact. The focus is on explaining engine performance in terms of power, energy utilization and exhaust emissions, its relation to internal processes like combustion and gas exchange at varying engine- operating condition.			

Course Objectives:

1	To enable the students to analyze the Ideal and actual air standard cycles and valve timing diagrams.
2	To make the students to study of fuel supply system in I.C. Engine.
3	To educate the student about combustion phenomenon and emission characteristics of engines.
4	To impart knowledge about various engine performance characteristics of engine.

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Explain fundamentals of I. C. Engine	II	Understand
CO2	Classify different systems if I. C. Engine	II	Understand
CO3	Solve for performance parameters of power plants.	III	Apply

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Introduction Introduction, Classification of Power plants, applications, Engine specifications. Engine Cycles: Engine cycles, Deviation of actual cycles from air standard cycles, Valve timing diagram for high and low speed engine, Port timing diagram. Working of Supercharging and Turbo-charging, Introduction to Alternative fuels.	6
2	Fuel Supply system for SI and CI Engine Fuel Systems for S.I. Engines: Engine fuel requirements, complete carburetor, Derivation for calculation of A/F ratio, Calculation of main dimensions of carburetors, Effect of altitude on Air fuel ratio. Electronic Petrol injection system (MPFI). Fuel Systems for C.I. Engines: 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. Governing of C.I. engines. Electronic diesel injection system. Calculations of main dimension of fuel injection system.	9

3	Performance Testing of I. C. Engine Performance parameters, Measurement of performance parameters like torque, power, Volumetric Efficiency, Mechanical Efficiency, BSFC, Brake and Indicated Thermal efficiencies. Numerical on Heat Balance Sheet and engine performance, Performance curves.	8
4	Combustion & Emission control Stages of combustion in S.I. and C.I. engine, Knocking in S.I. and C.I. engine, types of combustion chamber in S.I. and C.I. engine. S.I. engine emission (HC, CO, NO _x) Control methods- Evaporative (ELCD), Thermal, Catalytic converters, C.I. Engines Emission (CO, NO _x , Smog, Particulate), Control methods- Chemical, EGR, Standard pollution Norms like EURO, Bharat stage. Pollution monitoring instruments, Pollution measuring and control devices.	8
5	Resources and development of power in India- NTPC, NHPC and their role in Power development in India, Indian Electricity Grid Code, Present Power position in India and world. Different types of power plants – Thermal, Hydro, Gas Turbine, Nuclear and their characteristics, Comparison of Power plants with respect to various parameters, Combined Cycle, MHD - steam plant., Pumped storage, Compressed Air storage power plants and their characteristics.	7
6	Economics of Power Plant- Load Curves and Load duration curves (Numerical treatments), Performance and operational characteristics of power plants, Peak load, Intermediate load and Base load plants and their characteristics, Input output characteristics of power plants, Economic division of between Base load plant and peak load plants, Tariff methods, Cost of electric Energy, Fixed and operating cost	7

Text Books:

Sr. No.	
1	A Course in Power Plant Engineering, S.C. Arora and S. Domkundwar, Dhanpat Rai, 1988
2	A Text Book of Power Plant Engineering, R. K. Rajput, Laxmi Publications, New Delhi.
3	Internal Combustion Engines”, V. Ganesan, Tata McGraw Hill Publication.
4	“Internal Combustion Engines” Mathur and Sharma, Dhanpat Rai Publication , Delhi.
5	“Internal Combustion Engines”,R. K. Rajput, SciTech Publication.

Reference Books:

Sr. No.	
1	“Internal Combustion Engines”, J. B. Heywood, Tata McGraw Hill Publication .
2	“Internal Combustion Engines”, Maleev, CBS Publication and Distributors.
3	“Internal Combustion Engines”, Gills and Smith, Oxford and IBH Publishing Company
4	“Internal Combustion Engines Fundamentals”, E. F. Obert, Harper and Row Publication , New York.
5	Renewable Energy Resources, John Twidell & Anthony D. Weir, 2nd Edition, Taylor & Francis, 2006



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPC0602	L	T	P	Credit
Course Name:	Finite Element Analysis	3	-	0	3
Course Pre-Requisites:	1. Applied Mechanics 2. Strength of Materials				
Course Description:	This subject enables the student to understand the important concepts of FEA, its evolution and applications. Students will learn the mathematical formulation of FEA problems. The Knowledge gained through this subject will be helpful in solving the real life problems.				

Course Objectives:	
1	Introduce students to Finite Element Analysis fundamentals.
2	Introduce students to steps involved in FEA, domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.
3	To enable the students to formulate the design problems into FEA
4	Understand the practical (modeling and analysis) aspects of the FEA
5	Apply this theory and practical knowledge to solve 1-d, 2-d structural and thermal Problems manually and with using computers.

Course Outcomes:	After the completion of the course the student will be able to		
COs	CO Statement	Blooms Level	Descriptor
CO1	Explain the mathematical modeling and Finite Element Analysis .	II	Understand
CO2	Make use of advanced software for solving the problems and interpreting the results	III	Apply
CO3	Develop solutions of some mechanical real time problems.	III	Apply
CO4	Estimate the deformation, stresses, strains and reactions	V	Evaluate

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

Assessment Scheme:			
SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:		
Unit No.	Unit Content	No. of Lectures
1	Unit 1: Introduction: Introduction, An overview of engineering problems and methods for solving them, demonstration by an example – Physical system – Physical model – Mathematical model – Methods for solution – Solution. Need for using numerical method to solve engineering problems-Types of Engineering Analysis.	7 Hrs
2	Unit 2: Introduction to 1D bar element problems: Introduction to steps of FEM for the problem of finding elongation of an axially loaded bar as an example of a 1-D problem. Step- by-step development of the procedure of Galerkin weighted residual FEM for the bar problem - residual error, weighting function, discretization, elements and nodes, local variables, approximation functions (or shape functions), need for numerical integration and co-ordinate transformation, Gauss Legendre integration scheme. Process of assembly of local matrix equations into global, solution to the equations, equation solvers.	8 Hrs
3	Unit 3: Introduction to 2D truss element problems: FE formulation for truss, FEM procedure followed for the truss problems. Computation of derived quantities like strains and stresses from the nodal values of the field variables, Result post processing. Finite element formulation using variational and virtual work methods, demonstration for bar and truss problems.	7 Hrs

4	Unit 4: 2-D Problem from structural mechanics: Introduction to 2-dimensional problem from structural mechanics static analysis, Triangular and quadrilateral elements, Basic concepts of Plain stress and Plain strain. Constant strain triangular element Stiffness Matrix and Equation. Finite element Solution of a plane stress Problem. Higher order elements, iso-parametric elements.	8 Hrs
5	Unit 5: Potential field problems: Introduction to potential field problems, examples from structural mechanics - of torsion of noncircular prismatic bars, 2-D steady state heat transfer with convection from surface. Sources of errors, error analysis, remedies to minimize the errors. Application of FEM to Axisymmetric problems, Axisymmetric solids under rotation.	8 Hrs
6	Unit 6: Non-linear Static elasticity, Buckling, Modal, Transient Response, Harmonic Response, Shock Spectrum Analysis. Translators, types and use, importance of traslatotrs.	7 Hrs

Text Books:

Sr. No.	
1	M. J. Fagan, Finite element analysis, Longman Scientific and Technical
2	D. L. Logan, A first course in finite element method, 4 ed. Cengage learning
3	J. N. Reddy, An introduction to the finite element method, 2 ed. McGraw Hill
4	Introduction to Finite Elements in Engineering, 4th edition, ISBN 978-0-13-216274-6 by Tirupathi R. Chandrupatla

Reference Books:

Sr. No.	
1	S. S. Rao, the finite element method in engineering, 4 ed. Elsevier Science & Technology Books
2	T. A. Stolarski, Engineering analysis with ANSYS Software, Elsevier
3	Erdogan Madenci, Ibrahim Guven, The Finite Element Method And Applications In Engineering Using Ansys, Springer
4	N.S. Gokhale, S.S. Deshpande, S.V. Bedekar, A.N. Thite, Practical Finite Element Analysis, Finite to Infinite Publication



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPC0603	L	T	P	Credit
Course Name:	Mechatronics	2			2
Course Pre-Requisites:	Knowledge of basic Electronics and Electrical Engineering				
Course Description:	Studying the mechatronics course is of importance due to the global demand and developments in Mechatronic systems and automated manufacturing planning and controlling activities etc. The mechanical systems are becoming smart and for designing and developing such smart systems students of mechanical engineering must understand basic elements of smart systems such as sensors, signal conditioning devices, microcontrollers, digital logic and programs for automating the processes.				

Course Objectives:

1	To learn various concepts of automation, Mechatronics and PLC and the integration of different branches of engineering in Mechatronics
2	To prepare graduates of mechanical engineering with comprehensive knowledge of Mechatronics to enable them to apply the relevant knowledge and technologies for the design and realization of innovative systems and products
3	To prepare Mechanical Engineering students for advanced graduate studies in Mechatronics, Manufacturing engineering and related field

Course Outcomes:

After the completion of the course the student will be able to			
COs	CO Statement	Blooms Level	Descriptor
CO1	Demonstrate appropriate sensor for given application	II	Understand
CO2	Classify different signal conditioning techniques	II	Understand
CO3	Explain the various concepts related to different microcontrollers used in mechatronic systems.	II	Understand
CO4	Solve scenarios of automating the processes using the PLC programming approach.	III	Apply

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Introduction a) Introduction: Definition, Mechatronics advantages and its applications, Components of Mechatronic Systems b) Sensors and Transducers: Performance terminology, Contact and non-contact type switches and proximity sensors-inductive, capacitive, optical, pneumatic, potentiometric, thermal, incremental and absolute encoders.	8
2	Signal Conditioning and Actuators a) Signal Conditioning: Signal conditioning processes, voltage divider, rectification, Operational Amplifiers: inverting and non-inverting, summing, integrating, differential, analog to digital and digital to analog converters, multiplexing and de-multiplexing b) Actuators: Brushless DC servomotors, timing motors, SCR (Silicon Controlled Rectifiers) motors, Stepper motor	7
3	Introduction to Microcontroller Introduction to Microcontroller, Comparison between microprocessor and microcontroller, Organization of a microcontroller system, Architecture of 8051, Pin diagram of 8051, Addressing modes Introduction to Arduino, Types of Arduinos, Arduino Pin Diagram, Basics of Programming, Sample Circuits	7
4	Programmable Logic Controllers (PLC) Introduction to PLC, components of PLC Input-output module, Ladder diagram and PLC programming fundamentals: logic functions, latching, sequencing, timers (Delay On Timer, Delay OFF Timer, Cascading of Timers) counters (Up Counter, Down Counter), jumps, Internal relays, Disagreement circuit, Majority circuit.	8

Text Books:

Sr. No.	
1	"Mechatronics", W. Bolton, Pearson Education, 4th Edition
2	"Mechatronics", Mahalik, TATA McGraw Hill, (2006) Reprint,
3	"Microprocessor 8085", Gaokar Prentice Hall of India, 5th Edition.
4	"The 8051 Microcontroller -A System Approach", by Muhammad A. Mazidi, 1st Ed., PHI

5	“Programmable Logical Controller”, Reis Webb, Prentice Hall of India 5th Edition.
6	“Programmable Logical Controller”, Hackworth, Pearson Education, (2008).
Reference Books:	
Sr. No.	
1	“Mechatronics”,AppuKuttam, Oxford Publications, 1st Edition.
2	“Automated Manufacturing Systems”, S. Brain Morris, Tata McGraw Hill.
3	“Mechatronics and Microprocessor”, Ramchandran , Willey India, (2009)
4	“Mechatronics: Integrated Mechanical Electronic System”, Ramchandran , Willey India,1st Edition.
5	“Mechatronics Source Book”, N C Braga, Cengage Learning.



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPC0631	T	P	Credit
Course Name:	Power Plant Engineering Laboratory	-	2	1
Course Pre-Requisites:	Applied Thermodynamic, Basic Mechanical Engineering, Heat Mass Transfer.			
Course Description:	This course deals with demonstration of different engine components and systems and conduct of various experiments on engine performance in terms of power, energy utilization and exhaust emissions, its relation to internal processes like combustion and gas exchange at varying engine operating conditions.			

Course Objectives:

1	To make students familiar with various basic systems of a modern automobile technology.
2	To introduce the mathematical treatments required for vehicle performance
3	To make students aware about latest trends in transportation towards a safe, pollution free and fully automatic vehicle.
4	To empower students to face the real life automotive usage with greater confidence.

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Classify different power plants.	II	Understand
CO2	Demonstrate different I. C. Engine system.	II	Understand
CO3	Analyze the performance parameters of I. C. Engines.	IV	Analyze

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (Lab ISE)	50%	25 Marks (based on experiments)
2	End Semester Examination (POE)	50%	25 Marks

Course Contents:

Unit No.	Course Contents:	No. of sessions
1	Experiment No. 1:--- Study and demonstration of different types of power plants.	1
2	Experiment No. 2:--- Study and Demonstration of Engine systems: Air intake, Exhaust, Cooling, Lubrication systems.	1
3	Experiment No. 3:--- Study and Demonstration of fuel supply system in S.I. engine.	1
4	Experiment No. 4:--- Study and Demonstration of fuel supply system in C.I. engine.	1
5	Experiment No. 5:--- Study and Demonstration of Ignition system and starting system.	1
6	Experiment No. 6:--- Heat Balance sheet on Petrol/Diesel engine.	1
7	Experiment No. 7:--- Morse test on Petrol/Diesel engine.	1
8	Experiment No. 8:--- Variable speed test on Petrol/Diesel engine.	1
9	Experiment No. 9:--- Test on computerized Variable compression Ratio Engine.	1
10	Experiment No. 10:--- Industrial visit to engine manufacturing company.	1

Text Books:

Sr. No.	
1	A Course in Power Plant Engineering, S.C. Arora and S. Domkundwar, Dhanpat Rai, 1988
2	A Text Book of Power Plant Engineering, R. K. Rajput, Laxmi Publications, New Delhi.
3	Internal Combustion Engines”, V. Ganesan, Tata McGraw Hill Publication.
4	“Internal Combustion Engines” Mathur and Sharma, Dhanpat Rai Publication , Delhi.
5	“Internal Combustion Engines”,R. K. Rajput, SciTech Publication.
Reference Books:	
Sr. No.	
1	“Internal Combustion Engines”, J. B. Heywood,Tata McGraw Hill Publication .
2	“Internal Combustion Engines”,Maleev, CBS Publication and Distributors.
3	“Internal Combustion Engines”,Gills and Smith, Oxford and IBH Publishing Company
4	“Internal Combustion Engines Fundamentals”, E. F. Obert, Harper and Row Publication , New York.
5	Renewable Energy Resources, John Twidell & Anthony D. Weir, 2nd Edition, Taylor & Francis, 2006



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPC0632	L	T	P	Credit
Course Name:	Finite Element Analysis Lab	-	-	2	1
Course Pre-Requisites:	1. Applied Mechanics 2. Strength of Materials				
Course Description:	The course aims at solving the structural and thermal problems by FEA by hand calculations as well as by using Software.				

Course Objectives:

1	To provide the students the methodology of solving FEA problems by using hand Calculations
2	To train students in using the FEA software for solving FEA problems

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Explain structural and thermal problems by hand calculations as well as by using softwares	II	Understand
CO2	Analyze structural and thermal problems using FEA	IV	Apply

CO-PO Mapping:

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

Assessment Scheme:

One component of In Semester Evaluation (ISE)

SN	Assessment	Marks
1	In Semester Evaluation	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/Internal oral etc.

Course Contents:

Unit No.	Unit Content	No. of Sessions
1	Unit 1:--- 1-D Element Problems –Linear Static Analysis	2
2	Unit 2:--- 2-D Element Problems – Linear Static Analysis	2
3	Unit 3:--- 3-D Element Problems – Linear Static Analysis	2
4	Unit 4:--- Non-Linear Analysis of 1-D Element Problems Like Beams, Bars	2
5	Unit 5:--- 1-D Element Problems-Steady state And Transient Analysis	2
6	Unit 6: -- 2-D Element Problems of Homogeneous and Composite Slap in Steady State and Transient Analysis	2
7	Unit 7: -- 3-D Element Problems Steady State Analysis	2
8	Unit 8: -- Project-Creating or Importing and Map Meshing of 3-D component /Assembly of practical application and FEA Analysis of Same component /Assembly	2

Text Books:

Sr. No.	
1	Finite Element Analysis using Ansys 11.0 by Paleti Shrinivas, Krisha Chaitnay Sambana, Rajesh Kuma Datti.
2	Finite Element Analysis Theory and Applications with ANSYS by Saeed Moaveni
3	Engineering Analysis with ANSYS Software by Y. Nakasone and S. Yoshimoto
4	The finite element method And applications in Engineering using Ansys® by Erdogan Madenci, Ibrahim Guven
5	Practical Finite Element Analysis by Nitin Gokhale of M/S Finite to Infinite.
6	Reference Manual of Hypermesh Software
7	Online Tutorial HyperMesh Software.
8	Tutorial of Ansys Software.



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPC0633	L	T	P	Credit
Course Name:	Mechatronics Laboratory			2	1
Course Pre-Requisites:	Knowledge of basic Electronics and Electrical Engineering, Sensor and Actuator lab.				
Course Description:	Studying the mechatronics course is of importance due to the global demand and developments in Mechatronic systems and automated manufacturing planning and controlling activities etc. The mechanical systems are becoming smart and for designing and developing such smart systems students of mechanical engineering must understand basic elements of smart systems such as sensors, signal conditioning devices, microcontrollers, digital logic and programs for automating the processes.				

Course Objectives:

1	To provide graduates of mechanical engineering with fundamental skills in the field of mechatronics for advanced graduate studies in the area of Mechatronics, Manufacturing engineering, and related field
2	To stimulate students for developing simple mechatronics applications.
3	To introduce graduates of mechanical engineering with working principles and functioning of basic components, inputs, outputs and programming languages used in mechatronic systems

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Make use of Microcontrollers to demonstrate applications of mechatronics systems.	III	Apply
CO2	Solve scenarios of automating the processes by performing PLC programming.	III	Apply
CO3	Develop a small application of the Mechatronic system.	VI	Create

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Marks	Remark
1	ISE	25	ISE is based on laboratory performance and journals. Minimum 08 experiments to be performed and included in the journal.
2	ESE(POE)	25	ESE is based on a practical examination followed by an oral examination.

Course Contents:

Expt No.	Experiment Name	No. of Sessions
1	Study Inverting OPAMP	2 Hrs
2	Study Non-Inverting OPAMP	2 Hrs
3	Addition and Subtraction of 8-bit numbers using microcontroller 8051	2 Hrs
4	LED interfacing with Arduino	2 Hrs
5	Digital Sensor interfacing with Arduino	2 Hrs
6	Analogue Devices interfacing with Arduino.	2 Hrs
7	PLC programming for demonstrating applications of Logic gates.	2 Hrs
8	Applications based on timers using PLC ladder programming.	2 Hrs
9	Applications based on counters using PLC ladder programming	2 Hrs
10	Demonstration of Piece counting using rotary indexing mechanism	2 Hrs
11	Demonstration of temperature and flow sensor	2 Hrs
12	Fabrication of Simple Mechatronics working project by a group of 4/5 students using hardware like sensors, signal conditioning, actuators, and suitable software	2 Hrs

Text Books:

Sr. No.	
1	"Mechatronics", W. Bolton, Pearson Education, 4th Edition
2	"Mechatronics", Mahalik, TATA McGraw Hill, (2006) Reprint,
3	"Microprocessor 8085", Gaokar Prentice Hall of India, 5th Edition.
4	"The 8051 Microcontroller -A System Approach", by Muhammad A. Mazidi, 1st Ed., PHI
5	"Programmable Logical Controller", Reis Webb, Prentice Hall of India 5th Edition.
6	"Programmable Logical Controller", Hackworth, Pearson Education, (2008).

Reference Books:	
Sr. No.	
1	"Mechatronics",AppuKuttam, Oxford Publications, 1st Edition.
2	"Automated Manufacturing Systems", S. Brain Morris, Tata McGraw Hill.
3	"Mechatronics and Microprocessor", Ramchandran , Willey India, (2009)
4	"Mechatronics: Integrated Mechanical Electronic System", Ramchandran , Willey India,1st Edition.
5	"Programmable Logical Controller",Gary Dunning Cengage Learning, 3rd Edition



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPE0611	L	T	P	Credit
Course Name:	Fault Diagnosis and Condition Monitoring	3			3
Course Pre-Requisites:	Basics of mathematics, Physics, Analysis of Mechanical Elements, Dynamics of Machines, Mechanical vibrations				
Course Description:	In Industry, it is necessary to monitor the condition of equipments to avoid down time of machines and hence improve productivity of plant. There are many maintenance strategies in which condition monitoring using vibrations are most important. The subject contains basics of condition monitoring and various techniques used such as vibration analysis, motor signature analysis, NDT methods etc. The subject emphasizes on practical approach of condition monitoring				

Course Objectives:

1	To take overview of basic concepts of maintenance and condition monitoring.
2	To study vibration analysis of rotating elements for condition monitoring.
3	To acquaint students with the vibration measuring instruments and condition monitoring.
4	To acquaint students with various techniques of condition monitoring

Course Outcomes:

After the completion of the course the student will be able to			
COs	CO Statement	Blooms Level	Descriptor
CO1	Explain fundamentals of vibration measurement, maintenance strategies and condition monitoring.	II	Understand
CO2	Identify fault and state condition of rotating equipment.	III	Apply
CO3	Analyze response of mechanical system and provide corrective action.	IV	Analyze
CO4	Evaluate condition monitoring system for given equipment.	V	Evaluate

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Unit1:CONDITION MONITORING TECHNIQUES Introduction to Condition monitoring, definition, Types of condition monitoring, advantages and limitations of different condition monitoring techniques like wear debris monitoring, oil monitoring, vibration monitoring, thermography.	08 Hrs
2	Unit 2:DATA ACQUISITION Introduction, collection of vibration signal, vibration transducers, characteristics and mountings, conversion of vibrations to electrical signal.	08 Hrs
3	Unit 3:SIGNAL PROCESSING AND ITS APPLICATIONS Time and Frequency domain Signal analysis, Data Acquisition Systems and Filtering, Fourier Series and FFT, Instrumentation, Data Recording.	07 Hrs
4	Unit 4:MACHINERY FAULT DIAGNOSIS USING VIBRATION ANALYSIS Unbalance, bent shaft, Eccentricity, Misalignment, looseness, Belt drive problems, gear defects, bearing defects.	08 Hrs
5	Unit 5:- FAULT DETECTIONS IN ROTATING MACHINES Signal classification, signals generated by rotating machines and Case studies on such as Fans, Blowers, and Pumps.	07 Hrs

6	Unit 6:- :- FAULT DETECTIONS IN RECIPROCATING MACHINES Signals generated by reciprocating machines time frequency diagrams, torsional vibrations and Case studies on such as IC Engines, automobiles.	07 Hrs
Text Books:		
Sr. No.		
1	Machinery vibration Analysis & Predictive Maintenance by Paresh Girdhar, Elsevier publishers.	
2	Mechanical Fault diagnosis and condition monitoring by R. A .Collacott.	
3	Robert Bond Randall, Vibration-Based Condition Monitoring: Industrial, Aerospace and Automotive applications, 1st Edition, John Wiley &	
Reference Books:		
Sr. No.		
1	Vibration monitoring and diagnosis by R. A. Collacott.	
2	First course on condition monitoring in the process industries, by M.J.Neale, Nov 1979, Manchester.	
3	Management of Industrial Maintenance by Newman-Butterworth, March 1978.	
4	Condition Monitoring Manual by National Productivity council, New Delhi.	
5	John S. Mitchell, Introduction to Machinery Analysis and Monitoring, 1st Edition, Penn Well Books,1993	



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPE0612	L	T	P	Credit
Course Name:	Metal Forming and Joining Technology	3			3
Course Pre-Requisites:	basic manufacturing processes				
Course Description:	Metal forming techniques are use create different sheet metal product for engineering and residential applications. Theories of forming processes are good application of theory of plasticity like yielding criteria, application of two- and three-dimensional problem				

Course Objectives:	
1	Gain the fundamental knowledge about metal forming and plastic tech. processes
2	Understand the analysis of flow of material and its properties during the processes
3	Selection the process of metal forming as per the applications such as wire drawing, extrusion, rolling forging etc.

Course Outcomes:	After the completion of the course the student will be able to		
COs	CO Statement	Blooms Level	Descriptor
CO1	Select process parameter of different metal forming and joining processes	III	Apply
CO2	Explain various basic concepts of metal forming and joining processes	II	Understand
CO3	Illustrate various operations in metal forming and joining processes	II	Understand
CO4	Select various processes for specific manufacturing needs.	III	Apply

CO-PO Mapping:	
	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PSO1 PSO2 PSO3
CO1	3 2 1
CO2	2 2 1
CO3	2 2 1
CO4	2 2 1

Assessment Scheme:			
SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:		
Unit No.	Unit Content	No. of Lectures
1	Unit 1:- Theory of Plasticity Flow curve, Concepts of true stress and true strain, plane stress condition , stress tensor,yield criteria and their comparison., plastic stress-strain relationships. Strain tensor, strainhardening. Strain rate, Friction and Lubrication in metal forming	9
2	Unit 2:- Introduction to Forging and rolling Introduction to Forging Basic operations, types of forging, forging hammers/ presses, forging stress and force calculations, die design considerations, forging defects, applications Introduction to Rolling: Classification of rolling processes, rolling mill types, deformation of metal in rolling, roll bite, elongation, reduction, defects in rolling, rolling of sheets, plates, bars, sections and tubes, application--	7
3	Unit 3:--- Introduction to Extrusion and Drawing Introduction to Extrusion Equipment and principles, types of extrusion, direct, indirect, impact, hydrostatic, tube extrusion, metal flow in extrusion, defects, factors affecting extrusion load, Introduction to Drawing: Types of Drawing, Rod/wire drawing, equipment and principles of process, defects, Tube drawing, Seamless pipe manufacturing	7
4	Unit 4:- Fundamentals of Metal Joining Technologies: mechanisms for obtaining metallic continuity, Fusion based processes: principle of fusion welding processes, oxy-fuel has welding, common arc welding processes, laser beam welding, spot welding processes, newer variants of fusion welding processes	7
5	Unit 5 :- Solid-liquid joining processes: brazing and soldering, braze welding, Solid state joining processes: diffusion bonding, ultrasonic welding, and explosive welding and Adhesive joining	8

6	Unit 6 :- Metallurgical Aspects of Welding: weld thermal cycle, basics of residual stresses, Common issues related with joining technologies their causes and remedies: hardening and softening of heat affected zone, porosity, cracking.	7
Text Books:		
Sr. No.		
1	Manufacturing Processes – Begman, Amstead etc.(John Wiley)	
2	Rowe, Principles of Industrial Metal working Processes,	
3	Forging and Forging Die Design - Sharan, Prasad, Saxena	
4	Manufacturing Technology: Foundry, Forming and Welding by P.N. Rao (TMH)	
5	Manufacturing Engineering Technology by Kalpakjian (Addison Wesley)	
Reference Books:		
Sr. No.		
1	ASM Handbook on Forming	
2	Mechanical Metallurgy (S.I. Units) - Dieter, McGraw Hill	
3	Plastics for Industrial Use- Sasse John	
4	Metal Forming: Mechanics and Metallurgy by William F. Hosford and Robert M. Caddell: Explains the fundamental principles of metal form	
5	Metal Forming: Technology & Process Modelling by Uday S. Dixit: Covers the fundamentals of plasticity, friction, extrusion, and advanced	



Kolhapur Institute of Technology's College of Engineering (Empowered Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPE0613	L	T	P	Credit
Course Name:	Advanced Automobile Design	3		-	3
Course Pre-Requisites:	Basics Knowledge of 'Fundamentals of Automobile Design (Ready Engineer Part -I)', CAD, General Design procedure is essential.				
Course Description:	The course covers some of the practical & real-world design aspects for automobiles, especially for body-in-white (i.e. structures) and trims (i.e. interiors). This is one of the unique and highly advanced courses prepared by over 20 senior experts of TATA TECHNOLOGIES, PUNE working on multiple national and international projects of whole-vehicle development. The course is intended to provide an edge to the engineering students seeking career in design domain				

Course Objectives:

1	To enable students to understand and interpret the Product Life Cycle (PLM), BIW (Body-in-White) and trim commodities, and the foundational requirements of automobile design during the pre-program stage.
2	To develop the ability to apply design principles for BIW and plastic trims, including material selection, GD&T interpretation, sheet-metal/trim manufacturing processes, and appropriate joining techniques.
3	To equip students with the skills to perform design verification using DFMEA methodology, apply various test and validation methods, and understand functional, safety, and regulatory requirements for automotive systems.
4	To train students in the application of CAE techniques such as structural analysis, NVH, crashworthiness, durability, and plastics-trim specific simulations to support advanced vehicle design and verification.

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Explain the fundamental concepts and terminology related to Body-in-White (BIW) and automotive plastic trims, including their identification, necessity, and product lifecycle	II	Understand
CO2	Recommend appropriate material for BIW and Trims considering factors like cost, safety, weight, manufacturing methods, and vehicle regulations.	V	Evaluate
CO3	Illustrate concepts of GD&T, joining techniques for sheet metal and plastic components, and relevant manufacturing processes for BIW and trims.	II	Understand
CO4	Explain the application of DFMEA and CAE tools for the design verification and analysis of BIW and plastic trim components, including crashworthiness and durability assessments, and understand the significance of physical testing and manufacturing sequences.	II	Understand

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit No.	Unit Content	No of Hours
1	Requirement Specification in the Pre-Program Stage: a) Introduction to BIW. Identification of commodities for BIW: Closures, Body Shell. BIW terminology. BIW Assembly. b.) Introduction to Plastic trims. What is trim? Necessity of trim in automobile, Identification of various trim parts and their positions in vehicle. Various commodities of interior trim like Instrument panel, Centre console, Door trims, Pillar Trims, Seating Trims, Overhead Trims, Floor Carpets & Trunk trims. c) Product life cycle and important gateways for BIW: PLM: Introductions, Need, Benefits, Components/Elements. Phases of Product life cycle:	7 Hrs
2	BIW and TRIM Design and Materials a) Design concepts and considerations in BIW: BIW parts: Sheet metal, Extrusion, Cast, Moulding. Factors driving BIW Design like Package Space, Master Sections, Cost, Weight, Assembly Process, Manufacturing Methods, Vehicle regulations. Design considerations for Sheet Metal Parts b) BIW Materials and Grades (Steel, Aluminium, composites): Basic material selection criteria for automotive: Emissions, Safety and weight, Material Choice which is driven by Cost, Safety, Risk, Weight, Market Image, Emission. Classification of steel grade and their properties. Use of aluminium in automotive domain and its properties. Use of Composites in automotive domain and its properties. Light weight material for future automotive industry. c) Trim Materials in Automotive: Material Classification and Properties, Plastic Material and their applications: Polypropylene, ABS, Polycarbonate, Polyoxymethylene, Polyethylene, Polyamides, Usage and Selection Criteria, Plastic Additives: Types of additives, Impact of additives, , Application in instrument Panel Assembly.	8 Hrs

3	GD & T for BIW: a) Concept of GD & T , Importance of GD&T. BIW Dimensional Requirement. BIW Dimensional applications. GD&T Symbols. Illustration of Feature Control Frame. b) Sheet Metal Joining Process: Importance. Welding, Resistant Spot welding: Advantages, Disadvantages of RSW. Concept of Tailor Welded Blanks(TWB), Types of TWB. Laser Beam Welding (LBW): Types, Advantages, Disadvantages. Self Piercing Rivets (SPR) and its advantages. Adhesive Bonding: Types, Types of joints used in it. c) Manufacturing Processes of plastic trim: Vacuum Forming, Injection Molding, Heat Staking, Extrusion Blow molding along with their applications characteristics and limitations.	7 Hrs
4	DFMEA & CAE a) DFMEA (Design Failure Mode and Effect Analysis): Concept, Objectives of DFMEA. Over view of DFMEA process, Benefits of DFMEA, Prerequisites of DFMEA, DFMEA Flow, DFMEA team, DFMEA inputs & Outputs, DFMEA Methodology, Design of Plastic part: Overview, Wall thickness, Radii, Draft angle, Ribs, Bosses, Snaps, b) Concept of CAE , Applications of CAE, Various CAE methods for Design verification of BIW viz. Structural Analysis, Fatigue life Prediction, Noise and vibration, Crash Impact analysis, Multibody Dynamics, Thermal analysis, CFD. Verification and Validation with respect to FEA. Concept of FEA, Steps of FEA, meshing, Elements: Selection and its types.	8 Hrs
5	CAE ANALYSIS a) CAE Analysis of BIW: - Concept of Load Case, NVH Analysis: Load cases for NVH analysis: Static Bending stiffness, Static torsion stiffness, Natural frequency and normal modes, , CAE Crash Analysis: 1) Full vehicle level: Frontal, Side and rear Impact, 2) Component Level: Seating and roof crush., Durability analysis: Various load cases like Front and Rear Recovery analysis, Trained towing analysis, Floor pan fatigue, Roof and Body side oil canning, Vehicle jacking analysis, Vehicle hoisting analysis, Fatigue analysis of BIW. b) CAE Analysis OF Plastic Trims: . Types of CAE Analysis: Head Impact Analysis, Side Impact Analysis, Knee Impact Analysis, Durability Analysis, Creep Analysis, Moldflow Analysis. Applications of CAE Analysis. CAE Load cases for Interior Trims: Airbag deployment, Side occupant protection, Interior trims durability, Mold flow analysis. Gateway support.	8 Hrs
6	Test Validation & Assessment : Crashworthiness, Head Injury Criteria, Vehicle physical testing, Need of vehicle testing, Crash test requirements, Introduction to dummies, Importance of Dummies, Types of dummies. Frontal Crash test, Rear and side impact testing, Pedestrian head impact test, roll over test. Four post durability test. Wind tunnel testing. Automotive safety considering plastic components, Manufacturing - Sequence (after validation):, Welding & Assembly: Body shop, Paint Shop, Trim- chassis.	7 Hrs

Text Books:

Sr. No.	
1	Morello, L., Rosti Rossini, L., Pia, G., & Tonoli, A. (2010). The Automotive Body: Volume I: Components Design (Mechanical Engineering Series). Retrieved from http://www.springer.com/1161---A2
2	Huang, M. (2002). Vehicle crash mechanics. CRC Press.-A2
3	Failure Mode and Effect Analysis: FMEA from Theory to Execution, D. H. Stamatis, ASQ Quality Press, 2003, 0873895983, 9780873895989.
4	IGETIT PORTAL OF TATA TECHNOLOGIES.

Reference Books:

Sr. No.	
1	Boljanovic, V. (2004). SHEET METAL FORMING PROCESSES AND DIE DESIGN. A1 and A2
2	Weber, J. (2009). Automotive development processes: Processes for successful customer oriented vehicle development. Automotive Development Processes: Processes for Successful Customer Oriented Vehicle Development. Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-01253-2--A2
3	An Introduction to Modern Vehicle Design. Edited by Julian Happian-Smith, © Reed Educational and Professional Publishing Ltd 2002—A2
4	Automotive Product Development. A Systems Engineering Implementation, by Vivek D. Bhise, © 2017 by Taylor & Francis Group, LLC CRC Press is an imprint of Taylor & Francis Group, an Informa business.—A2
5	Design and Manufacture of Plastic Components for Multifunctionality. (2016). In Design and Manufacture of Plastic Components for Multifunctionality. https://doi.org/10.1016/c2014-0-00223-7-A2
6	Effective FMEAs: Achieving Safe, Reliable, and Economical Products and Processes using Failure Mode and Effects Analysis, Carl Carlson, ISBN: 978-1-118-00743-3 June 2012.



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMEPE0614	L	T	P	Credit
Course Name:	Introduction to CFD	3			3
Course Pre-Requisites:	Fundamental knowledge of Fluid Mechanics, Heat Transfer and elementary numerical solving techniques.				
Course Description:	Computational fluid dynamics (CFD) is a branch of fluid mechanics that uses numerical analysis and data structures to solve and analyze problems that involve fluid flows. Computers are used to perform the calculations required to simulate the interaction of liquids and gases with surfaces defined by boundary conditions which solve the problem and produce simulated results.				

Course Objectives:

1	To provide the basic fundamental knowledge required for the study of computational fluid dynamics.
2	To familiarize students with different numerical methods used in computational fluid dynamics.
3	To provide practical experiences in using commercial computational fluid dynamics software.

Course Outcomes:

COs	CO Statement	Blooms Level	Descriptor
CO1	Interpret the basic fundamental of the principles of CFD.	II	Understand
CO2	Apply governing equations for fluid flow and generate appropriate computational solution.	III	Apply
CO3	Analyze the CFD results and discuss the findings.	IV	Analyze

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Introduction to Computational Fluid Dynamics: General introduction: Historical background and spectrum of application. History and Philosophy of computational fluid dynamics, CFD as a design and research tool, Applications of CFD in engineering	8
2	Fundamental Differential Equation: Classification of Partial Differential Equations (PDEs): Elliptic, Parabolic, Hyperbolic. Relevance to Fluid Flow Problems. Boundary Conditions and Physical Interpretation of Boundary Conditions. Fundamentals of Discretization: Pre-processing, Solution, Post-processing, Finite Element Method, Finite difference method, Well posed boundary value problem, Possible types of boundary conditions.	7
3	Grid Generation: • Importance of Grid Generation in CFD, Structured and Unstructured Grids, Advantages and Disadvantages. • Grid Quality Metrics: Aspect Ratio, Skewness, Orthogonality. • Grid Generation Techniques: Algebraic Grid Generation, Elliptic Grid Generation. • Boundary Layer Meshing: Importance of Near-Wall Resolution, Adaptive Grid Refinement (Introduction), Common Grid Formats.	7
4	Solution Methods for Algebraic Equations: Discretization, Direct Methods: Gaussian Elimination, LU Decomposition, Iterative Methods: Jacobi, Gauss-Seidel, Successive Over-Relaxation (SOR), Convergence Criteria, Choice of Solver: Factors Affecting Solver Selection, Pressure-Velocity Coupling: SIMPLE, SIMPLER, SIMPLEC Algorithms, Solution of Transient Problems: Implicit and Explicit Methods.	8

5	Turbulence Modeling. Introduction to Turbulence: Characteristics of Turbulent Flow, Reynolds-Averaged Navier-Stokes (RANS) Equations. Turbulence Models: Zero-Equation Models (Mixing Length Model), One-Equation Models (Spalart-Allmaras Model), Two-Equation Models (k-epsilon, k-omega). Limitations of the Models, Direct Numerical Simulation (DNS).	7
6	Overview of Commercial CFD Software Packages (ANSYS Fluent): Pre-processing: Geometry Creation, Mesh Generation using CFD software. • Setting up the Problem: Choosing appropriate solver, boundary conditions, material properties, Running the Simulation: Monitoring convergence, Post-processing: Visualization of Results, Application in industrial problems.	8
Text Books:		
Sr. No.		
1	Computational Fluid Dynamics, John D. Anderson Jr., McGraw Hill Book Company.	
2	An Introduction to Computational Fluid Dynamics, H. K. Versteeg & W. Malalasekera, Longman Scientific & Technical.	
3	Introduction to Computational Fluid Dynamics: The Finite Volume Method by H. Versteeg and W. Malalasekera	
4	Introduction to Computational Fluid Dynamics, Anil W. Date (Professor Emeritus, IIT Bombay), Cambridge University Press	
5	Introduction to Computational Fluid Dynamics: Development, Application and Analysis, Atul Sharma (Professor, IIT Bombay), Ane Books Pvt. Ltd.	
Reference Books:		
Sr. No.		
1	T. J. Chung, Computational Fluid Dynamics, Cambridge University Press.	
2	J. H. Ferziger and M. Peric, Computational Methods for Fluid Dynamics, Springer.	
3	John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Taylor & Francis.	
4	An Introduction to Computational Fluid Dynamics: The Finite Volume Method, H. K. Versteeg and W. Malalasekera, Pearson Education.	
5	Numerical Heat Transfer and Fluid Flow, Suhas V. Patankar, CRC Press (Hemisphere Publishing)	



Kolhapur Institute of Technology's College of Engineering (Empowered Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:		UMEAE0604										L	T	P	Credit
Course Name:		Business Communication and Value Science												2	1
Course Pre-Requisites:		Course Pre-Requisite: 1. Awareness of common words used in daily verbal communication. 2. Basic idea of sentence formation and there by paragraph building and writing. 3. Awareness of basic communication channels and active and passive listening skills. 4. Awareness of basic social etiquettes and knowledge of group work and communication. 5. Basic idea of like skills and value system													
Course Description:		Course Description: Being a practice – oriented course, this course focuses on Practicing various skills of communication and Life Skills.													
Course Objectives:															
1	To demonstrate the importance of various modes of communication and their applications in business.														
2	To improve modes of expression in written and oral communication.														
3	To understand what Life skills are and their importance in leading a happy life.														
4	To introduce them to key concepts of values, life skills.														
Course Outcomes:		After the completion of the course the student will be able to													
COs	CO Statement											Blooms		Descriptor	
CO1	To Understand the importance of (Written business communication) Basic tenets of Business communication.											I		Understand	
CO2	To Apply the basic communication in different types of business communication.											III		Apply	
CO3	To Recognise the need for value system and life skills.											I		Understand	
CO-PO Mapping:															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	
CO1							2	3	3		1				
CO2							2	3	3		1				
CO3							2	3	3		2				
Assessment Scheme:															
SN	Assessment					Weightage		Marks		Remark					
1	In Semester Evaluation (ISE)					100%		50		based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.					
Course Contents:															
Practical No.: 1	Overview of business communication significance of business communication.												2		
Practical No.: 2	Introduction to essentials of business communication. a) Formal and informal communication b) Downward upward lateral and diagonal communication 2Hrs.												2		
Practical No.: 3	Basics to effective communication interactive and non interactive techniques of communication.												2		
Practical No.: 4	Effective Writing Guidelines for ideas writing, References, Bibliographical research tools, use of Library and interact for collection, classification and interpretation of data & transformation.												2		
Practical No.: 5	Business correspondence – Need and importance of business letters, office memorandum, office circulars, notices and orders.												2		
Practical No.: 6	Technology for communication – effective IT communication tools, Conducting Self introduction.												2		
Practical No.: 7	Spoken English – Effective Negotiation, elements, Process, general guidelines conducting and group discussion												2		

Practical No.: 8	Oral Presentation- Making a presentation - Content and organising features of a good presentation - Delivering a presentation	2
Practical No.: 9	Understanding life Skills – Need for life skills and Values. Importance of critical life skills	2
Practical No.: 10	Values – Sadachar. Self confidence, achievement orientation dealing with ambiguity, team work	2
Practical No.: 11	Self Exploration – SWOT Analysis and Goal setting	2
Practical No.: 12	Realities of Facing life – Stress Management, Working with rhythm and balance, Embarking diversity, Motivation – Self Motivation	2
Practical No.: 13	Presentation on - Case study : Business Leaders Social Reformers	2

Text Books:

Sr. No.	
1	Effective Technical Communication – by Rizvi and Ashraf, Mc Graw – Hill, India 2017
2	Business Communication – by K.K. Siaha, Galgetia publishing company India
3	Business Correspondence and Report Writing – by R.C. Sharma and Krishna Mohan Mc Graw – Hill, India
4	Business Communication – by Asha Kaur, Prentice Hall of India
5	Managerial Communication – by P.D. Chaturvedi and Mukesh Chaturvedi, Pearson Publication, India
6	“The Professional”, Subroto Bagchi, 1st edition, Penguin Publishers.
7	Business Communication: Building Critical Skills – by Locker, Kitty O., and Stephen Kyo Kaczmarek Mc Graw – Hill, India
8	Soft Skills – by Dr. Alex, Chand Publications India

Reference Books:

Sr. No.	
1	Seven Habits of highly effective people – by Stefan convey.
2	Emotional Intelligence – by Dianel Goleman, Harvard Business Review Press.
3	Law of Success – by Napoleon Hill
4	Think and Grow Rich – by Napoleon Hill
5	How to Stop Worrying and Start Living – by Dale Carnegie
6	Critical Thinking – by Bruce Walker
7	Focus – the hidden drives of Excellence - by Dianel Goleman



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:	UMECC0634	L	T	P	Credit
Course Name:	Co -Curricular Activities-III	-	-	2	1

Course Pre-Requisites:	None: This course is open to all third-year engineering students interested in enhancing their personal and professional development through co-curricular activities.				
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Course Description:	Co-Curricular activities are an integral part of curriculum which provides educational activities to the students and thereby help in broadening their experiences. Co-Curricular activities can be defined as the activities that enhance and enrich the regular curriculum during the normal college hours. All CoCurricular activities are organized with specific purpose which may according to the nature and form of activities. This course introduces students to a variety of co-curricular activities aimed at enhancing their professional and personal development within the field of engineering and technology. Through practical projects, competitions, workshops, and community engagement, students will develop teamwork, leadership, communication, and technical skills essential for success in their careers.				
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Course Objectives:

1	To encourage students to showcase their intellectual and independent thinking skills.
2	To imbibe a sense of confidence and managerial capabilities among students.
3	To promote the ability to work in team, organize and analyse available resources.
4	To build responsiveness among students about the social and cultural responsibilities.

Course Outcomes:	After the completion of the course the student will be able to
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COs	CO Statement	Blooms Level	Descriptor
CO1	Demonstrate the ability to critically analyse information and apply independent judgment in decision-making within the context of the activity.	II	Understand
CO2	Apply principles of management and organizational skills to plan, coordinate, and execute tasks related to the co-curricular activity	III	Apply
CO3	Collaborate effectively with peers to achieve common goals and objectives within the cocurricular activity. .	III	Apply
CO4	Reflect on their roles and responsibilities as members of a diverse community, fostering empathy and inclusivity.	IV	Analyze

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (Lab ISE)	100%	50 Marks
	ISE: Assessment is based on the student's participation in various Co-Curricular Activities and Guidelines given in "Rules for Assigning Activity Points: Activity – Event Grade Point Scheme" Policy Document		

Course Contents:

Course Guidelines: 1. Students are entitled to gain academic knowledge in this fast-paced environment, but it is also necessary for them to develop their personalities in both internal and external situations. 2. Co-curricular activities help students grow and develop their personalities. These activities contribute to a student's total personality development. 3. Not every student is intellectually inclined. Similarly, not all pupils are interested in co-curricular activities. Therefore, there is a need to provide a solid balance of co-curricular and extra-curricular activities in order to achieve the course learning objectives. 4. It primarily refers to intellectual, physical, emotional, and social growth that can be attained by a careful mix of academic, co-curricular, and extra-curricular activities. 5. So, keeping the course learning objectives the "Rules for Assigning Activity Points: Activity – Event Grade Point Scheme" Policy Document is proposed. 6. Student participation is assessed and reflected in the final activity performance report in order to get most students involved in extra-curricular activities (Group A) and co-curricular activities (Group B) as shown in Table 1 in the Policy Document. 7. All undergraduate students must choose at least ONE activity/event from each group i.e. (Group A and B). 8. Students shall choose one activity/ event from Group A and One from Group B that take place oncampus or off-campus. 9. Freedom shall be given to the students to take part in more than one activity under the group. 10. Students are expected to actively participate in activities, participate in contests, and earn grade points. 11. One student in each group must earn up to 50 grades in one semester so that they can achieve up to 100 grades in one year. 12. Grades for each semester are awarded based on the points achieved by the student, as shown in Table 2 in the Policy Document.	
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Course Structure: (Refer Rules for Assigning Activity Points: Activity – Event Grade Point Scheme)

Sr. No.	Initiatives	Criteria, Activities and Assignments
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1	Introduction to Co-Curricular Activities	Orientation, Induction, Course Overview
2	National Initiatives Participation	Participation, Achievement Levels and Assigned Activity Points in NCC, NSS, Unnat Bharat/ Unnat Maharashtra Abhiyan, Ek Bharat Shreshtha Bharat (EBSB)
3	Sports and Games Participation	Participation, Achievement Levels and Assigned Activity Points in Sports and Games
4	Cultural Activities Participation	Participation, Achievement Levels and Assigned Activity Points in Music, Performing Arts, Literary Arts
5	Professional Self Initiatives	Participation, Achievement Levels and Assigned Activity Points in 1. Technical Events/Quiz/Paper Contest/Project Contest / Model Making etc. 2. MOOC/ NPTEL/ SWAYAM/ Coursera etc. 3. Competitions/ Events Conducted by Professional Societies (ISTE, IET, CSI, IEEE, IETE, SAE, ISRO-IIRS, SWE, ISHRAE, ASM, ISNT etc.) 4. Attending Full time Conference/ Seminars/ Exhibitions/ Workshop/ STTP Conducted at IITs/ NITs/ Reputed Institutes/ Universities 5. Attending Full time Conference/ Seminars/ Exhibitions/ Workshop/ STTP Conducted at KITCoEK 6. Paper Presentation in National/ International Conference of High Repute 7. Poster Presentation in National/ International Conference of High Repute 8. Paper Publication in National/ International Journal of High Repute 9. Industrial Training/ Internship (at least for 04 Weeks) 10. Participation in Institute Level Student Clubs
6	Entrepreneurship and Innovation	Participation, Achievement Levels and Assigned Activity Points in 1. Prototype Developed and Tested 2. Awards for Products Developed 3. Innovative Technologies Developed and Used by Industries 4. Got Funding from Government/ Industry for Innovative Ideas 5. Patent-Filed/ Published/ Approved/ Licensed 6. Social Innovations
7	Leadership & Management of Clubs/ Activities	Participation, Achievement Levels and Assigned Activity Points in 1. Elected Student Representative of Student Council (University Representative, General Secretary, Cultural, Sports, NSS Secretary, Ladies Representative, Academic Toppers, Invitee Members) 2. Office Bearer of Professional Society Chapter (ISTE, IET, CSI, IEEE, IETE, SAE, ISRO-IIRS, SWE, ISHRAE, ASM, ISNT etc.) 3. Office Bearer of Institute Level Student Club (Developer Student Club, Gaganvedhi, Walk With World, Team Mavericks, Cultural Club, Aura, Amateur Write Club, Rotaract Club of KIT Sunshine, Women Development and Gender Equality Cell, Shourya, Lead India etc.) 4. Office Bearer of Departmental Student Association 5. Office Bearer of ECell, Digital Content Lab etc. 6. Student Ambassador for Mayura AICTE IDEA Lab/ NIDHI iTBI etc. 7. Editorial Board Member of Annual Magazine 8. Editorial Board Member of E-Newsletter 9. Member of Governance Committee/ Statutory Committee
8	Culminating Event and Reflection	Final Presentations, Course Reflection, Documentation, Assessment and Evaluation

Participation Levels:

1. Level: I College Level Events
2. Level: II District/ Central/ Zonal Level Events
3. Level: III State Level Events
4. Level: IV National Level Events
5. Level: V International Level Events

Approval Documents:

1. Certificate
2. Letter from Authorities
3. Appreciation recognition letter
4. Documentary evidence
5. Legal Proof

Grading Scheme:

Grade Range	Grade Academic	Performance
90-100	O	Outstanding
71 to 90	A+	Excellent
68-71	A	Very Good
65-68	B+	Good
60-65	B	Average
55-60	C	Below Average
50-55	D	Marginal
< 50	F1	Fail due to Poor Performance

1	CAD/CAM- Principals and ApplicationsI, P.N. Rao, Tata McGraw Hill, 2nd Edition.
2	CAD/CAM/CAEII,N.K. Chougule, SciTech Publication, Revised Edition.
3	Ibrahim Zeid —Mastering CAD CAMI Tata McGraw-Hill PublishingCo.2007
4	Radhakrishnan P, SubramanyanS.andRaju V., —CAD/CAM/CIMI, 2nd Edition, New Age International (P) Ltd, New Delhi,2000.
Reference Books:	
Sr. No.	
1	Various 3D modeling Software Manuals
2	CNC Programming manual.
3	Machine DrawingI, N. D. Bhatt and V.M. Panchal, Charoter Publications
4	Mastering CAD CAMI,Ibrahim Zeid, Tata McGraw-Hill, Special Indian Edition, (2007).
5	Machine DrawingI, N. Siddheshwar, P. Kannaiah, V V S Sastry, Tata McGraw Hill Publications, 2nd Edition.
6	CAM/CAM – Theory and Practicel,Ibrahim Zeid, R. Sivasubramaniam, Tata McGraw Hill,2nd Edition.
7	CAD/CAM – Concepts and applicationsI, Chennakesava R. Alavala – Prentice Hall of India

**Kolhapur Institute of Technology's College of Engineering (Empowered Autonomous), Kolhapur****Department of Mechanical Engineering**

Course Code:	UMEMM0641	L	T	P	Credit
Course Name:	Data Visualization and Analysis	3		-	3
Course Pre-Requisites:	Statistics and Fundamentals of Python				
Course Description:	This course gives knowledge on basics of statistical analysis of data. Also provides the insights of data behavior and its properties through graph visuals.				

Course Objectives:

1	Explain foundational concepts of data science and analytics, including data types, exploratory data analysis (EDA), and the use of core analytical libraries such as NumPy, Pandas, SciPy, and Matplotlib.
2	Demonstrate the ability to visualize and analyze raw datasets using statistical tools, charts, and graphical techniques to interpret data patterns, relationships, and descriptive statistics.
3	Apply data transformation and preprocessing techniques—such as cleansing, handling missing values, discretization, outlier filtering, and sampling—to prepare datasets and generate meaningful synthetic data.
4	Develop and evaluate machine learning models using transformed datasets by performing hypothesis testing, regression analysis, and supervised/unsupervised learning methods, including time-series forecasting and model performance evaluation.

Course Outcomes:

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Apply basics of data analytical concepts	III	Apply
CO2	Make use of raw data to analyze the data using statistical tools	III	Apply
CO3	Explain the data transformation methods to generate synthetic data	II	Understand
CO4	Illustrate the model using transformed data	II	Understand

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	End Semester Examination (ESE)	100%	Assessment is based on 100% course content.

Course Contents:

Unit No.	Unit Content	No of Hours
1	Understanding Data Science: Definition of data science and data analytics, Data Analytics Cycle: steps in EDA, Making sense of data: Numerical Data, Categorical Data and Measurement of Data, Getting Started with data analysis libraries: Numpy, Pandas, Scipy and Matplotlib.	7 Hrs
2	Data Visualization: Data Visualization Tools : Matplotlib: Line Chart, Bar Chart, Scatter Chart, Area Chart, Pie Chart, Table Chart, Histogram. Seaborn: Visualizing distributions of data, Visualizing statistical relationships	8 Hrs
3	Data Transformation: Data Cleansing, loading CSV file, applying descriptive statistics, data refactoring, dropping columns, replacing values, handling missing values, renaming axis indices, discretization and binning, outlier detection and filtering, Permutation and Random Sampling.	8 Hrs
4	Descriptive Data Analysis: Understanding statistics: Distributive function, descriptive statistics, Measure of Central Tenancy, Measures of Dispersion. Grouping dataset and correlation: groupby mechanics, data aggregation, pivot tables, correlation definition , types of correlation analysis, case study of multivariate analysis using titanic dataset	8 Hrs
5	Time Series Analysis: Understanding the time series dataset, data cleaning, time based indexing, visualizing time series, grouping and resampling time series data, time series forecasting and its methods, case studies of weather forecasting.	7 Hrs
6	Model Development and Evaluation: Hypothesis Testing, Understanding regression, model evaluation, understanding supervised learning, unsupervised learning and reinforcement learning, understanding machine learning workflow.	7 Hrs

Text Books:

Sr. No.	
1	Hands on Exploratory Data Analysis with Python” by Suresh Kumar Mukhiya and Usman Ahmed,2020 Packt Publication.
2	Data Visualization: Using Power BI and Tableau by Ramesh Behl published by McGraw Hill, ISBN-13 : 978-9364440349

Reference Books:

Sr. No.	
1	Python: Data Analytics and Visualization”, by Phuong Vo.T. H, Martin Czygan, Ashish, Kirthi Raman, 2017 Packt Publication
2	Data Analytics & Visualization All in one” for Dummies A Wiley Brand,2024

3	Storytelling with Data: A Data Visualization Guide for Business Professionals, Cole Nussbaumer Knaflic, John Wiley & Sons (Wiley) ISBN-13: 978-1119002253
4	The Visual Display of Quantitative Information, Edward R. Tufte, Graphics Press, LLC, ISBN-13: 978-1930824133
5	Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures, Claus O. Wilke, O'Reilly Media, ISBN-13: 978-9352138111 (Indian reprint)



Kolhapur Institute of Technology's College of Engineering, Kolhapur (Empowered Autonomous)

Department of Mechanical Engineering

Course Code:	UMEMM0642	L	T	P	Credit
Course Name:	Micro Electro Mechanical Systems	3			3
Course Pre-Requisites:	Knowledge of basic Electronic Devices and Circuits, Digital Electronics				
Course Description:	A MEMS (Micro-Electro Mechanical Systems) course typically covers the fundamental principles of designing and fabricating miniature mechanical devices integrated with electronic circuitry, including topics like, micro sensing and actuation mechanisms, micro-fabrication techniques, device modeling, packaging.				

Course Objectives:

1	To study the evolution of micro fabrication.
2	To learn about the Micro sensors and Micro actuators.
3	To study various fabrication technologies.
4	To study various machining processes.

Course Outcomes: After the completion of the course the student will be able to

COs	CO Statement	Blooms Level	Descriptor
CO1	Explain the fundamentals of Micro Electro Mechanical Systems and polymer and optical MEMS.	II	Understand
CO2	Outline the Polymer in MEMS and Optical MEMS.	II	Understand
CO3	Demonstrate MEMS techniques in Micro Sensor and Micro Actuators.	II	Understand
CO4	Explain the various MEMS Fabrication Technologies and Micro Machining Processes.	II	Understand

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	End Semester Examination (ESE)	100%	100% course contents

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	INTRODUCTION TO MEMS: Basic definitions – evolution of Micro fabrication – Micro systems and Microelectronics, scaling laws: Scaling in Electrostatic force, Electromagnetic force, Rigidity of structures, Fluid mechanics and Heat transfer.	8
2	MICRO SENSORS: Introduction – Micro sensors: Bio medical sensors and Biosensors – Chemical sensors – Optical sensors – Pressure sensors – Thermal sensors, Acoustic wave sensors.	8
3	MICRO ACTUATORS: Micro Actuation: Actuation using thermal Forces, Piezo electric crystals, Electro static forces. SMA based Micro actuators, Micro actuators: Micro grippers, Micro motors, Micro valves, Micro pumps, Micro accelerometers – Micro fluidics.	7
4	MEMS FABRICATION TECHNOLOGIES: Materials for MEMS: Silicon, Silicon compounds, Piezo electric crystals, Polymers Micro system Fabrication Process: Photolithography, Ion implantation, Diffusion, Oxidation, CVD, Sputtering, Etching techniques	7
5	MICRO MACHINING: Micro Machining: Bulk micro machining, Surface micro machining, LIGA process. Packaging: Micro system packaging, Essential packaging technologies, Selection of packaging materials.	7
6	POLYMER AND OPTICAL MEMS: Polymers in MEMS - Polimide - SU-8 - Liquid Crystal Polymer (LCP) - PDMS - PMMA - Parylene - Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors - Optical MEMS - Lenses and Mirrors - Actuators for Active Optical MEMS. Application of MEMS - Case studies: Blood Pressure Sensor, Microphone, MEMS vibratory gyroscope	8

Text Books:

Sr. No.	
1	Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGraw Hill, 2002.
2	Cheng Liu, "Foundations of MEMS", Pearson education India limited, 2006.

3	S. Fatikow U. Rembold, "Microsystem Technology and Microrobotics", Springer-Verlag Berlin Heidelberg New York in 1997.
4	Stephen D Senturia, "Microsystem Design", Springer Publication, 2000.
5	Gregory T. A. Kovacs, "Micro-Machined Transducers Sourcebook" (McGraw-Hill)
Reference Books:	
Sr. No.	
1	Marc Madou, "Fundamentals of Micro fabrication" CRC press 1997.
2	Stephen D.Senturia, "Micro system Design" Kluwer Academic publishers, 2001.
3	K.Anatha Suresh, K.J.Vinoy, S.Gopala Krishnan, K.N.Bhat, V.K.Aatre, "Micro and smart systems", Willy India.
4	Nitaigrun Premchand Mahalik, "MEMS", Tata McGraw Hill, 2007.
5	Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures" (CRC Press)



Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Mechanical Engineering

Course Code:		UMEMM0643										L	T	P	Credit
Course Name:		Energy Storage Devices										3			3
Course Pre-Requisites:		Basic knowledge of Thermodynamics, Heat Transfer and Material Science.													
Course Description:		This course provides a comprehensive overview of various energy storage technologies, focusing on their principles, applications, and performance characteristics. It covers electrical, thermal, mechanical, and chemical energy storage systems, emphasizing their role in sustainable energy systems.													
Course Objectives:															
1		To understand the fundamental principles and classifications of various energy storage devices.													
2		To analyze the performance characteristics and applications of different electrical energy storage systems.													
3		To analyze the operational principles and applications of thermal and mechanical energy storage systems.													
4		To evaluate the energy storage systems into renewable energy													
Course Outcomes:			After the completion of the course the student will be able to												
COs		CO Statement										Blooms Level		Descriptor	
CO1		Classify and compare different energy storage technologies.										II		Understand	
CO2		Apply the knowledge of energy storage in different applications, i.e: supercapacitors, and fuel cells.										III		Apply	
CO3		Analyse thermal energy storage systems like sensible and latent heat storage.										IV		Analyze	
CO4		Evaluate the energy storage system.										V		Evaluate	
CO-PO Mapping:															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	
CO1	3										2	3			
CO2	2	2	2								2	2			
CO3	2	2	2	2		2					1	2	2		
CO4	2	2	2	2		2					1	2	2	2	
Assessment Scheme:															
SN	Assessment					Weightage		Remark							
4	End Semester Examination (ESE)					100%		100% course contents							
Course Contents:															
Unit No.	Unit Content													No. of Lectures	
1	Need for energy storage, classification of energy storage systems, performance parameters (energy density, power density, cycle life, efficiency), applications of energy storage. Energy storage and the smart grid. Environmental impacts of energy storage.													8	
2	Electrical Energy Storage: Batteries: Fundamentals of electrochemical storage, types of batteries (lead-acid, lithium-ion, nickel-based, flow batteries), battery characteristics and modeling, battery management systems (BMS), battery safety and recycling. Solid state batteries.													8	
3	Electrical Energy Storage: Capacitors and Fuel Cells Supercapacitors: principles, types, and applications. Fuel cells: principles, types (PEMFC, SOFC), performance characteristics, and applications. Hybrid energy storage systems (battery-supercapacitor).													7	
4	Thermal Energy Storage Sensible heat storage (water, solids), latent heat storage (phase change materials), thermochemical energy storage, applications in solar thermal systems and building heating/cooling. Thermal energy storage for concentrated solar power.													8	
5	Mechanical Energy Storage Pumped hydro storage, compressed air energy storage (CAES), flywheel energy storage, principles, and its applications.													7	

6	Energy Storage System Integration and Applications. Integration of energy storage into renewable energy systems (solar, wind), energy storage for grid stabilization, microgrids, electric vehicles, and portable electronics, economic analysis of energy storage systems. Energy storage for off grid applications.	7
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Text Books:

Sr. No.	
1	Energy Storage: A Systems Approach" by J.A. Duffie and W.A. Beckman.
2	Energy Storage Systems" by Godfrey Boyle.
3	Non-Conventional Energy Sources by G D Roy
4	Principles of Energy Storage Systems, P. Jayarama Reddy, BS Publications.
5	Engineering Energy Storage, Jacob Joseph Lamb and Odne Stokke Burheim,

Reference Books:

Sr. No.	
1	J. G. Weisend, The Handbook of Cryogenic Engineering, CRC Press, 1998.
2	R. B Scott.,Cryogenic Engineering, Van Nostrand and Company Inc., 1985.
3	Cryogenic Technology and Applications, A. R. Jha, Butterworth-Heinemann, 2005
4	Cryogenic Engineering - Fifty Years of Progress, Timmerhaus et. al., Springer, 2007
5	Arora and Domkundwar, Refrigeration and Air-conditioning, Dhanpat Roy & Co., 2018.