



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

Department of Mechanical Engineering

Course Code:	UMEC0501	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	PO12	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.	7

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.	7
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.	6
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.	7
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.	7
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:	UMEC0502	L	T	P	Credit
Course Name:	Metrology & Quality Control	3			3
Course Pre-Requisites:	This course requires the basic knowledge of the following: 1. Metric and SI units of physical quantities 2. Statistics 3. Trigonometry and basics of manufacturing engineering.				
Course Description:	In today's technology-driven world, products must be manufactured with high accuracy and precision to ensure quality and reliability. Dimensional control and measurement are essential for validating this accuracy. Measuring instruments and precision techniques play a vital role in achieving these standards. This course covers the principles, construction, applications, and use of measurement instruments and techniques to support high-quality engineering outcomes.				

Course Objectives:

1	Choose suitable instrument / gauge / method of inspection for determining geometrical and dimensional measurements
2	Understand the basic concepts of metrology, various standards and methods of dimensional measurement.
3	Make use of different tools and advance instruments to measure the various parameters of screw threads, gears and surface quality
4	Analyze the quality by appropriate Quality Control Tools or technique for given application.
5	Develop an ability of problem solving and decision making by identifying and analyzing the cause for variation and recommend suitable corrective actions for quality improvement.

Course Outcomes:

After the completion of the course the student will be able to			
COs	CO Statement	Blooms Level	Descriptor
CO1	Select appropriate measuring instrument for specific application	I	Remember
CO2	Demonstrate basic concepts of metrology, various standards and methods of dimensional measurement.	II	Understand
CO3	Make use of different tools and advance instruments for evaluating different parameters	III	Apply
CO4	Analyze the quality by appropriate Quality Control Tools or technique for given application.	IV	Analyse
CO5	Develop an ability of problem solving in quality related aspects	III	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2									2	2	1	
CO2	2	2	2	2								2	2	2	
CO3	3	3	2	2						2		2	3	2	2
CO4	3	2	2	2	3			2		2		2	3	2	
CO5	3	3	3	3	3			3		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	Basics of Metrology Need of measurement, errors in measurement, and standards of measurement, Line & End, Linear measurement: slip gauges and other basic devices of linear measurements. Angular measurement: Bevel Protractor, Clinometers, Angle Dekkor, Sine bar, Angleslip gauges. Calibration & Need for Calibration. Tolerances and Gauging: Unilateral and bilateral tolerances, Limit and Fits, Types of Fits, plain gauges and gauge design (numerical treatment) , interchangeability and selective assembly.	7

2	Comparators, Interferometry & Advance metrology Comparators : Mechanical(Sigma, Twisted strip), Pneumatic(Differential),Electrical (LVDT). Optical – (Profile Projector) , and their applications Interferometry: Principle of Interferometry and application in checking of flatness, height. Coordinate Measuring Machine (CMM): Fundamental features of CMM – role of CMMs – types of CMM and Applications, – types of probes, Laser in Metrology, Automatic inspection system, Machine vision for online-offline inspection.	7
3	Metrology of Thread &Gears Measurement of Thread form: Thread form errors, Measurement of Minor, Major and Effective diameter (Two Wire Method), Flank angle, pitch & pitch error Floating Carriage Micrometer (Numerical). Gear Metrology: Types of errors, Gear tooth Vernier, Chordal thickness method, Constant chord, Base tangent (Numerical), Gear Rolling Tester.	7
4	Surface finish measurement & G.T. Surface Finish: Types of textures obtained during m/c operation, CLA(Ra), RMS, Rz assessment methods, direction of lay, texture symbols, ,instruments used in surface finish assessment. Symbol for designating surface finish, straightness, flatness, squareness, roundness on drawing Geometric dimensioning & Tolerances (GD&T) for geometric features.	6
5	Introduction to Quality and Quality Tools Various definitions, Concept of Quality, evolution of quality, quality of design and conformance, balance between cost of quality and value of quality, Deming's cycles & 14 Points, Juran Trilogy approach, Seven Quality Tools (basic) ,5S, Kaizen, Poka yoke, Kanban, JIT, FMECA, Zero defects, TPM. Six Sigma: DMAIC - Concept and Applications.	8
6	Statistical Methods in Quality Control Statistical quality control: Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable (X bar & R Chart) & Attribute (P, np & C Chart) , Process capability(Indices: cp, cpk, ppk), Statistical Process Control..Inspection, stages of inspection, sampling inspection, single, double and multiple sampling plan. Operating characteristic curves, conflicting interests of consumer and producer, producer and consumers risks, AQL, LTPD.	7

Text Books:

Sr. No.	
1	Jain, R. K. Engineering Metrology. Khanna Publishers, 2005.
2	Gupta, I. C. Engineering Metrology. Dhanpat Rai Publications, 2012.
3	M. Mahajan, —Statistical Quality Controll Dhanpat Rai & Co., 2012
4	K.J. Hume – Engineering Metrology. Macdonald & Evans, 1970.

Reference Books:

Sr. No.	
1	N.V Raghavendra and L. Krishnamurthy, Engineering Metrology and Measurements, Oxford University Press, 2014.
2	J.F.W. Gayler and C.R. Shotbolt, —Metrology for Engineersl, Cassell, 1990
3	K.W.B. Sharp, —Practical Engineering Metrology, Pitman London, 1st Edition 1973
4	R.C. Gupta, —Statistical Quality Controll, Khanna Publication, 1st Edition,1978
5	Statistical Quality Control by Douglas C. Montgomery – The gold-standard reference for statistical process control (SPC), control charts, and acceptance sampling methods
6	Metrology & Quality Control by Anup Goel (Technical Publications) – A focused academic text explaining linear and angular measuring tools alongside quality control tools and Total Quality Management (TQM).



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

Department of Mechanical Engineering

Course Code:	UMEC0503	L	T	P	Credit
Course Name:	Dynamics of Machines	3			3
Course Pre-Requisites:	Engineering Physics, Applied Mechanics, Kinematics of Machines.				
Course Description:	This course is an introduction to the Dynamics and Vibrations of Lumped-Parameter models of Mechanical Systems. Topics covered include Inertia forces and Inertia torques in mechanisms. Balancing of multi-cylinder in-line engines. Gyroscopic motion: Simple theory of gyroscopic couple, gyroscopic effects in machinery, applications of gyroscopes. Fluctuation of energy and speed in machines: crank-effort and turning moment diagrams in flywheels. Free and forced vibrations of one-degree-of-freedom systems with and without viscous damping.				

Course Objectives:

1	Identify the various types of gear trains used for transmission of motion and power.
2	Analyze the gyroscopic effects on vehicles, aero plane and ship.
3	Analyze the problems on balancing of rotary and reciprocating masses.
4	Perform force analysis of simple mechanisms and balancing.
5	Study basic concepts of vibration analysis.

Course Outcomes:

After the completion of the course the student will be able to			
COs	CO Statement	Blooms Level	Descriptor
CO1	Utilize various terminology related to kinematics of machine elements.	III	Apply
CO2	Identify the various mechanisms and its components.	III	Apply
CO3	Apply analytical formulae to simple mechanisms.	III	Apply
CO4	Analyze dynamics of simple mechanisms.	IV	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	1	
CO2	2	2	1										2	1	1
CO3	2	2	2	1	1							1	2	2	1
CO4	2	3	2	1	1	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	Unit 1:---Gear Trains Types of Gear trains- Simple, Compound, Reverted, Epicyclic gear train, Tabular method for finding the speeds and torques of elements in epicyclic gear train. Equivalent mass Moment of Inertia applied to gear trains.	06 Hrs
2	Unit 2:---Gyroscope Gyroscopic couple, Spinning and Precessional motion, Gyroscopic couple and its effect on – i) Aero plane ii) Ship iii) Four-Wheeler iv) Two –Wheeler.	07 Hrs
3	Unit 3:---Static and Dynamic force analysis Velocity and acceleration of slider crank mechanism by analytical method, Inertia force and torque, D'Alembert's principle, Dynamically equivalent system, Force analysis of reciprocating engine mechanism.	07 Hrs
4	Unit 4:--- Balancing and Flywheel 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.	07 Hrs

5	Unit 5:---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.	07 Hrs
6	Unit 6:---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.	06 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
2	Ghosh A. and Mallick A.K., (1988), “Theory of Mechanisms and Machines”,
3	William T Thomson, Marie Dillon Dahleh and Chandramouli Padmanabhan, (2004),
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:	UMEC0504	L	T	P	Credit
Course Name:	Machine Design	3			3
Course Pre-Requisites:	Analysis of Mechanical Elements, Kinematics of Mechanics, Engineering Mathematics.				
Course Description:	The Machine design 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, Couplings, Welded and Bolted joints.				

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	
COs	CO Statement
CO1	Explain fundamental principles of fatigue and stress concentration in design of components
CO2	Identify parameters required for design of mechanical Components.
CO3	Determine the design parameters of mechanical components
CO4	Design of power transmission elements

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2								1	2	2	1
CO2	2	2	3	2								1	2	2	1
CO3	2	2	3	2								2	2	2	2
CO4	2	3	2	2								2	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	Unit 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, fatigue design for components under combined stresses.	7
2	Unit 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.	6
3	Unit 3: 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

4	Unit 4: Design of Spur and Helical gear i) 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. ii) Helical Gears: Terminology, Formative number of teeth in helical gears, force analysis, beam & wear strength of helical gears, effective load & design of helical gear.	7
5	Unit 5: Design of bevel and worm gear i) Bevel Gear : Types of bevel gears, Straight tooth bevel gear terminology and geometrical relations. Guideline for selection of dimensions and minimum number of teeth, Force analysis, Beam and wear strength, Dynamic tooth load, Design of straight tooth bevel gears based on beam and wear strength. ii) Worm and worm wheel : 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.	7
6	Unit 6:--- Design of Bolted & Welded Joints Design of bolted joints subjected to Eccentric Loading- 1) In a plane containing bolts, 2) Parallel to axis of bolt, 3) 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.	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.

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 Design” Schaum's outline series.
5	Machine Design, Hall, Holowenko Laughlin, Tata McGraw Hill Pub. Schaums Outline Series.

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

Course Code:	UMEC0505	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	PO12	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:		UMEC0506										L		T		P		Credit	
Course Name:		Geometrical Dimensions & Tolerancing - Lab														2		1	
Course Pre-Requisites:		Basic Knowledge of different units, types of errors in measurement and basic electrical components with their principle. Basic knowledge of scale, scale factor and different measurement with units. Also knowledge of Basics of Geometrical Dimensional Tolerances, limit, fits																	
Course Description:		The course integrates measurements of industrial parts with various mechanical and electronic measuring instruments and their usage.																	
Course Objectives:																			
1		To develop students knowledge of basics of Measurements, Metrology and measuring devices.																	
2		To know the concepts of various measurement systems & standards with regards to realistic applications.																	
3		The application of principle of metrology and measurements in industries.																	
Course Outcomes:			After the completion of the course the student will be able to																
COs		CO Statement										Blooms Level			Descriptor				
CO1		List various geometrical tolerances used in production										I			Remember				
CO2		Explain the significance of measurement system, errors,										II			Understand				
CO3		Demonstrate use of metrological tools for linear, angular measurements.										II			Understand				
CO4		Explain the basics of standards of measurement, limits, fits & tolerances industrial applications										II			Understand				
CO5		Analyze Manufacturing process with the help of Control Charts and Process Capability										IV			Analyze				
CO-PO Mapping:																			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3				
CO1	2			1									2	2	2				
CO2	2	2	2	2									2						
CO3	2	1		2									2	2					
CO4	2	2	2	2									2						
CO5	2	2		2	2								2	2					
Assessment Scheme:																			
SN		Assessment					Weightage		Remark										
1		In Semester Evaluation (ISE)					100%		Lab Experiments and Assignments										
Course Contents:																			
Expt. No.		Content												No. of Practicals					
1		Experiment No. 1: -- Study & Use of various linear measuring instruments (Vernier and micrometers) Outcomes: Demonstrate use of linear Measuring Instruments. Experimentation: Use of instrument, calibration , Measurement and Calculation with Interpretation												2					
2		Experiment No. 2: -- Study and use of mechanical & pneumatic comparator Outcomes: Demonstrate calibration process Theoretical Background: Calibration need and importance Experimentation: Use of instrument, calibration , Measurement and Calculation with Interpretation												1					
3		Experiment No. 3: --Study & use of Bevel protractor and Sine Bar for measurement of Angle. Outcomes: Demonstrate use of Angle Measuring Instruments Theoretical Background: Construction & Working of angle measuring instruments Experimentation: Use of instrument, calibration , Measurement and Calculation with Interpretation												2					
4		Experiment No. 4: --An assignment on geometric dimension and tolerance (concept, symbols, inspection) Outcomes: Demonstrate geometric dimension and tolerance Theoretical Background: Concept ,symbol, application												1					
5		Experiment No. 5: -- Measurements of Screw thread parameters using two wire method Experimentation: Use of instrument, calibration , Measurement and Calculation with Interpretation												1					
6		Experiment No. 6: -- Measurement of gear tooth thickness using gear tooth vernier caliper. Outcomes: Demonstrate use of Gear Measuring Instruments Experimentation: Use of instrument, calibration , Measurement and Calculation with Interpretation												1					

7	Experiment No. 7: --Study & Use of Coordinate measuring machine (CMM) for dimension measurement (Linear & Geometric). Outcomes: Demonstrate use of CMM Experimentation: Use of CMM, Measurement and Calculation with Interpretation	1
8	Experiment No. 8: --- Study & use of Variable (X-Bar & R-Chart) chart Outcomes: Demonstrate use of Gear Measuring Instruments Theoretical Background: Statistical concepts, Control charts Experimentation: Data collection, use of statistical techniques, data analysis, calculation, plotting of graph with interpretation	1
9	Experiment No. 9: --- Study & use of Attribute (P) chart Outcomes: Demonstrate use of Gear Measuring Instruments Theoretical Background: Statistical concepts, Control charts Experimentation: Data collection, use of statistical techniques, data analysis, calculation, plotting of graph with interpretation	1
10	Experiment No. 10: --- Study and use of dial indicator as a mechanical comparator for run out (eccentricity), roundness Measurement Outcomes: Demonstrate use dial & bench center for roundness & runout inspection Experimentation: Setting of instrument, method of measurement, calculation, plotting of graph with interpretation	1
Text Books:		
Sr. No.		
1	Jain, R. K. Engineering Metrology. Khanna Publishers, 2005.	
2	Gupta, I. C. Engineering Metrology. Dhanpat Rai Publications, 2012.	
3	M. Mahajan, —Statistical Quality Controll Dhanpat Rai & Co., 2012	
4	K.J. Hume – Engineering Metrology. Macdonald & Evans, 1970.	
Reference Books:		
Sr. No.		
1	N.V Raghavendra and L. Krishnamurthy, Engineering Metrology and Measurements, Oxford University Press, 2014.	
2	J.F.W. Gayler and C.R. Shotbolt, —Metrology for Engineersl, Cassell, 1990	
3	K.W.B. Sharp, —Practical Engineering Metrologyl, Pitman London, 1st Edition 1973	
4	R.C. Gupta, —Statistical Quality Controll, Khanna Publication, 1st Edition,1978	
5	Statistical Quality Control by Douglas C. Montgomery – The gold-standard reference for statistical process control (SPC), control charts, and acceptance sampling methods	



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

Department of Mechanical Engineering

Course Code:	UMEC0507	L	T	P	Credit
Course Name:	Dynamics of Machines Lab			2	1
Course Pre-Requisites:	Applied Mechanics, Engineering Physics, Kinematics of Machines.				
Course Description:	This Lab course is an introduction to the Dynamics and Vibrations of Lumped-Parameter models of Mechanical Systems. Topics covered include Inertia forces and Inertia torques in mechanisms. Balancing of multi-cylinder in-line engines. Gyroscopic motion: Simple theory of gyroscopic couple, gyroscopic effects in machinery, applications of gyroscopes. Fluctuation of energy and speed in machines: crank-effort and turning moment diagrams in flywheels. Free and forced vibrations of one-degree-of-freedom systems with and without viscous damping.				

Course Objectives:

1	Identify the various types of gear trains used for transmission of motion and power.
2	Analyze the gyroscopic effects on vehicles, aero plane and ship.
3	Analyze the problems on balancing of rotary and reciprocating masses.
4	Perform force analysis of simple mechanisms and balancing.
5	Study basic concepts of vibration analysis.

Course Outcomes:

After the completion of the course the student will be able to			
COs	CO Statement	Blooms Level	Descriptor
CO1	Utilize various terminology related to kinematics of machine elements.	III	Apply
CO2	Identify the various mechanisms and its components.	III	Apply
CO3	Apply analytical formulae to simple mechanisms.	III	Apply
CO4	Analyze dynamics of simple mechanisms.	IV	Analyze

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	25	practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group
2	End Semester Examination (ESE)	25	Assessment is based on Practical oral examination

Lab Course Contents:

Unit No.	Unit Content	No. of Sessions
1	Experiment No.1:- Demonstration on Differential Gear Train & Torque Measurement in Epicyclic Gear Train. Aim & Objectives: To study various types of gear trains and analysis of Epicyclic Gear Train. Outcomes: Able to analyze the Epicyclic Gear Train. Experimentation: Use of Tabular method for the Analysis of gear train model 02Hrs. available in laboratory	02 Hrs
2	Experiment No.2:- Verification of gyroscopic principle and determination of gyroscopic couple Aim & Objectives: To Verify experimentally the principles of Gyroscope. Outcomes: Able to describe effect of gyroscopic couple on various systems. Experimentation: Verification of active and reactive gyroscopic couples values using experimental setup. Results and Discussions: Calculation of active and reactive gyroscopic couples	02 Hrs
3	Experiment No.3:- Determination of M.I. using Bifilar and Trifilar suspension system. Aim & Objectives: To determine radius of gyration of rectangular bar using Bifilar and Trifilar suspension method. Outcomes: Able to determine radius of gyration of components. Experimentation: To determine value of Radius of gyration and M.I. of rectangular bar and Circular disc Experimentally. Results and Discussions: To verify the Radius of gyration and M.I. analytically	02 Hrs

4	Experiment No. 4:- Determination of M.I. of connecting rod by Compound pendulum method. Aim & Objectives: To determine radius of gyration of connecting rod as Compound Pendulum. Outcomes: Able to determine radius of gyration and M.I. of components like Connecting rod. Experimentation: To determine value of Radius of gyration and M.I. of connecting rod Experimentally. Results and Discussions: To verify the Radius of gyration and M.I. analytically	02 Hrs
5	Experiment No. 5:- 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	02 Hrs
6	Experiment No. 6:- 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
7	Experiment No.7:-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
8	Experiment No. 8:- 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	02 Hrs
9	Experiment No. 9:- 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
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.
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
2	Ghosh A. and Mallick A.K., (1988), "Theory of Mechanisms and Machines",
3	William T Thomson, Marie Dillon Dahleh and Chandramouli Padmanabhan, (2004),
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:	UMEC0508	L	T	P	Credit
Course Name:	Project Lab II			2	1
Course Pre-Requisites:	Basic sciences, Basic engineering sciences, Engineering Drawing				
Course Description:	This course provides an opportunity to students to work on real life problems related to identified course and to provide optimum solution to them. This approach is known as student's centric learning. Because of this way of learning, improvement in important process skills like problem solving ability, critical thinking, team working, communication skills and self learning abilities can be achieved.				

Course Objectives:

1	To have a focus on long-term, multidisciplinary, and student-centered project-based learning activities.
2	To foster autonomous and collaborative learning by using resources to solve problems from the real world.
3	Possessing the ability to create software based on the principles of mechanical engineering, mostly by utilizing previously acquired information.
4	To gain hands-on experience in the specification, design, implementation, and testing phases of the mechanical system development life cycle
5	To gain an ability to choose and use the proper mechanical engineering concepts while designing and evaluating a particular mechanical system.

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 problem through a rigorous literature survey and formulate / set relevant aims and objectives	III	Apply
CO2	Develop a suitable solution based on the fundamentals of mechanical engineering by possibly integration of previously acquired knowledge.	VI	Create
CO3	Analyze the results and arrive at valid conclusions	IV	Analyse
CO4	Make use of technology in proposed work and demonstrate learning in oral and written form.	III	Apply
CO5	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	PO12	PSO1	PSO2	PSO3
CO1	2	1	1			1	1	1				2	2	2	2
CO2	2	2	2	1	2	1	1				2	2	2	2	2
CO3	2	2	2	1								2	2		
CO4	2	2	2		1			2		3	2	2	2		
CO5									3			2			2

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE	100%	25 Marks

Course Contents:

Preamble:

Worldwide, engineering education is currently going through considerable structural changes. The engineering curriculum must be regularly revised in light of emerging topics and with a multidisciplinary focus due to the fast changing technological landscape. In order to include these fresh themes into educational programs while maintaining the development of traditional abilities, it is required to develop, execute, and assess creative pedagogical approaches. In this setting, interest in project-based learning strategies is quickly growing across the educational community. The typical classroom teaching method used in the majority of engineering programs places a strong emphasis on lectures and gives students little (if any) control over how they will learn.

However, the rapid advancement of engineering and technology necessitates the adoption of a teaching strategy that would help students not only build a foundation of abilities relevant to their business, but also prepare them for future career choices.

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.

Project Selection: Suitable project should be identified with respect to the problem statement specified by the course coordinator of CLPBL course. A survey of journal articles, patents, or a field visit can be used to choose the project. Problems can be theoretical, practical, social, technical, symbolic, cultural, or scientific. The issue must have the following components: an analysis of the issue, design and development of the system, and the viability of finding a solution (hardware or virtual). It is advised to "learn by doing" in order to solve problem-based initiatives. The concept starts with the identification of an issue, which frequently develops from a query or "wondering." Then, this defined problem serves as the foundation for learning. Students' exploration of many academic fields and professional settings results in problems that can be theoretical, practical, social, technical, symbolic, cultural, and/or scientific in nature.	
Ethical Practices, teamwork and project management: Use Indian standards or any relevant standards for project manufacturing, respect the time of others, attend the reviews, poster presentation and model exhibitions, strictly follow the deadline of project completion, comply with all legislation requirements that govern workplace health and safety practices.	
Effective Documentation: It is necessary for the students to master excellent writing techniques in order to equip our engineering graduates with the ability to create successful documentation. The literature review, problem statement, aim and objectives, system block diagram, system implementation details, discussion and analysis of results, conclusion, system limitations, and future scope are anticipated to be included in the PBL final report. It is expected that PBL mentors and guides will instruct students on how to use reliable information sources (such as scholarly articles, books, and periodicals) relating to their PBL topic.	
Evaluation & Continuous Assessment The comprehensive and ongoing monitoring and evaluation of student achievement is key to the PBL concept's effectiveness. It is recommended that regular reporting of all actions be mandated. Students must maintain a PBL log book at the department with regular evaluations of their PBL work. The following should be recorded in the PBL log book: 1. Student guidance and information 2. The PBL guide's weekly oversight, 3. Evaluation form for the PBL guide to review the PBL 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%)	
Reference Books/ Articles	
Sr. No.	
1	John Larmer, John R. Mergendoller, and Suzie Boss, "Setting the Standard for Project Based Learning"
2	John Larmer and Suzie Boss, "Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences"
3	Erin M. Murphy and Ross Cooper, "Hacking Project Based Learning: 10 Easy Steps to PBL and Inquiry".
4	Shinde, V. . Design of Course Level Project Based Learning Models for an Indian Engineering Institute: An assessment of students' learning experiences and learning outcomes. Institute for Planning, Aalborg University, 2014.
5	Vikas V Shinde and S S Inamdar. (2013). Problem Based Learning (PBL) for Engineering Education in India: Need and Recommendations. Wireless Peers Communication, 69, 1097-1105.
6	Shinde, V. Relevance of the problem and project-based learning (PBL) to the Indian engineering education, across the disciplines: research into best practice. In 3rd international research symposium on PBL (pp. 489–501). U.K.: Coventry University, 28–29 November 2011.



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

Department of Mechanical Engineering

Course Code:	UMEE0511	L	T	P	Credit
Course Name:	Numerical Methods	3	0	0	3
Course Pre-Requisites:	Engineering Mathematics-I, Engineering Mathematics-II, Engineering Mathematics-III, Numerical Methods in Engineering				
Course Description:	The course is aimed to provide elementary knowledge of numerical methods and statistical techniques and enable students to apply various tools and techniques to solve problems in mechanical engineering. The subject provides the students with a strong background on numerical approximation strategies and a basic knowledge on the theory that supports numerical algorithms. The course starts with introduction of numerical methods and its applicability in mechanical engineering with an introduction to basic computation using C++ or MATLAB. It covers the concepts of solution techniques of linear and non-linear equations and systems of equations. Differentiation and integration using numerical methods are covered. Application of different initial value and boundary value problems in mechanical engineering using finite difference method is taught. An introduction to solution of partial differential equation and finite element method is also covered.				

Course Objectives:

CO1	To provide the student with general techniques to formulate, model and mathematically solve advanced design engineering problems.
CO2	To introduce the students with basic numerical methods and software tools for solving design engineering problems.
CO3	To enable the students to use appropriate analytical and computational tools to investigate design problems.
CO4	To prepare students to outline the physical systems and formulate mathematical models for them.
CO5	To make students to solve differential equations using numerical techniques and transform technique.

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Solve design engineering problems by using appropriate numerical methods	III	Apply
CO2	Relate experiments and analyze the numerical data.	II	Understand
CO3	Interpret interpolation, statistical data and approximation for design engineering problems.	II	Understand
CO4	Develop machines, systems, and projects required for industry	III	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2			1										
CO2		3	1		1									1	
CO3		2	1		1									1	
CO4		2	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	Errors: Introduction of Numerical error and accuracy, Types of errors, Rules for estimate errors, Error Analysis, accuracy of numerical results. Roots of Equation Bisection method, Regula falsi method Newton Raphson's, Multiple Roots, Iteration system of non- linear Equations, Secant method	07 Hrs
2	Linear Algebraic Equation: Gauss Elimination Method- Naïve Gauss Elimination, Pitfalls of Elimination, Techniques of improving solutions, Gauss- Jordan method Matrix Invention- LU decomposition, Gauss Seidel, Jacobi Iteration method, System of linear equations	06 Hrs
3	A. Curve Fitting: Least Square Regression – Linear regression, Polynomial Regression Interpolation – Newton's divided difference, Interpolating polynomial, Lagrange's interpolating polynomial. B. Statistics: Mean and standard deviation	07 Hrs
4	Numerical Differentiation and Integration Numerical Integration (Simpsons, Trapezoidal and Gauss Quadrature methods). Solution of Non linear equations, Applications of numerical techniques. Integration of Equation: Romberg's Integration and Gauss Quadrature. Numerical differentiation, Differentiation formulae, Derivation of unequally spaced data, Forward difference, Central difference, Backward difference Problems based on engineering applications.	07 Hrs
5	Ordinary Differential Equation: Taylor's series method, Picard's Method, Runge-Kutta method, Euler's Method, Improved polygon method, System of equation Boundary value and Eigen value problem, Finite Difference Method, Eigen value problem based on polynomial method, Determination of Eigen values by Power method, Problems based on engineering applications.	06 Hrs

6	Partial Differential Equation: Finite Difference – Elliptic equation, Laplace's equation, Liebmen's Method, Secondary variables, Boundary condition. Problems based on engineering application. Finite Difference- Parabolic Equation , Explicit Method, Introduction of MATLAB, Mechanical Engineering Problem solving approach by using MATLAB.	07 Hrs
Text Books:		
Sr. No.		
1	Dr. B. S.Grewal, —Numerical Methodsl, Khanna Publishers, New Delhi.	
2	E. Balguruswamy, —Numerical Methodsl, Tata McGraw Hill Publication Company Ltd.	
3	Steven C. Chapra, —Numerical Methods for Engineersl, Tata McGraw Hill Publications, New Delhi	
4	Numerical Methodsl, S.Arumugam, A. Thangapandi Isaac and A.Somasundaram, Scitech Publications India Pvt.Ltd.,Chennai.	
Reference Books:		
Sr. No.		
1	J.N. Kapoor, —Mathematical Modelngl,New Age Mumbai, first Edition,2005. Kreyszig, —Advanced Mathematicsl,LaurieRosatone, USA.	
2	S.C. Chapra, —Applied Numerical Methods with MATLAB for Engineers and Scientistsl, Tata McGraw Hill Education Pvt. Ltd., New Delhi	
3	Sigiresu S Rao, —Engineering Optimizationl,New Age International Publisher	
4	R. L. Burden and J. D. Faires, —Numerical Analysis Theory and Applicationsl, Cengage Learning India Pvt. Ltd., New Delhi	



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

Department of Mechanical Engineering

Course Code:	UMEE0512	L	T	P	Credit
Course Name:	Advanced Energy Technology	3	0	0	3
Course Pre-Requisites:	Basic Physics, Chemistry, Basic Mechanical Engg				
Course Description:	The course will cover following topics Solar , wind ,biomass ,tidal energy and prospective , efficient use of primary energy sources, different power plants, Energy management				

Course Objectives:

1	Acquire the knowledge of renewable sources of energy and utilization.
2	Enable the student to estimate the potential of energy sources.
3	Study various power stations , Performance and economic analysis
4	Understand the new trends in power and energy sectors

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Demonstrate need of different energy sources and their importance	II	Understand
CO2	Make use of Renewable energy for power generation	III	Apply
CO3	Analyze the utilization of solar, wind energy etc	IV	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3						2						2		
CO2	3						2						2		
CO3	2	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	Unit 1:--- Introduction to Renewable Energy sources -Environmental degradation due to energy production and utilization, primary and secondary pollution-air, thermal and water, depletion of ozone layer, global warming, biological damage due to environmental degradation, pollution due to thermal power stations and their control, Energy management and marketing, Energy audit .	6 Hrs
2	Unit 2:--- Introduction to Solar Energy , Solar potential, Solar radiation spectrum, Solar radiation geometry (Numerical on angle of incidence only), Solar radiation data, ,Solar Collectors (Flat plate, evacuated tube, Cylindrical parabolic, Concentrating paraboloid), Graphical representation of efficiency of various Collectors , Testing of Solar flat plate collectors – BIS code (No numerical), Thermal Energy storage (Introduction and types)	7 Hrs
3	Unit 3:--- Photovoltaic cell Operating Principle of Photovoltaic cell concepts, Photo-cell materials, Cell module array, Series and parallel connections, Maximum power point tracking, Design of standalone system with battery and AC or DC load (Descriptive Treatment), Applications, Introduction, Principle and operation of fuel cells, classification and types of fuel cell. Fuel for fuel cells, Application of fuel cells.	7 Hrs
4	Unit 4:---Wind Energy Wind parameters and wind data, Power from wind, Site selection, Wind energy conversion systems and their classification, Construction and working of typical wind mill, Introduction to OTEC and Hybrid systems (Diesel-PV, Wind-PV Biomass-Diesel systems)	6 Hrs

5	Unit 5:--- Other Renewable Energy Sources Renewable Energy Sources Biomass: as a source of energy, Classification of biomass, Biomass conversion processes, Biogas plant and its components, Types of biogas plants. Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India. Ocean Energy: Ocean Thermal Energy Conversion, Principles utilization, setting of Ocean Thermal Energy Conversion plants, Comparison with normal thermal power cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics	8 Hrs
6	Unit 6:--- Energy conservation and Energy Management Energy efficiency and energy conservation in boilers, furnaces, HVAC, motors, compressors, etc. solar passive architectural techniques and Green buildings, Energy Conservation and its Importance; Energy Strategy for the Future; The Energy Conservation Act, 2001 and its Feature, Energy Management	6 Hrs

Text Books:

Sr. No.	
1	Non-conventional energy sources by G.D. Rai, Khanna Publishers
2	Solar Energy: Principles of Thermal Collection and Storage by S,P Sukhatme, Tata McGraw Hill
3	Solar Engineering of Thermal processes, J.A.Duffie and W.A.Beckman, 2ndedition, John Wiley, New York, 1991.
4	Handbook of Biogas Technology, Pratek Shilpkar & Deepti Shilpkar

Reference Books:

Sr. No.	
1	Fuel Cells by Bockris and Srinivasan; McGraw Hill
2	Solar Energy: Fundamentals and Applications by H.P. Garg& Jai Prakash, Tata McGraw Hill.
3	Wind Power Technology, Joshua Earnest, PHI Learning, 2014.
4	Non Conventional Energy Resources by S. Hasan Saeed and D. K. Sharma, S. K. Kataria& Sons.
5	Renewable Energy Sources, J W Twidell& Anthony D. Weir. ELBS Pub.
6	Energy Conversion Systems, R D Begamudre, New Age International (P) Ltd., Publishers,

Kolhapur Institute of Technology's College of Engineering Kolhapur (Autonomous)																
Department of Mechanical Engineering																
Course Code:		UMEE0513										L	T	P	Credit	
Course Name:		Safety and Maintenance Engineering										3			3	
Course Pre-Requisites:		Preliminary knowledge of various types of machines and introduction to functions of management														
Course Description:		This course aims to impart knowledge of maintenance of equipment in industries. In order to avoid accidents and to survive and progress proper maintenance of equipment is necessary to be done in industry. This course provides information about wear, corrosion, lubrication, preventive maintenance; decision tree to diagnose faults, important provisions of factory act, alignment of equipment etc. This course also provides basic knowledge and skills regarding maintenance problems, their causes and remedies in industries.														
Course Objectives:																
1	To understand safety engineering aspects in industry.															
2	To educate and train for safety in order to prevent causes and cost of accident.															
3	To understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.															
4	To understand the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.															
Course Outcomes:		After the completion of the course the student will be able to														
COs	CO Statement										Blooms Level		Descriptor			
CO1	Explain the importance of safety										II		Understand			
CO2	Outline various factories acts and rules related to employee's safety										II		Understand			
CO3	Make use of preventive maintenance to carry out plant maintenance										III		Apply			
CO4	Identify and avoid accidental hazards										III		Apply			
CO5	Choose appropriate method for reconditioning and retrofitting process of machine elements										III		Apply			
CO-PO-Mapping:																
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03	
CO1	2	2											2			
CO2	2	2											2			
CO3	1	1	3										1	2		
CO4	1		3						2	1			1	2		
CO5	2		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 the development of industrial safety and management: History and development of Industrial safety, Implementation of factories act, Formation of various councils, Safety and productivity, Accident, Injury, Hazard, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents.Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety, Safety policy. Safety Officer-responsibilities, Safety analysis, PHA, HAZOP methodology													7		
2	Accident preventions, PPE, Safe workplace design: Personal protective equipment (PPE), Working in hot environment like casting, forging, rolling, sheet metal and other metalworking processes, Safety education and training, First aid, Firefighting equipment, Accident reporting, Investigations, Industrial psychology in accident prevention, Safety trials. Housekeeping,5S of housekeeping, confined space entry, Safety hazards in machines, Point-of-Operation, Principle of machine guarding , Designing safety features in machine and equipment, types of guards and devices, Safe layout for process industries, engineering industry, thermal power stations, metal powders manufacturing, Emergency response preparedness, Poka-Yoke for safe design and operation,													7		
3	Safety Acts Introduction to factory act, Indian boiler (amendments) act, pesticides act, explosives act ,workman compensation act, electricity act, Hazardous waste management, E waste rules,industrial hygiene, occupational safety, diseases prevention, ergonomics, occupational diseases, stress, fatigue, health, safety and the physical environment, engineering methods of controlling chemical hazards, control of industrial noise and protection against it, Introduction to OSHA [Occupational Safety and Health Administration], NSCI safety awards scheme - an overview. Introduction to SIL (safety integrity level),types of hazardous waste and their disposal,													6		
4	Principles of Maintenance planning: Basic Principles of maintenance planning-Objectives and principles of planned maintenance activity. Safety Officer's Role in Maintenance Work, Importance and benefits of sound Maintenance systems, Reliability and machine availability, Equipment Life cycle, Measures for Maintenance Performance: Equipments breakdowns, Mean Time Between Failures, Mean Time To Repair, Factors of availability, Maintenance organization, Maintenance economics													6		

5	Maintenance policies and preventive maintenance: Maintenance categories- Comparative merits of each category- Preventive maintenance, Maintenance schedules: Repair cycle, Principles and methods of lubrication, Fault Tree Analysis, Total Productive Maintenance: Methodology and Implementation	7
6	Condition Monitoring: Condition Monitoring: Cost comparison with and without Condition Monitoring, On-load testing and off load. Methods and instruments for Condition Monitoring, Temperature sensitive tapes, Pistol thermometers, Infrared thermography, Lubrication oil analysis, wear-debris analysis, Noise Vibration and harshness analysis of machines, Applications of IOT in condition monitoring	7
Text Books:		
Sr. No.		
1	Srivastava, S.K., —Industrial Maintenance ManagementI, S. Chand and Co.	
2	Armstrong, —Condition MonitoringI, BSIRSA	
3	Davies, —Handbook of Condition MonitoringI, Chapman and Hall	
4	Ray Asfahl, C., —Industrial Safety and Health ManagementI, 5th Edition, Prentice Hall	
3	Higgins, L.R., —Maintenance Engineering Hand bookI, 5th Edition, McGraw Hill	
2	Bhattacharya, S.N., —Installation, Servicing and Maintenancl, S. Chand and Co.	
3	Willie Hammer, —Occupational Safety Management and EngineeringI, Prentice Hall	
Reference Books:		
Sr. No.		
1	White, E.N., —Maintenance PlanningI, Documentation, Gower Press	
2	Garg, M.R., —Industrial MaintenanceI, S. Chand and Co.	
3	S.C.Mishra, —Reliability and Maintenance EngineeringI, New Age Publishing house	
4	Engineering Systems Reliability, Safety, and Maintenance An Integrated Approach, B.S. Dhillon, CRC Press Taylor & Francis Group	
5	Fundamentals of Process Safety Engineering, Samarendra Kumar Biswas Umesh Mathur Swapan Kumar Hazra, CRC Press Taylor & Francis Group	
6	Health and Safety: Risk Management, Fifth edition ,Dr.Tony Boyle.	

Kolhapur Institute of Technology's College of Engineering Kolhapur (Autonomous)																
Department of Mechanical Engineering																
Course Code:		UMEE0514										L	T	P	Credit	
Course Name:		Smart Materials										3			3	
Course Pre-Requisites:		Applied Physics, Materials Engineering, Machine Tools & Process, Manufacturing Processes														
Course Description:		The content of this course covers basics of different smart materials, their potential use in engineering fields. This course is also useful in helping students to learn the use of smart materials to automate the different tasks at micro/nano level workspace and to develop micro/nano system. It will also impart knowledge of nanomaterials, its synthesis and nanocomposites with tailored properties which can be used for several applications.														
Course Objectives:																
1	To study the working principles of various smart materials.															
2	To identify applicability of various smart materials as actuator and sensor.															
3	To study advances in smart materials.															
Course Outcomes:		After the completion of the course the student will be able to														
COs	CO Statement										Blooms Level		Descriptor			
CO1	Classify smart materials and explain their functions										IV		Analyze			
CO2	Explain the smart materials and their uses										II		Understand			
CO3	Make use of different sensors and actuators										III		Apply			
CO4	Choose suitable material for actuators										V		Evaluate			
CO-PO Mapping:																
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1			1										1			
CO2	1		1										1			
CO3		1	2										1			
CO4			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	Overview of Smart Materials Introduction, Components of smart systems – Sensors, actuators, Transducers, MEMS, Overview of the following materials with focus on synthesis, constitutive/governing relationships, strengths and weaknesses, and applications (both sensing and actuation etc)Piezoelectric Materials, Magnetostrictive Materials, Shape Memory Alloys, Electroactive Polymers Active smart polymers, Shape Memory Alloys (SMA) – Phase Transformations													6		
2	Types of Smart Materials Introduction to HBLS (high bandwidth low strain) generating smart materials- Piezoelectric and Magnetostrictive materials, LBHS (low bandwidth high strain) generating smart materials- Shape memory alloys and electro-active polymer													6		
3	Actuators Based on Smart Materials HBLS based actuators- Piezoelectric actuators- Induced strain actuation model, Unimorph and bimorph actuators, Actuators embedded in composite laminate. Magnetostrictive actuators - Mini actuators, Thermal instabilities, Magnetostrictive composites, MEMS based actuators. LBHS based actuators: Shape memory alloy based actuators, Electro-active polymer.													8		
4	Sensors Based on Smart Materials Sensors based on HBLS smart materials- Piezoelectric sensors, Magnetostrictive sensors, MEMS sensors, Sensors based on LBHS smart materials- Shape memory alloy based encoders, EAP based sensors													7		
5	Manufacturing techniques for smart materials: Micromanufacturing, high resolution lithography, LIGA process, Generative manufacturing processes such as STL, SLS, SPB, BPM, LOM, SGC, FDM, BIS, BPM, Self-assembly process, Ion beam processes													7		
6	Applications of Smart Material Structural applications of smart materials, Structural acoustic control, and vibration control applications. Aerospace and transportation applications													6		
Text Books:																
Sr. No.																
1	Brian Culshaw, Smart Structures and Materials, Artech House, 2000															

2	Gauenzi, P., Smart Structures, Wiley, 2009
3	Jasprit Singh, Smart Electronic Materials: Fundamentals and Applications, Cambridge University Press, 2005.
4	Michelle Addington and Daniel L. Schodek, Smart Materials and Technologies, Elsevier (2005).
5	A.J. Moulson and J.M. Herbert, Electroceramics: Materials, Properties, Applications, 2nd Ed., John Wiley & Sons, Chichester, West Sussex; New York, 2003 (ISBN:0471497479)
6	G. Gautschi, Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic
7	Emission Sensors, Materials and Amplifiers, Springer, New York, 2002 (ISBN:3540422595)
8	Cady, W. G., Piezoelectricity, Dover Publication
Reference Books:	
Sr. No.	
1	Smart Material Systems and MEMS by Vijay K. Vardhan, K. J. Vinoy, Wiley India M.V. Gandhi and B.S. Thompson, "Smart Materials and Structures", Chapman & Hall, London; New York, 1992 (ISBN: 412370107)
2	G. Gautschi, "Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers", Springer, Berlin; New York, 2002 (ISBN:3540422595)
3	Smart Materials by Mel Schwartz, CRC Press, Taylor & Francis.
4	SenolUtku, "Theory of Adaptive Structures : Incorporating Intelligence into Engineered Products", CRC Press (1998), ISBN: 9780849374319
5	A.V. Srinivasan, "Smart Structures: Analysis and Design", Cambridge University Press, Cambridge; New York, 2001 (ISBN: 0521650267)
6	K. Uchino, "Piezoelectric Actuators and Ultrasonic Motors", Kluwer Academic Publishers, Boston, 1997 (ISBN: 0792398114)
7	G. Engdahl, "Handbook of Giant Magneto strictive Materials", Academic Press, San Diego, Calif.; London, 2000 (ISBN: 012238640X)
8	K. Otsuka and C.M. Wayman, "Shape Memory Materials", Cambridge University Press, Cambridge; New York, 1998 (ISBN: 052144487X)
9	Eric Udd, "Fibre Optic Sensors: An Introduction for Engineers and Scientists", John Wiley & Sons, New York, 1991 (ISBN: 0471830070)
10	André Preumont, "Vibration Control of Active Structures: An Introduction", 2nd Edition, Kluwer Academic Publishers, Dordrecht; Boston, 2002 (ISBN: 1402004966)



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

Department of Mechanical Engineering

Course Code:	UMEE0515	L	T	P	Credit
Course Name:	Industrial Product Design	3	0	0	3
Course Pre-Requisites:	Manufacturing Processes, Machine Drawing and Computer Aided Drafting, Manufacturing Engineering				
Course Description:	The course is focused on new product development process through innovative ideas, screening of such ideas, feasibility study and building reliable product by gathering needs from the consumers. This course motivates and educates students to develop new products for betterment of society. This course is also useful for young entrepreneurs for converting their ideas into commercial product through systematic product development procedure.				

Course Objectives:

1	To prepare students to create and execute design solutions for problems of form, usability, physical ergonomics, marketing, brand development, and sales of industrial products.
2	To educate students to conceptualize and evaluate ideas to create new reliable products.
3	To introduce students to product architecture.
4	To estimate costing for a new product and study cost dynamics.

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Demonstrate the knowledge of indentifying customer needs for successful product development through Market research and survey.	II	Understand
CO2	Develop the knowledge of product specifications through concept and apply knowledge of integration of design aspects like product architecture, ergonomics, aesthetics, reliability and product data management.	III	Apply
CO3	Explain cost of new product by considering various components for designing the product using DFX methodology.	II	Understand
CO4	Identify the importance of Personal Protective Equipments for Industrial safety.	III	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					1							3		
CO2	3												3		
CO3	3	3	1										3		2
CO4	2	2	1	2		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 :- Challenges of product development, Identify customer needs, Successful product development, Quality aspect of product design, Market Research, Survey.	6
2	Product Development Process and Planning :- Innovation and Creativity in Product Design, Product Planning Processes, Product specifications: Process of setting specifications. (Concept Generation – Selection – Testing).	7
3	Product Architecture :- Implication of architecture, Establishing the architecture, Related system level design issue, Product Data Management, Use of Computerized Data Management and Process, Industrial Design: Overview. Reliability of Product:	7
4	Design for X Methodology:- Rules, guidelines, and methodologies along the product life cycle phases : Development phase, Production phase, Use phase, Disposal phase, Concurrent Engineering. Product Costing: Different costs, Pre-requisites for cost accounting, Volume -Varity matrix and its impact on product costing, Value engineering.	6
5	Aesthetics: Aesthetic Considerations, Visual Effects of Form and Colour in Product Design. Ergonomics: Ergonomics and product design and automated systems, Anthropomorphic data and its applications in ergonomic design, Limitations of Anthropomorphic data, General approach to the Man-Machine Relationship - Workstation Design and environment (working position and posture). Control Displays and User Interfaces: Configurations and sizes of various Control Displays and User Interfaces	9
6	Industrial Safety: Personal protective Equipment and Environment Control Prevention and specific safety measures for manufacturing and processing industry and chemical industry. Introduction to Internet of Things (IoT) and Industry 4.0 - Applications and Advantages	5

Text Books:

Sr. No.	
1	“Product Design and Development”, Karl T. Ulrich, Steven G. Eppinger, Irwin Tata McGraw Hill, 3rd Edition.
2	“Product Design and Manufacturing”, A. C. Chitale and R.C. Gupta, Prentice Hall of India, 3rd Edition.

3	"Product Design", Otto and Wood, Pearson education.
4	"Human Factor Engineering", L P Singh, Galgotia Publication Pvt. Ltd, 1st Edition.
Reference Books:	
Sr. No.	
1	"Introduction to Ergonomics", R. C. Bridger, Tata McGraw Hill Publication.
2	"New Product Development", Tim Jones, Butterworth, Heinemann, Oxford, (1997).
3	"Industrial Design for Engineers", Mayall W. H, London, Hiffe ebooks Ltd.



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

Department of Mechanical Engineering

Course Code:	UMEE0516	L	T	P	Credit
Course Name:	Tribology	3			3
Course Pre-Requisites:	Engineering Mathematics, Fluid Mechanics, Machine Design, Manufacturing Process				
Course Description:	Tribology is the study of friction, wear and lubrication, and design of Tribological Components, science of interacting surfaces in relative motion.				

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

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	PO12	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	FRICITION Introduction, Laws of friction, kinds of friction, causes of friction, area of contact, friction measurement, theories of friction.	6
3	WEAR Types of wear, various factors affecting wear, measurement of wear, theories of wear, Wear debris analysis; Wear reduction methods.	6
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	7
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	6
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.	7

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:	UMEE0517	L	T	P	Credit
Course Name:	Project Management	3			3
Course Pre-Requisites:	Fundamental knowledge of management				
Course Description:	Course comprises of introduction to project management, project identification, selection and project planning. It covers concepts of project activities, work breakdown structure, activity duration, resource requirements. It also introduce about project scheduling, project risk management, project costing ,project execution, control and closeout.				

Course Objectives:

1	To define concepts of project and project management
2	To explain various steps in project identification, selection and planning
3	To identify details of work breakdown structure, activity duration, resource requirements
4	To decide about project schedules and durations using Gantt chart, network analysis
5	To analyze project risks and role of computers in project management
6	To analyze aspects of project costing, project execution, control and close-out

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Define concepts related to project and project management	I	Remember
CO2	Explain steps in project identification, selection and project planning	II	Understand
CO3	Identify aspects of work breakdown structure, activity duration, resource requirements	III	Apply
CO4	Make use of Gantt chart, network analysis in deciding project schedules and project durations	III	Apply
CO5	Analyze project risks, role of computers , aspects of project costing, project execution, control and close-out	IV	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1										1		1	1	
CO2	2										1		2	1	
CO3	2	2	2	2							2		2	1	1
CO4	2	2	2	2							3		2	1	1
CO5	2	2	1	1							3		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 Project Management Definition of a project, project management & its need, characteristics, objectives & importance of projects, classification of projects, project management process ,project management life cycle & its phases, roles and responsibilities of project managers, types of project managers, forms of project management-basic, programme, new venture& product management(pm)	7
2	Unit 2: Project Identification, Selection, Planning Project ideas and sources, steps in project identification process, feasibility studies and types, feasibility report and its contents, financial institutions, project break even point project planning-scope, delivery, resources, budget, quality & risk, forms of organization structures-functional. geographical, product, matrix, pure	7

3	Unit 3: Project Activities, Work Breakdown structure, Activity duration, Resource Requirements Work breakdown structure (wbs)-product oriented and functionally oriented wbs, responsibility chart and responsibility matrix, integrating wbs and organization structure methods for estimating activity duration, determining resource requirements	6
4	Unit 4: Project Scheduling Activity, events, work packages, Gantt chart, scheduling of projects using network analysis PERT & CPM: Introduction to project evaluation and review, introduction to critical path method, deciding project duration using network diagram, finding critical path, calculation of earliest start time, latest finish time, slack, total float, free float, three time estimates, variance	8
5	Unit 5: Project Risk Management Introduction, risk, risk management, steps in risk management, Risk Analysis, Use of computers in project management	4
6	Unit 6: Project Costing ,Project Execution, Control, Close-out Elements of cost estimates and budgets of projects, Introduction to methods for assessing economic viability of projects, Project execution & Control-conduct project execution and control kick-off, manage cssq (cost, scope, schedule, quality) monitor & control risk. manage project execution ,gain project acceptance, Project close-out, steps for closing the project	8
Text Books:		
Sr. No.		
1	1.Engineering Project Management-Parameshwar P Iyer-Vikas Publishing House Pvt Ltd	
2	2.Project Management- S. Choudhury, - TMH Publishing Co. Ltd, New Delhi	
3	3.Prasanna Chandra, —Projects – Planning, Analysis, Financing, Implementation and Review, Tata McGraw Hill,4th Ed, 1997	
Reference Books:		
Sr. No.		
1	NYS Project Management Guidebook -Release 2	
2	John M Nicholas, —Project Management for business and technology, 2nd edition, Pearson Education Asia, 2001	
3	Effective Project Management Robert K. Wysocki, Robert Beck. Jr., and David B. Crane; - John Wiley & Sons.	
4	Total Project Management- The Indian Context- P. K. Joy, - Macmillan India Ltd., Delhi	
	Project Management in Manufacturing and High Technology Operations- Adedeji Bodunde Badiru, -John Wiley and Sons.	
5	Fundamentals of PERT/ CPM and Project Management- S.K. Bhattacharjee; - Khanna Publishers, New Delhi	



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

Department of Mechanical Engineering

Course Code:	UMEO0501	L	T	P	Credit
Course Name:	ENGINEERING ECONOMICS	3			3
Course Pre-Requisites:	Basic knowledge of Process Engineering,				
Course Description:	Engineering management relies on the knowledge of engineering economics to be able to evaluate projects from a financial perspective. Optimizing financial performance of a project is a key responsibility of an engineer in the decision making process. This course is designed to present engineering students the major concepts and techniques of engineering economics that are needed in the decision making process. The emphasis of this course is on the analytical analysis of cost calculation/ estimation of component, fund management and economic aspects of a enterprise.				

Course Objectives:

1	To acquire knowledge of Costing to be able to evaluate component/product from a financial perspective.
2	To apply analytical formulae to estimate the cost of a component.
3	To present engineering students the major concepts of fund management that are needed in the decision making process.
4	To emphasize the strong correlation between engineering design and manufacturing of products/systems and the economic issues they involve.

Course Outcomes:

COs	CO Statement	Blooms Level	Descriptor
CO1	Identify elements of cost, demand and supply.	III	Apply
CO2	Estimate the cost of a component.	V	Evaluate
CO3	Evaluate projects from a financial perspective.	V	Evaluate
CO4	Solve engineering economic analysis problems.	III	Apply
CO5	Demonstrate the effects of depreciation, taxes, inflation and price change.	III	Understand

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2						1	1	3	3	1			
CO2	1	2						1	1	3	3	3			
CO3	1	2						1	1	3	3	3			
CO4	1	2						1	1	3	3	3			
CO5								1	1	3	3	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:--- Introduction to Engineering Economy, Time value of money, Cash Flow, Law of Supply and Demand, Types Of Efficiency , Definition and scope of Concept of cost, cost unit, cost center, classification of cost, Definition of costing, cost-price-profit equation, desirable conditions for a costing system. Cost Estimating: Definition, purpose and functions of Cost Estimation, role of Estimator, estimating procedures. 1.2, Break Even Analysis, Economic Order quantity.	6 Hrs.
2	Unit 2:--- Depreciation 2.1 Elements of Cost, Depreciation Causes of depreciation of assets. Calculation of depreciation values using different methods of depreciation 2.2 Review of purchasing procedure, recording of stock and consumption of Material by LIFO, FIFO, Weighted average method. (numerical on above)	7 Hrs.

3	Unit 3:--- Cost Estimation 3.1 Process of breaking down product drawing in to simpler elements or shapes, estimating the volume, weight and cost. Machine Hour Rate Calculation. Decision under risk and uncertainty.	7 Hrs.
4	Unit 4:--- Overhead and Cost Accounting Method 4.1 Methods of Overhead Allocation, apportionment, absorption of overheads.(Numerical) 4.2 Cost Accounting Methods: Job costing, Batch costing, Unit costing, Process costing, Contract costing, Activity based costing. (numerical)	7 Hrs.
5	Unit 5:--- Fund Management and Taxation 5.1 Sources of funds for business organization Concepts of wants, scarcity, choice, opportunity cost, demand and supply curves, price determination. Minimum Attractive Rate of Returns, Internal Rate of Returns (IRR) 5.2 Taxation: Effect of taxation on economic studies, Introduction to Direct and Indirect tax, GST – concepts and general principles. 5.3 Introduction Circular Economy for sustainability	7 Hrs.
6	Unit 6:---Cost Control and Cost Reduction Budget meaning, Use of Budget in planning and control, Budgetary control, Budget objectives, classification of budgeting, standard cost, variance analysis, marginal cost, Zero Base Budgeting (ZBB)	6 Hrs.

Text Books:

Sr. No.	
1	Mechanical Estimating and Costing By B.P. Sinha. Tata McGraw Hill Publishing Co. Ltd. N. Delhi
2	Mechanical Estimating and Costing T.R. Banga and S.C.Sharma, Khanna Publishers, Delhi-6
3	Theory & Problems of Management & Cost Accounting – M.Y. Khan, P. K. Jain
4	Cost Accounting: R.R. Gupta.
5	A Text Book of Estimating and Costing Mechanical – J.S. Charaya & G. S. Narang
6	Cost Accounting, 13/e - B. K. Bhar, (Academic Publishers, Kolkata)

Reference Books:

Sr. No.	
1	Principles & Practice of Cost Accounting – N. K. Prasad (Book Syndicate Pvt. Ltd.)
2	Costing Simplified: Wheldom Series – Brown & Owier (ELBS)
3	Cost Accounting: B. Jawaharlal (TMH)
4	Cost Accounting: Jain, Narang (Kalyani Publishers)
5	Mechanical Estimation and Costing – TTTI, Chennai (TMH)



 Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur																
Department of Mechanical Engineering																
Course Code:		UME00503										L	T	P	Credit	
Course Name:		Enterprise Resource Planning										3	0	0	3	
Course Pre-Requisites:		This course requires the basic knowledge of the following: 1.Basics of Industrial Management 2.Basics of Computer Software and Hardware.														
Course Description:		In today's world managing the future means managing information. Almost all organizations are turning to some sort of ERP package as a solution to their information management problems.ERP packages if chosen correctly, implemented judiciously and used efficiently have the ability to raise productivity and profits of companies. Knowledge of ERP systems is therefore crucial for today's day to day working.														
Course Objectives:																
1	To elaborate basics, evolution and importance of ERP.															
2	To explain ERP and related technologies.															
3	To explain the students the business modules of ERP.															
4	To explain the ERP Implementation process.															
5	To apply Programming knowledge in ERP software design															
6	To explain the ERP market with the help of case studies															
Course Outcomes:		After the completion of the course the student will be able to														
COs		CO Statement										Blooms		Descriptor		
CO1		Explain the evolution of an ERP system and the ERP market.										II		Understand		
CO2		Explain ERP and related information technologies										II		Understand		
CO3		Summarize the business modules of ERP and the implementation process of ERP package.										II		Understand		
CO4		Apply the programming knowledge in ERP software design										III		Apply		
CO-PO Mapping:																
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2															
CO2	2															
CO3	2	2											2	2		
CO4	2															
Assessment Scheme:																
SN	Assessment					Weightage		Remark								
1	In Semester Evaluation 1 (ISE1)					10%		Assignment, Test, Quiz, Seminar, Presentation, etc.								
2	Mid Semester Examination (MS)					30%		50% of course contents								
3	In Semester Evaluation 2 (ISE2)					10%		Assignment, Test, Quiz, Seminar, Presentation, etc.								
4	End Semester Examination (ES)					50%		100% course contents								
Course Contents:																
Unit No.	Unit Content												No. of Lectures			
1	Introduction to ERP: Introduction, Business Functions and Business Processes, Role of the Enterprise, Evolution, Reasond for the growth of ERP market, Advantages , Limitations of ERP.												6			
2	ERP and Related Technologies Business Process Reengineering (BPR), Business Intelligence (BI), Business Analytics (BA), Data warehousing , Data mining, OLAP, Product Life cycle management, Supply chain management (SCM), Customer Relationship management (CRM), Geographic Information system (GIS)												7			
3	ERP Modules Introduction and study of Business modules like Finance, Mfg. and Production, HR, Plant Maintenance, Quality and Material Management, Sales and Distribution												6			
4	ERP Implementation Life cycle and Implementation process Challenges to successful ERP Implementation, Objectives of ERP Implementation, Different Phases of ERP Implementation, ERP Deployment models, ERP Transition strategies, Organization of the ERP Project team, Success and Failure factors of the ERP implementation												8			

5	Development and Applications of ERP Module Design and Development of sample ERP module, Gathering requirements, Deciding technology, Development phase, Testing of ERP, User feedback.	7
6	ERP Market and Case Studies Brief account of ERP market, various ERP packages like SAP, BAAN, Oracle, QAD, PeopleSoft etc, Case studies based on implementation of ERP for various areas in Manufacturing, Marketing and other businesses, ERP career.	6
Text Books:		
Sr. No.		
1	. “Enterprise Resource Planning”, Alexis Leon, Tata McGraw Hill Publication, ISBN 0-7-463712-6.	
2	“Enterprise Resource Planning”, Bret Wagner, Delmar Learning, International Edition,ISBN 10: 1439081085, ISBN–13: 978-1439081082.	
3	“Enterprises Resource Planning”, Venkateshwara, Scitech Publication.	
4	“Entrepreneurship”,Chris Boulton, Patric Turner, Willey India.	
5	“Management Information System”,S. Sadagopan, PHI, New Delhi, 2nd Edition.	
Reference Books:		
Sr. No.		
1	“Modern ERP: Select Implement and Use”, Marianne Bradford, Hand M Books,lulu.com, ISBN: 978-	
2	“Enterprises Resource Planning”, E.F. Monk, B.J. Wagner, Cengage Learning.	
3	“Enterprises Resource Planning”, A. R Singla, Cengage Learning.	
4	“Enterprises Resource Planning-Concepts and Practices”, Vinod Kumar Garg and Venkitakrishnan N.	



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

Department of Mechanical Engineering

Course Code:	UMEO0504	L	T	P	Credit
Course Name:	Innovation Tools and Methods for Entrepreneurs	2			3
Course Pre-Requisites:	A Student who is going to enroll for this course should have following abilities: 1. Creativity and Innovativeness 2. Problem identification 3. Apply design thinking approach to develop working prototype 4. Structured approach to problem solving				
Course Description:	This course helps students to identify different tools for developing the solution that he has already learned to ideate in the previous course —Creativity and Design Thinkingl. Further, students get information about various tools to carry out competitor analysis and user journey map. It would help him to come up with detailed specifications and USP of the product based on the competitor survey.				

Course Objectives:

1	To explain structured approach to define the problem with every possible detail, identify conflicts and solve them.
2	To apply user journey map to the selected problem to show user interaction at various stages
3	To analyze the solutions provided by competitors for effectiveness and gaps if any.

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Recall the concepts of innovation and various innovative tools used for product development.	I	Remembering
CO2	Demonstrate user journey mapping to understand user interaction at various stages of a selected problem.	II	Understanding
CO3	Analyze competitors' solutions to evaluate their effectiveness and identify gaps and opportunities.	III	Applying
CO4	Apply the Design Thinking process to develop a prototype and formulate a Business Model for the identified idea.	III	Applying

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3									1				2		
CO4										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	Unit-1Systematic Innovation Principals of Innovations, Ethics of Innovation, Innovation policy, Innovation systems, Sustainability, Systemic Innovation Systems Thinking.	4
2	Unit-2 TRIZ Introduction,Central concepts behind TRIZ, features of TRIZ,Use of TRIZ Principles, Advantage of TRIZ	4
3	Unit-3User Journey Map (UJM) Introduction, Need of Customer Journey Mapping, Step-by step process of UJM creation,Content of User Journey Map, The benefits of Customer Journey Mapping.	4
4	Unit-4Competitor Analysis Introduction, Competitive Analysis Framework, Benefits of using Competitive Analysis Framework,Types of Competitive Analysis Framework	4
5	Unit-5 Design Thinking: Introduction, Working of Design Thinking, Phases of Design Thinking,Ways to Get Started with Design Thinking, Advantages & Limitations of Design Thinking	4
6	Unit-6 Business Model Canvas: Introduction to Business Models, Defining the Business Model, Purpose, Role and Importance of Business Models, Key elements of a Business Model and the interactions & interdependencies among the elements.	4

Text Books:

Sr. No.	Name of Text Book
1	The innovation algorithm: TRIZ, systematic innovation and technical creativity, GS Al'tshuller - 1999
2	TRIZ: Systematic innovation in manufacturingYT San, YT Jin, SC Li - 2009
3	User experience mappingPW Szabo - 2017
4	Online computation and competitive analysisA Borodin, R El-Yaniv– 2005
5	Operating model canvasA Campbell, M Gutierrez, M Lancelott - 2017

Reference Books:	
Sr. No.	Name of Reference Book
1	J. Knapp. Design Sprint, Simon & Schuster Publisher.
2	D. Silverstein. The Innovator's Toolkit, Wiley Publishing House.
3	M. A. Orloff. ABC-TRIZ: Introduction to creative design thinking with modern TRIZ modeling,
4	M. Lavery. Entrepreneurship, OpenStax Publication.



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

Department of Mechanical Engineering

Course Code:	UMEO0505	L	T	P	Credit
Course Name:	Operations Research	3			3
Course Pre-Requisites:	This course requires the basic knowledge of the following: 1. Basics of Mathematics. 2. Basic functional areas in Engineering				
Course Description:	Operation Research is now has wide scope of application in various fields. OR Techniques help in solving various industrial problems. These include methods like Linear Programming, Transportation, Assignment, Sequencing, Queing, Gaming, Inventory Control, Replacement, Decision theory and network modeling. These techniques help to obtain the optimal solutions.				

Course Objectives:

1	To state the scope and importance of Operation Research.
2	To understand various OR Techniques for solving industrial and real life problems.
3	Apply the various models of operation research to solve industrial and real life problems to get optimal solutions

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Develop the LP model to solve engineering and	III	Apply
CO2	Analyze assignment models for engineering problems to	IV	Analyze
CO3	Discuss different transportation models.	V	Create
CO4	Solve game problems for pay-off matrix to get optimal mix	III	Apply
CO5	Make use of queing, sequencing and replacement theories to get optimal solutions for various problems.	III	Apply
CO6	Construct networks for optimizing project duration and	III	Apply

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Declared Test, Quiz, Seminar, Group Discussion, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents (Normally First Three Modules)
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Declared Test, Quiz, Seminar, Group Discussion, etc.
4	End Semester Examination (ESE)	50%	100% course contents with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Unit 1: Introduction to Operation Research and Linear Programming problems History and development of OR, Scope and Applications, Types of Operations Research, OR models and their applications in different areas Linear Programming Problems Formulation of LPP, Various methods of solving LPP- Graphical Method, Simplex Method (Minimization and maximization), concept of Duality	10
2	Unit 2: Transportation Model and Assignment Model A. Transportation Model: Basic Transportation problems, Conditions for testing optimality, unbalanced transportation problems, degeneracy. B. Assignment Model: Allocation Methods to solve balanced and unbalanced assignment problems, HAM, Alternate optimal solution, Traveling salesman problem	8

3	Unit 3: Gaming Theory Introduction, two-person zero-sum game, Minimax and Maximin principle. Saddle point. Methods for solving game problems with mixed strategies. Introduction to graphical, and iterative methods for solving game problems	5
4	Unit 4: Queing Theory and Sequencing A. Queuing Theory: Queuing Systems: Introduction, cost associated with, Classification of queuing models. Kendall's notations. Models: $\{(M/M/1): (a / FSFS)\}$. Single server models. B. Sequencing Sequencing of n jobs on two machines, n jobs on three machines.	6
5	Unit 5: Replacement Theory Introduction, Replacement model for items whose maintenance cost increases with time (money value constant) and with change in money value, selection of best machine, replacement of items that fail suddenly, individual and group replacement policies.	5
6	Unit 6:--- Network Model : Introduction, Concepts and construction of network diagrams, CPM, PERT, Probability of completing projects by given date, Crashing Analysis, Resource Scheduling.	8

Text Books:

Sr. No.	
1	Operations Research, S. D. Sharma,
2	Operations Research, Hira Gupta, S. Chand & Co. Ltd., New Delhi.
3	Operations Research, Kanti Swarup, Man Mohan and P. K.Gupta, Sultan Chand & Sons,
4	Optimization in EngineeringI, Biswal, SciTech Publication,2nd Edition.
5	Operations ResearchI, Manohar Mahajan Dhanapat Rai and Sons.
6	Engineering Optimization Methods and ApplicationI, A Ravindran ,K.M. Ragdell ,G.V. Rklaitis, Willey India Ltd

Reference Books:

Sr. No.	
1	Operations Research-An Introduction, H. Taha, Maxwell Macmillan, New York.
2	Principles Operations Research, Wrangler, Prantice-Hall of India, New Delhi.
3	Production and Operation ManagementI, Tripathy, SciTech Publication, 2nd Edition.
4	Introduction to Operation ResearchI, Paneer Selvam, Prentice Hall of India
5	Wiest J. D. & Levy F. K.: Managerial Guide to PERT/CPM, Prentice Hall of India Pvt. Ltd.
6	Srinath L.S "PERT & CPM principles & Applications" Affiliate East West Press (P) Ltd., New Delhi,



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

Department of Mechanical Engineering

Course Code:	UMEA0501	L	T	P	Credit
Course Name:	Intellectual Property Rights	2			0
Course Pre-Requisites:	Innovative and Creative Mindset, Genuine interest towards Entrepreneurship Development and Management.				
Course Description:	This course will cover the philosophy of intellectual property rights, various technical and legal dimensions of IPR, and implications of IPR for growth and development of science and technology, along with the various socio-economic and ethico-legal consequences of IPR on economic development. This course also covers all kinds of Intellectual Property Rights and focuses on India's new IP Policy and Government schemes for IPR.				

Course Objectives:

1	To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
2	To disseminate knowledge on patents, patent regime in India and abroad and registration
3	To disseminate knowledge on copyrights and its related rights and registration aspects To disseminate knowledge on trademarks and registration aspects
4	To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
5	To create awareness about current trends in IPR and Govt. steps in fostering IPR

Course Outcomes:

After the completion of the course the student will be able to			
COs	CO Statement	Blooms Level	Descriptor
CO1	Describe about the concepts of Intellectual Property Rights	II	Understand
CO2	Distinguish and understand the world of Intellectual Property	IV	Analyze
CO3	Explain why it needs to be protected. How is it protected	II	Understand
CO4	Analyse discuss and debate about the latest legal problems confronting the world and the solutions being offered	IV	Analyze
CO5	Summarize new and upcoming areas of Intellectual Property (IP) like Biotechnology, Domain Names, Creative Commons etc.	II	Understand

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (ISE1)	50% (50)	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	In Semester Evaluation (ISE2)	50% (50M)	Assignment, Test, Quiz, Seminar, Presentation, etc.

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS: Concept and meaning of IPR, Need for IPR, Kinds of Intellectual Property rights Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design. IPR in India : Genesis and development Introduction to TRIPS, WIPO AND WTO.	4
2	PATENTS Meaning of Patent, Patents - Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board	5
3	COPYRIGHTS Definition, Types of copy right, Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights	4

4	TRADEMARKS : Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board	4
5	OTHER FORMS OF IP Design Design: meaning and concept of novel and original - Procedure for registration, 1. Geographical Indication (GI) Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration, 2 Plant Variety Protection Plant variety protection: meaning and benefit sharing and farmers' rights – Procedure for registration 3 Layout Design Protection Layout Design protection: meaning – Procedure for registration	7
6	CURRENT CONTOUR India's New National IP Policy, Govt. of India step towards promoting IPR – Govt. Schemes in IPR	3

Text Books:

Sr. No.	
1	Prabuddha Ganguli, <i>Intellectual Property Rights: Unleashing the Knowledge Economy</i> , Tata McGraw-Hill Education, New Delhi, 2nd Edition, 2011.
2	R. Radha Krishnan and S. Balasubramanian, <i>Intellectual Property Rights</i> , Excel Books, New Delhi, 1st Edition, 2007.
3	P. Narayanan, <i>Intellectual Property Law</i> , Eastern Law House, Kolkata, 4th Edition, 2017.
4	B. L. Wadehra, <i>Law Relating to Intellectual Property</i> , Universal Law Publishing Co. Pvt. Ltd., New Delhi, 5th Edition, 2019.

Reference Books:

Sr. No.	
1	Nithyananda, KV.(2019).Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India
2	Neeraj, P.,&Khusdeep, D.(2014).IntellectualPropertyRights. India, IN:PHI learning Private Limited.
3	Ahuja,VK. (2017).Law relating to IntellectualPropertyRights. India, IN: Lexis Nexis
4	W. R. Cornish, David Llewelyn and Tanya Aplin, <i>Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights</i> , Sweet & Maxwell, London, 8th Edition, 2013.
5	N. S. Gopalakrishnan and T. G. Agitha, <i>Principles of Intellectual Property</i> , Eastern Book Company, Lucknow, 2nd Edition, 2014.
6	N.R.Subbaram.S.Viswanathan,“Handbook Indian PatentLawand,Practice” Printers and publishers Pvt, Ltd, 2008.



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

Department of Mechanical Engineering

Course Code:	UMEC0601	L	T	P	Credit
Course Name:	Design of HAVC and Refrigeration system	3			3
Course Pre-Requisites:	Applied Thermodynamics, Fluid Mechanics, Heat & Mass Transfer.				
Course Description:	Course Description: This subject enables the student to understand refrigeration cycles, their analysis and performance evaluation. Students will learn different refrigerants, their properties. The students will also learn components of refrigeration systems.				

Course Objectives:

1	Study basic refrigeration cycles and Psychrometry
2	Performance Evaluation of Refrigeration and Air Conditioning Systems
3	Enable the students to analyze and solve refrigeration related problems by applying principles of mathematics, science and engineering.
4	To develop a professional approach to lifelong learning in the refrigeration/ air conditioning

Course Outcomes:

After the completion of the course the student will be able to			
COs	CO Statement	Blooms Level	Descriptor
CO1	Apply knowledge of mathematics, science, and engineering for the needs in refrigeration and air conditioning.	III	Apply
CO2	Analyze different refrigeration and air conditioning systems with their applications.	IV	Analyse
CO3	Evaluate refrigeration and air-conditioning systems under different conditions.	V	Evaluate

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3						1		1			1	3		
CO2	2	2											2	2	2
CO3	2	2		3									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: Basic Refrigeration Cycles : Carnot cycle, Reversed Carnot cycle, Simple Vapor compression cycle, effect of subcooling, suction vapor superheating, Liquid to suction vapor heat exchanger, Calculations and performance of above cycles, Actual vapor compression cycle, Bell Coleman - Reversed Bryton cycle, Air cycles for aircrafts (Descriptive Treatment).	8
2	Unit 2: Multi pressure System and Refrigerants Multi pressure System: Removal of flash gas, Flash inter-cooling, Water-cooling, Multistage, Multi-evaporator and Cascade System. Refrigerants: Classification, Desirable Properties like Thermodynamic, physical and chemical. Comparison among commonly used refrigerants, Selection of Refrigerants, Effect on Ozone depletion and global warming, Alternative Refrigerants. Secondary refrigerants.	7

3	Unit 3: Cryogenics and Vapor Absorption System: Introduction to cryogenic engineering and application, liquefiers and cryocoolers. Cryogenic systems and applications Cryogenics: Vapor Absorption System: Aqua Ammonia system, Enthalpy-Concentration chart, analysis of system. Lithium Bromide -water vapor absorption system, Coefficient of Performance, Comparison with Vapor Compression cycle. (Descriptive treatment only)	7
4	Unit 4: Refrigeration Equipment & System Design : Compressor, Condenser, Evaporator, Expansion devices, and selection, different controls and accessories, use of insulation, its types and applications. Design of refrigeration systems - Household refrigerator, Ice plant, Cold storage, refrigerated vehicle, Water Chiller Types of	6
5	Unit 5: Psychrometry: Moist air as a working substance, Psychrometric properties of air, use of Psychrometric tables and charts, processes, combinations and calculations, ADP, Coil condition line, sensible heat factor, bypass factor, air washer and it's applications. Comfort: Thermal exchange between human body and environment, factors affecting comfort, effective temperature, comfort chart, ventilation requirements.	6
6	Unit 6: Heating and Cooling Load Calculation: Representation of actual air conditioning process by layouts and on Psychrometric charts, load analysis1, GSHP, ESHF, Enumeration and brief explanation of the factors forming the load on refrigeration and air conditioning systems, Energy requirements of different types of air conditioning systems, Energy conservation in air conditioning Design Analysis of Air Conditioning System: Design of Air conditioning systems: Design considerations, Load calculations, Single unit room air-conditioner, Central air conditioning plant, Industrial drying systems	8

Text Books:

Sr. No.	
1	C. P. Arora , “Refrigeration and Air conditioning”, Tata McGraw Hill Education Private
2	Roy J. Dossat “Principles of Refrigeration”, Pearson, fourth edition, 2007.
3	Stoecker & Jones, “Refrigeration and Air-conditioning”, McGraw Hill Book Company, New
4	Dr. S.N. Sapali “Refrigeration and Air-conditioning”, PHI (Second Edition) 2016
5	Manohar Prasad-Refrigeration and air conditioning, New age international publishers

Reference Books:

Sr. No.	
1	Wilbert F. Stoecker, Industrial refrigeration handbook, 1st edn., McGraw-Hill Professional
2	Shan K. Wang, “Handbook of air conditioning and refrigeration” McGraw-Hill international edition, second edition.
3	ISHRAE Hand Book
4	Edward Pita-Air Conditioning Principles and Systems: An Energy Approach, Pearson Publisher,
5	Roy J. Dossat —Principles of Refrigerationl, Pearson, fourth edition, 2007
6	Basics of refrigeration and air conditioning- P N Anantnarayanan, Mcgraw Hill Education India Pvt Ltd.



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

Department of Mechanical Engineering

Course Code:	UMEC0602	L	T	P	Credit
Course Name:	Power Plant Engineering	3	-	-	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 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. Engines	II	Understand
CO2	Classify different systems of I. C. Engines.	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	PO12	PSO1	PSO2	PSO3
CO1	3					2	2					1	3	2	2
CO2	2					2	2					1	2	2	2
CO3	2	2	1	2		1	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.	5
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.	6
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, NOx) Control methods- Evaporative (ELCD), Thermal, Catalytic converters, C.I. engine emission (CO, NO, Soot, Particulates) Control methods- Chemical, EGR, Swirl, Turbo-charging, Noise, etc.	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.	6
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	6

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:	UMEC0603	L	T	P	Credit
Course Name:	Mechatronics System	3			3
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, Industry 4.0 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	Summarize components and applications of Mechatronics systems along with key concepts related to Industry 4.0.	II	Understand
CO2	Explain the various concepts related to different microcontrollers used in mechatronic systems.	II	Understand
CO3	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	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1									3	1	1
CO2	2	1	1	2	1								2	1	2
CO3	2	3	3	1	2								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	Mechatronics Systems: Definition of Mechatronics, Mechatronics advantages and its applications, Mechatronics systems, Components of Mechatronic Systems, Multi-discipline scenario, Traditional Vs Mechatronic Design, Case studies of Mechatronic systems designs, Introduction to SCADA and MEMS and its applications.	6
2	Digital Circuits and Microcontroller: Digital logic, Number systems, Logic gates, Boolean algebra, Application of logic gates, Sequential logic, Flip flop, D flip flop, JK flip flop, Master-slave flip flop. Introduction to Microcontroller, Comparison between microprocessor and microcontroller, Organization of a microcontroller system, Architecture of 8051, Pin diagram of 8051, Addressing modes, Instruction types and set, Selection and Applications of Microcontroller.	7
3	Modern Microcontrollers: Introduction to Arduino, Types of Arduinos, Introduction to Arduino UNO, Arduino UNO board breakdown, Prototyping environment, Arduino Integrated Development Environment (IDE), setting up Arduino board, Arduino Pin Diagram, Sample Circuits, creating sketches, basic Programming, introduction to the Raspberry Pi board, comparison of Arduino board with Raspberry Pi board, IoT implementation using Arduino.	7

4	Programmable Logic Controllers (PLC) : Introduction, Definition, PLC system and components of PLC Input-output module, PLC advantages and disadvantages. Ladder diagram and PLC programming fundamentals: Basic components and other symbols, Fundamentals of ladder diagram, Machine control terminology, Instruction list, Update – Solve ladder – Update, Physical components Vs. program components, Light control example, Internal relays, Disagreement circuit, Majority circuit, Oscillator, Holding (sealed or latches) contacts, Always ON always OFF contacts, Nesting of ladders. PLC Communication Services – Protocol- Definition, Networks, Nodes, and Topologies, Communication Methods, Deterministic and Non deterministic bus system, Control Protocols.	8
5	PLC Functions: Timers in PLC – Introduction, Delay On Timer, Delay OFF Timer, Retentive Type Timer on Delay, Cascading of Timers, industrial application of Timers. Counters in PLC – Introduction, Up Counter, Down Counter, industrial application of Counters Fault finding and troubleshooting of PLC.	6
6	Industry 4.0: Introduction: Smart Manufacturing for Industry 4.0, An example of a smart manufacturing system for Industry 4.0, Timeline of Industry 1.0–4.0. Technologies in Industry 4.0: Big Data, Cloud Manufacturing, Internet of Things, Autonomous Robots, Simulation, Horizontal and Vertical Systems Integration, Cyber Security, Additive Manufacturing, Augmented Reality, The Smart Factory of the I4.0, Cyber-Physical Systems, Internet of Services.	6

Text Books:

Sr. No.	
1	“Mechatronics”, W. Bolton, Pearson Education, 4th Edition.
2	“Mechatronics”, Mahalik, TATA McGraw Hill, (2006).
3	“Microprocessor 8085”, Gaokar Prentice Hall of India, 5th Edition.
4	“Programmable Logical Controller”, Hackworth, Pearson Education, (2008).
5	“Programmable Logical Controller”, Reis Webb, Prentice Hall of India 5th Edition.

Reference Books:

Sr. No.	
1	“Mechatronics”, Appu Kuttam, Oxford Publications, 1st Edition.
2	“Automated Manufacturing Systems”, S. Brain Morris, Tata McGraw Hill.
3	“Mechatronics and Microprocessor”, Ramchandran , Willey India, (2009).
4	“Programmable Logical Controller”, Gary Dunning Cengage Learning, 3rd Edition.
5	“SCADA”, Stuart A. Boyer, ISA Publication, 4th Edition



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

Department of Mechanical Engineering

Course Code:	UMEC0604	L	T	P	Credit
Course Name:	Control Systems	2			2
Course Pre-Requisites:	There are no formal prerequisites for this course; however you will need some knowledge of material from the following courses: physics, mathematics and electrical engineering.				
Course Description:	This course provides an introduction to linear systems, transfer functions, and Laplace transforms. It covers stability and feedback, and provides basic design tools for specifications of transient response				

Course Objectives:

1	Understand different dynamic systems and to be able to model such systems. This assists in understanding the wider implications of these engineering concepts, including responsibility in social, cultural and environmental issues
2	Understand the concept of feedback and how it influences the response of a system
3	Understand the response of a dynamic system to an input signal and to be able to predict the response of a particular system. This applies the mathematical and engineering sciences, including physics, to real-life problems.
4	To synthesize and demonstrate the efficacy of solutions to part or all of complex engineering problems, including formulating models from first principles of engineering science and mathematics

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Construct models of physical systems in forms suitable for use in the analysis and design of control systems	III	Apply
CO2	Make use of block diagram reduction, signal flow Technique and state space to represent control system	III	Apply
CO3	Identify the time domain responses of first and second-order systems to inputs like step, impulse etc.	III	Apply
CO4	Analyze time domain control system by applying stability criteria and sketching Root locus	IV	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2											3			
CO2	3	2											3			
CO3	2	2	2										2	2		
CO4	2	3	2	3									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%	Assessment is based on 100% course content with 60-70% weightage for course covered after MSE.

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Basic Elements and Mathematical Modeling of Control System : Classification of control system: Open loop and Closed loop systems, Linear-non linear, SISO-MIMO, etc. Advantages and limitations of open loop and closed loop systems and its applications. Modeling of Electric systems, Translational and rotational mechanical systems	8
2	Control system representation: Block diagram Algebra, Signal flow graph reduction using mason's gain formula. State space representation-concept of state, state variables and state model	7
3	Time Response Analysis: Time response of first order systems for impulse, step inputs, Transient response of second order systems for unit step input. Time domain specifications. Steady state Error and Error Constants	8
4	Stability & Root Locus Analysis: Stability criterion-Routh's stability. Root Locus-significance and Construction. Effect of addition of Poles and Zeros.	7

Text Books:

Sr. No.	
1	Control System Engineering, R Anand Natarajan, P. Ramesh Babu, SciTech Publication, 2nd Edition.
2	Control Systems ,A. Anand Kumar, Prentice Hall Publication.
3	Automatic Control Engineering, F.H. Raven Tata McGraw Hill Publication, 5th Edition.
4	Feedback Control Systems, R.A.Barapte, Tech-Max publications.

Reference Books:

Sr. No.	
1	Modern Control Systems, K Ogata, , Prentice Hall Publication ,3rd Edition.
2	Automatic Control Systems, B.C. Kuo, Wiley India Ltd. / Prentice Hall Publication, 7th Edition.

3	Automatic Control Engineering, D. Roy and Choudhari, Orient Longman Publication.Calcutta
4	Modern Control Engineering, K. Ogata, Pearson Education



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

Department of Mechanical Engineering

Course Code:	UMEC0605	L	T	P	Credit
Course Name:	HVAC and Refrigeration Lab			2	1
Course Pre-Requisites:	knowledge of Applied Thermodynamics, Fluid Mechanics, Heat & Mass Transfer.				
Course Description:	Students will be able to conduct trials on refrigeration and air conditioning systems. They will evaluate the performance of the systems further they will able to design HVAC systems				

Course Objectives:

1	To enable the students to perform the experiment and analyze results based on principles of mathematics, science and engineering.
2	To prepare students to use modern tools and techniques in HVAC
3	To train students with effective communication skill to demonstrate refrigeration/air conditioning theories.
4	To develop skills to fulfill industrial needs.
5	To develop a professional approach to lifelong learning in the refrigeration/ air conditioning

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Perform the experiments in refrigeration and air-conditioning as per given objectives	3	Apply
CO2	Analyze different refrigeration and air- conditioning systems with their applications.	4	Analyze
CO3	Evaluate the performance of different systems under different condition	5	Evaluate

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	100%	Experiments based upon 100% course contents

Course Contents:

Unit No.	Unit Content	No. of sessions
1	Experiment No. 1: Trial on vapour compression refrigeration system.	2
2	Experiment No 2: Trial on Heat Pump tutor	2
3	Experiment No 3: Trial on ice plant tutor.	2
4	Experiment No 4: Trial on Domestic refrigeration tutor	2
5	Experiment No 5 : Trial on air conditioning Tutor	2
6	Experiment No 6 : Trial on Cascade refrigeration tutor	2
7	Experiment No 7: Demonstration and study of accessories and controls used in refrigeration system.	2

8	Experiment No 8: Detailed load calculations and equipment selection for Cold Storage/ Ice factory/ water chiller	2
9	Experiment No 9: Visit to Cold storage / Ice factory .	4
Text Books:		
Sr. No.		
1	C. P. Arora,—Refrigeration and Air conditioningl, Tata McGraw Hill Education Private	
2	Roy J. Dossat —Principles of Refrigerationl, Pearson, fourth edition, 2007.	
3	Stoecker & Jones, “Refrigeration and Air-conditioning”, McGraw Hill Book Company, New	
4	Dr. S.N. Sapali “Refrigeration and Air-conditioning”, PHI (Second Edition) 2016	
Reference Books:		
Sr. No.		
1	Wilbert F. Stoecker, Industrial refrigeration handbook, 1st edn., McGraw-Hill Professional Publishing,1998	
2	IHRAE Handbook – Fundamentals of Refrigeration, 2015	
3	Shan K. Wang, “Handbook of air conditioning and refrigeration” McGraw-Hill international second edition., 2000	
4	Stocker. ,“Refrigeration and Air Conditioning”, McGraw-Hill Publishing , 2nd Edition,2008	
5	Willis H. Carrier, “Carrier Hand Book ”Jonathan Castro, 2013	



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

Department of Mechanical Engineering

Course Code:	UMEC0606	L	T	P	Credit
Course Name:	Power Plant Engineering Lab	-	-	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	PO12	PSO1	PSO2	PSO3
CO1	3												3	2	2
CO2	3												3	2	2
CO3	2	3	1		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:	UMEC0607	L	T	P	Credit
Course Name:	Mechatronics and Industry 4.0 Lab			2	1
Course Pre-Requisites:	Knowledge of basic Electronics and Electrical Engineering, Sensor and Actuator lab.				
Course Description:	Studying the mechatronics course is of important due to the global demand and developments in Mechatronic systems, Industry 4.0 and automated manufacturing planning and controlling activities etc. Mechanical systems are becoming smart and for designing and developing such smart systems students of mechanical engineering must understand the basic elements of smart systems such as sensors, signal conditioning devices, microcontrollers, microprocessors, 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	Demonstrate technologies and concepts related to Industry 4.0.	II	Understand
CO4	Develop a small application of the Mechatronic system.	VI	Create

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE	100%	25 Marks for Lab Journal
NOTE : ISE are based on laboratory performance and journals. Minimum 08 experiments to be performed and included in the journal. Students must Fabricate Simple Mechatronics working project using hardware like sensors, signal conditioning, actuators, and suitable software			

Course Contents:

Expt No.	Experiment Name	No.of Sessions in Hours
1	Addition and Subtraction of 8-bit numbers using microcontroller 8051	2
2	LED interfacing with Arduino	2
3	Digital Sensor interfacing with Arduino	2
4	Analogue Devices interfacing with Arduino.	2
5	PLC programming for demonstrating applications of Logic gates.	2
6	Applications based on timers using PLC ladder programming.	2
7	Applications based on counters using PLC ladder programming.	2
8	Real-life application solving using PLC ladder programming.	2
9	Demonstration of SMART MACHINE TOOL in Industry 4.0 Lab.	2
10	Demonstration of Additive Manufacturing system.	2
11	Demonstration of Augmented Reality and Virtual Reality (ARVR) Lab.	2
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

Text Books:

Sr. No.	
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1	"Mechatronics", W. Bolton, Pearson Education , 4th Edition.
2	"Mechatronics", Mahalik, TATA McGraw Hill, (2006).
3	"Microprocessor 8085", Gaokar Prentice Hall of India, 5th Edition.
4	"Programmable Logical Controller", Hackworth, Pearson Education, (2008).
5	"Programmable Logical Controller", Reis Webb, Prentice Hall of India 5th Edition.
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.

Title of the Course: VIBRATION MEASUREMENT AND CONDITION MONITORING LAB Course Code: UMEC0608												L	T	P	Credit
												-	-	02	01
Course Pre-Requisite: Basics of mathematics, physics, Dynamics of Machines															
Course Description: In industry, it is require to monitor the condition of equipments to avoid doen time of machines and hence improve productivity of plant.There are many maintenance strategies in which condition monitoring using vibrations is most imprtant. The subject contain basics of condition monitoring and various techniques used such as vibration analysis, motor signature analysis, NDT methods etc. The subject imphsises 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 other techniques of condition monitoring															
Course Learning Outcomes:															
CO	After the completion of the course the student should be able to											Bloom’s Cognitive level		Descriptor	
CO1	Explain fundamentals of vibration measurement, maintenance strategies and condition monitoring.											II	Understanding		
CO2	Idetify fault and state condition of rotating equipment.											III	Applying		
CO3	Analyze response of mechanical system and provide corrective action.											IV	Analyze		
CO4	Develop condition monitoring system for given equipment.											V	Design		
CO-PO Mapping:															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											3	2		
CO2	2	3	1									2	1	2	
CO3	2	2	2	2	1							1	1	1	1
CO4		3	2	1										1	2
1:low, 2: medium, 3:high															

Assessments :**Teacher Assessment:**

One component of In Semester Evaluation (ISE) having 100% weightage.

Assessment	Marks
ISE	25

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

LABORATORY CONTENT

Experiment 1 : Study of forced vibration and support excitation.

Experiment 2 : Study and demonstration of vibration measuring instruments and exciters.

Experiment 3 : Study of maintenance strategies and role of FMECA in maintenance.

Experiment 4 : Study of signal analysis, filtering and data acquisition.

Experiment 5 : Study and demonstration of FFT analyser.

Experiment 6 : Case study of Bearing fault analysis using vibration measurement

Experiment 7 : Case study of Gear box fault analysis using vibration measurement

Experiment 8 : Noise measurement of various rotating elements and identify their condition.

Experiment 9 : Case study of motor current signature analysis technique.

Experiment 10 : Study and demonstration of NDT methods used for condition monitoring.

Textbooks:

1. "Mechanical Vibrations", Singiresu S.Rao , Pearson Education,
2. Machinery Condition Monitoring: Principles and Practices, A.R.Mohanty,CRC Press, 2014
3. "Mechanical Vibrations", G. K. Grover, Published by Nemchand and Brothers, Roorkee.
4. "Mechanical Vibrations", Dr. V. P. Singh, Published by S. Chand and Sons New Delhi.
5. "Noise and Vibration Control", Leo L. Bernack, Tata Mc- Graw Hill Publication.
6. "Mechanical Vibration and Noise Engineering",A. G. Ambekar, Prentice Hall of India.
7. "Fundamentals of Vibrations", Balchandran Magrab ,Cengage Learning.
8. "Theory of Vibrations with Applications", W. Thomson, Pearson Education,2nd Edition.
9. "Mechanical Vibration",Dr Debabrata Nag, Wiley India Pvt. Ltd ,ISBN 978-81-265-3090-

References:

1. "Mechanical Vibration",Austin Church, Wiley Eastern. 2nd Edition.
2. "Schaumm's Outline series in Mechanical Vibration", S. Graham Kelly, 6th Edition.
3. "Kinematics, Dynamics and Design of Machinery",Waldron, Wiley India, 2nd Edition.

4. "Mechanical Vibrations", J.P. Den Hartog, Tata McGrawhill Book Company Inc., 4th Edition.
5. "Introduction to Dynamics and Control", Leonard Meirovitch, J. Wiley, New York.
6. "Elements of Vibration Analysis" Leonard Meirovitch, Tata McGrmv-Hill, New York. 2nd Edition.
7. "Principles of Vibration", Benson H. Tongue, Oxford University Press., 4th Edition.
8. "Vibrations and Noise for Engineers", Kewal Pujara Dhanpat Rai and Sons, (1992).
9. "Mechanical vibration", William J Palm III Wiley India Pvt. Ltd., ISBN 978-81-265-3168-4, 1st Edition.
10. "Fundamentals of vibrations", Leonard Meirovitch, McGraw Hill International Edition.
- 11 "Principles of Vibration Control", . Asok Kumar Mallik, Affiliated East-West Press.
- 12 "Mechanical Vibrations", A.H. Church, John Wiley and Sons, Inc, New York, 1994.



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

Department of Mechanical Engineering

Course Code:	UMEC0609	L	T	P	Credit
Course Name:	Project Lab III			2	1
Course Pre-Requisites:	Basic sciences, Basic engineering sciences, Engineering Drawing				
Course Description:	This course provides an opportunity to students to work on real life problems related to identified course and to provide optimum solution to them. This approach is known as student's centric learning. Because of this way of learning, improvement in important process skills like problem solving ability, critical thinking, team working, communication skills and self learning abilities can be achieved.				

Course Objectives:

1	To have a focus on long-term, multidisciplinary, and student-centered project-based learning activities.
2	To foster autonomous and collaborative learning by using resources to solve problems from the real world.
3	Possessing the ability to create software based on the principles of mechanical engineering, mostly by utilizing previously acquired information.
4	To gain hands-on experience in the specification, design, implementation, and testing phases of the mechanical system development life cycle
5	To gain an ability to choose and use the proper mechanical engineering concepts while designing and evaluating a particular mechanical system.

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 problem through a rigorous literature survey and formulate / set relevant aims and objectives	III	Apply
CO2	Develop a suitable solution based on the fundamentals of mechanical engineering by possibly integration of previously acquired knowledge.	VI	Create
CO3	Analyze the results and arrive at valid conclusions	IV	Analyze
CO4	Make use of technology in proposed work and demonstrate learning in oral and written form.	III	Apply
CO5	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	PO12	PSO1	PSO2	PSO3
CO1	2	1	1			1	1	1				2	2	2	2
CO2	2	2	2	1	2	1	1				2	2	2	2	2
CO3	2	2	2	1								2	2		
CO4	2	2	2		1			2		3	2	2	2		
CO5									3			2			2

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE	100%	25 Marks

Course Contents:

Preamble:

Worldwide, engineering education is currently going through considerable structural changes. The engineering curriculum must be regularly revised in light of emerging topics and with a multidisciplinary focus due to the fast changing technological landscape. In order to include these fresh themes into educational programs while maintaining the development of traditional abilities, it is required to develop, execute, and assess creative pedagogical approaches. In this setting, interest in project-based learning strategies is quickly growing across the educational community. The typical classroom teaching method used in the majority of engineering programs places a strong emphasis on lectures and gives students little (if any) control over how they will learn.

However, the rapid advancement of engineering and technology necessitates the adoption of a teaching strategy that would help students not only build a foundation of abilities relevant to their business, but also prepare them for future career choices.

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.

Project Selection: Suitable project should be identified with respect to the problem statement specified by the course coordinator of CLPBL course. A survey of journal articles, patents, or a field visit can be used to choose the project. Problems can be theoretical, practical, social, technical, symbolic, cultural, or scientific. The issue must have the following components: an analysis of the issue, design and development of the system, and the viability of finding a solution (hardware or virtual). It is advised to "learn by doing" in order to solve problem-based initiatives. The concept starts with the identification of an issue, which frequently develops from a query or "wondering." Then, this defined problem serves as the foundation for learning. Students' exploration of many academic fields and professional settings results in problems that can be theoretical, practical, social, technical, symbolic, cultural, and/or scientific in nature.	
Ethical Practices, teamwork and project management: Use Indian standards or any relevant standards for project manufacturing, respect the time of others, attend the reviews, poster presentation and model exhibitions, strictly follow the deadline of project completion, comply with all legislation requirements that govern workplace health and safety practices.	
Effective Documentation: It is necessary for the students to master excellent writing techniques in order to equip our engineering graduates with the ability to create successful documentation. The literature review, problem statement, aim and objectives, system block diagram, system implementation details, discussion and analysis of results, conclusion, system limitations, and future scope are anticipated to be included in the PBL final report. It is expected that PBL mentors and guides will instruct students on how to use reliable information sources (such as scholarly articles, books, and periodicals) relating to their PBL topic.	
Evaluation & Continuous Assessment The comprehensive and ongoing monitoring and evaluation of student achievement is key to the PBL concept's effectiveness. It is recommended that regular reporting of all actions be mandated. Students must maintain a PBL log book at the department with regular evaluations of their PBL work. The following should be recorded in the PBL log book: 1. Student guidance and information 2. The PBL guide's weekly oversight, 3. Evaluation form for the PBL guide to review the PBL 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%)	
Reference Books/ Articles	
Sr. No.	
1	John Larmer, John R. Mergendoller, and Suzie Boss, "Setting the Standard for Project Based Learning"
2	John Larmer and Suzie Boss, "Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences"
3	Erin M. Murphy and Ross Cooper, "Hacking Project Based Learning: 10 Easy Steps to PBL and Inquiry".
4	Shinde, V. . Design of Course Level Project Based Learning Models for an Indian Engineering Institute: An assessment of students' learning experiences and learning outcomes. Institute for Planning, Aalborg University, 2014.
5	Vikas V Shinde and S S Inamdar. (2013). Problem Based Learning (PBL) for Engineering Education in India: Need and Recommendations. Wireless Peers Communication, 69, 1097-1105.
6	Shinde, V. Relevance of the problem and project-based learning (PBL) to the Indian engineering education, across the disciplines: research into best practice. In 3rd international research symposium on PBL (pp. 489–501). U.K.: Coventry University, 28–29 November 2011.

Title of the Course: MECHANICAL VIBRATIONS Course Code: UMEE0621												L	T	P	Credit
												03	-	-	03
Course Pre-Requisite: 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 vibration is necessary to improve performance of system and to optimize the system at both design stage and application stage. The subject contains - Introduction to vibration. Two degrees of freedom systems, Multi degree vibrations. Numerical methods for multi degree vibration analysis, vibration measurement and condition monitoring, and introduction to Noise effects and measurement.															
Course Objectives: 1. To take overview of basic concepts of vibration analysis. 2. To study vibration analysis of two and multi-degree of freedom systems 3. To acquaint students with the principles of vibration measuring instruments and condition monitoring. 4. To acquaint students with noise measurement and its control.															
Course Learning Outcomes:															
CO	After the completion of the course the student should be able to											Bloom's Cognitive			
												level	Descriptor		
CO1	Explain fundamentals of vibration and noise in mechanical systems.											II	Understanding		
CO2	Solve numerical of natural frequency of mechanical system.											III	Applying		
CO3	Analyze vibratory response of mechanical system.											IV	Analyze		
CO4	Develop mathematical models to represent dynamic system.											V	Design		
CO-PO Mapping:															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											3	2		
CO2	2	3	1									2	1	2	
CO3	2	2	2	2	1							1	1	1	1
CO4		3	2	1										1	2
1: low, 2: medium, 3:high															

Assessments:**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: - Introduction to vibrations - Overview of types of vibrations, overview of analysis of vibrations - Free, forced, damped and undamped vibration of single degree of freedom systems	04 Hrs.
Unit 2: - Two Degrees of Freedom: Principal modes and natural frequencies of two DOF systems (spring-mass, pendulum, two rotors, etc.) Co-ordinate coupling and principal co-ordinates. Harmonic excitation, Vibration Dampers and absorbers, Dynamic vibration absorber – Tuned and Un tuned type.	08 Hrs.
Unit 3: - Introduction to Multi degrees of Freedom: Free vibrations of Multi DOF System-Flexibility and stiffness influence coefficient, Equation of motion, Rayleigh's method, Matrix iteration method, Holzer method. Introduction to nonlinear vibrations.	08 Hrs.
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.	06Hrs.
Unit 5 – Basics of Noise: Basic definitions, human response to sound, Decibel scale, Relation among sound power, Sound intensity and sound pressure level, Octave Band Analysis, Noise-Effects, Rating and regulation Non auditory and Auditory effects of noise, Noise standards and limits, Ambient emission noise standards in INDIA, Hazardous noise explosion, Day night noise level. Noise measurement and control	07Hrs.

Unit 6 – Condition Monitoring and Fault Diagnosis : data acquisition – time domain and frequency domain, signal analysis and data filtering, Vibration and noise monitoring, vibration analysis of rotating elements – bearing, gear, fan/blower, pump, IC engine, Motor current signature analysis, wear debris and oil analysis.	07Hrs.
Textbooks: 1. “Mechanical Vibrations”, Singiresu S.Rao , Pearson Education, 2. “Mechanical Vibrations”, G. K. Grover, Published by Nemchand and Brothers, Roorkee. 3. “Mechanical Vibrations”, Dr. V. P. Singh, Published by S. Chand and Sons New Delhi. 4. “Noise and Vibration Control”, Leo L. Bernack, Tata Mc- Graw Hill Publication. 5. “Mechanical Vibration and Noise Engineering”,A. G. Ambekar, Prentice Hall of India. 6. “Fundamentals of Vibrations”, Balchandran Magrab ,Cengage Learning. 7. “Theory of Vibrations with Applications”, W. Thomson, Pearson Education,2nd Edition. 8. “Machinery Condition Monitoring: Principles and Practices, A.R.Mohanty,CRC Press, 2014	
References: 1. “Mechanical Vibration”,Austin Church, Wiley Eastern. 2nd Edition. 2. “Schaumm’s Outline series in Mechanical Vibration”, S. Graham Kelly, 6th Edition. 3. “Kinematics, Dynamics and Design of Machinery”,Waldron, Willey India, 2nd Edition. 4. “Mechanical Vibrations”, J.P. Den Hartog, Tata McGrawhill Book Company Inc., 4th Edition. 5. “Introduction to Dynamics and Control”, Leonard Meirovitch, J. Wiley, New York. 6. “Elements of Vibration Analysis” Leonard Meirovitch, Tata McGrmv-Hill, New York. 2nd Edition. 7. “Principles of Vibration”,Benson H. Tongue,Oxford University Press., 4th Edition. 8. “Vibrations and Noise for Engineers”, Kewal Pujara Dhanpat Rai and Sons, (1992). 9. “Mechanical vibration”, William J Palm III Wiley India Pvt. Ltd., ISBN 978-81-265-3168-4, 1st Edition. 10. “Fundamentals of vibrations”, Leonard Meirovitch, McGraw Hill International Edition. 11 “Principles of Vibration Control”, . Asok Kumar Mallik, Affiliated East-West Press. 12 “Mechanical Vibrations”, A.H. Church, John Wiley and Sons, Inc, New York, 1994.	
Unit wise Measurable students Learning Outcomes: 1. Identify types of vibratory system as Undamped, Damped, SDOF, MDOF 2. Model the vibratory system for analysis purpose. 3. Evaluate natural frequencies and mode shapes of two DOF systems. 4. Evaluate natural frequencies and mode shapes of MDOF systems. 5. Measure the vibration parameters of system using instruments. 6. Understand the terms related to acoustic and measure the noise level.	



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

Department of Mechanical Engineering

Course Code:	UMEE0622	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, specially 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 commodities of BIW, trims and the concept of Product life cycle	II	Understand
CO2	Recommend appropriate material for BIW and Trims considering material properties which satisfy the requirements	V	Evaluate
CO3	Illustrate the concept of GD&T for BIW, sheet metal joining processes and plastic parts manufacturing processes	II	Understand
CO4	Explain the concept and methodology of DFMEA and CAE	II	Understand
CO5	Identify appropriate CAE method to carry out various BIW and Trims analysis	III	Apply
CO6	Explain various types of physical vehicle testing and various steps involved in assembly of car on assembly line	II	Understand

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1										2	2		
CO2	3	3										2	1		
CO3	3											2	1		
CO4	3	2		2	3							2	2		
CO5	3	2		2	3							2	3		2
CO6	3	1	2	2	1							2	3		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 Hours
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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) Introduction to preprogram stages like voice of customer, competitor insight, innovation, Project and quality planning, legislation. A, B, C surfaces, CAS vs Class -A surfaces, Bazier Curves, Types of continuities. d) Product life cycle and important gateways for BIW: Definition of PLM. Product life cycle: Design milestones, Types of builds, Launch of Vehicle. Flow chart of PLM, Design gateways: Design phases like virtual build, Prototype build, Mass Production. Launch of Vehicle	6 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 for 1. Manufacture, 2. Assembly and Part location on a vehicle. b) BIW Materials and Grades (Steel, Aluminium, composites): Evolution of automobile to modern Design. 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.	7 Hrs
3	GD & T for BIW: a) Concept of GD & T, Importance of GD&T. International standards for GD&T like BS, ASME, ISO. Role of GD & T on drawing, BIW Dimensional Requirement. BIW Dimensional applications. GD&T Symbols. 3-2-1 Principle. Types of locators. Principles of location. Illustration of Feature Control Frame. BIW Examples and case studies. 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) Introduction to Design Verification: Concept of Design Verification. Process of verifying Design. Commonly used verification methods like Demonstration, Inspection, analysis, Similarity, Testing. Preparation of verification activities. Conducting verification activities. Gateway support for Design verification. c) 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.	7 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, Trailed 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.	7 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, Side Pole Impact Test, Pedestrian head impact test, roll over test. Four post durability test. Wind tunnel testing. Automotive safety considering plastic components, NCAP, BHARAT NCAP, Active Safety and Passive safety features in modern passenger vehicles. Future trends in BIW, BIW for EV, Manufacturing - Sequence (after validation):, Welding & Assembly: Body shop, Paint Shop, Trim- chassis.	6 Hrs
Text Books:		
Sr. No.		
1	Alavala, C. R. (2009). Finite element method: basic concepts and applications. New Delhi: PHI Learning. 621.1232 ALA 009847 & 013721	
2	Bathe, K.J., & Bathe, K.J. (2002). Finite element procedures. New Delhi: Prentice-Hall of India. 620.00422 BAT 006424	
3	Deb, D. (2006). Finite element method: concepts and applications in geo-mechanics. New Delhi: Prentice-Hall of India. 624.17 DEB 008045	
4	<u>Failure Mode and Effect Analysis: FMEA from Theory to Execution, D. H. Stamatis, ASQ Quality Press, 2003, 0873895983, 9780873895989.</u>	
5	IGETIT PORTAL OF TATA TECHNOLOGIES.	
Reference Books:		
Sr. No.		
1	J.A. Brydson, “Plastic Materials”	
2	Schwartz & Goodman “Plastic materials and Processing”	
3	Irwin Rubin, “Handbook of plastic materials and technology”	
4	Fred W. Billmeyer, “Textbook of Polymer Sciences”	
5	Lorenzo Morello, Lorenzo Rosti Rossini, Guiseppe Pia, Andrea Tonoli – “The Automotive Body”, Springer Publications.	



Department of Mechanical Engineering

Course Code:	UMEE0623	L	T	P	Credit
Course Name:	COMPUTATIONAL FLUID DYNAMICS	3			3
Course Pre-Requisites:	Fluid Mechanics, Heat Transfer, Elementary Numerical Analysis, ODE, PDE				
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				

Course Objectives:

1	To Equip students with the knowledge base essential for application of computational fluid dynamics to engineering flow problems
2	To Provide the essential numerical background for solving the partial differential equations governing the fluid flow.
3	To Develop students' skills of using a commercial software package

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	Build flow problem properly within CFD context	III	Apply
CO2	Take part in solid modeling and meshing.	IV	Analyze
CO3	Assess the CFD results by comparing with available data, and discuss the findings.	V	Evaluate

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												2		1
CO2		3													
CO3		3						2					3	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 : Computational Fluid Dynamics: What, When, and Why?, CFD Applications, Numerical vs Analytical vs Experimental, Modeling vs Experimentation. Principles of Conservation: Reynolds transport theorem, Conservation of mass, Conservation of linear momentum: Navier-Stokes equation, Conservation of Energy, General scalar transport equation. Classification of Partial Differential Equations and Physical Behaviour: Mathematical classification of Partial Differential Equation, Illustrative examples of elliptic, parabolic and hyperbolic equations, Physical examples of elliptic, parabolic and hyperbolic partial differential equations	6
2	Approximate Solutions of Differential Equations: Error Minimization Principles, Functional involving higher order derivatives, Approximate solution of differential equations through variational formulation, Boundary conditions in the variational form: Primary and secondary variables, Essential and natural boundary conditions, Approximate solutions of differential equations, Properties of variational form, Weighted residual approach: trial function and weighting function, Requirement of trial function and weighting function, Least square method, Point Collocation method, Galerkin's method, Rayleigh-Ritz method	7

3	Fundamentals of Discretisation: Pre-processing, Solution, Post-processing, Finite Element Method, Finite difference method, Well posed boundary value problem, Possible types of boundary conditions, Conservativeness, Boundedness, Transportiveness, Finite Volume Method: Some Conceptual Basics and Illustrations through 1-D Steady State Diffusion Problems: FV Discretisation of a 1-D steady state diffusion type problem, Implementation of boundary conditions	7
4	Discretisation of Unsteady State Problems: 1-D unsteady state diffusion problems: implicit, fully explicit and Crank-Nicholson scheme. Consequences of time-discretisation in finite discretisation, Consistency, Stability, Convergence, Stability analysis of parabolic equations (1-D unsteady state diffusion problems), Stability analysis of parabolic equations (1-D unsteady state diffusion problems), Stability analysis of hyperbolic equations: Solution of Systems of Linear Algebraic Equations: Criteria for unique solution, infinite number of solutions and no solution, Solution techniques for systems of linear algebraic equations, Generalized analysis of the iterative methods, Sufficient condition for convergence, Rate of convergence, Relaxation methods, Gradient search methods: Steepest descent method and Conjugate gradient method	6
5	Discretisation of Convection-Diffusion Equations: A Finite Volume Approach: Finite volume discretisation of convection-diffusion problem: Generalized convection-diffusion formulation, Discretisation of Navier Stokes Equations: Discretisation of the Momentum Equation: SIMPLE Algorithm, SIMPLER Algorithm Unstructured Grid Formulation: Discretisation of the Momentum Equation using unstructured grid	7
6	What is there in implementing a CFD code?: The basic structure of a CFD code: Pre-processor, Solver and Post-processor, User-defined-subroutines, Solution to some basic problems in heat transfer and fluid flow. Introduction to Turbulence Modeling: Important features of turbulent flow, Vorticity transport equation, Statistical representation of turbulent flows: Homogeneous turbulence and isotropic turbulence, General Properties of turbulent quantities, Reynolds average Navier stokes (RANS) equation, Closure problem in turbulence: Necessity of turbulence modeling, Different types of turbulence model: Eddy viscosity models, Mixing length model, Turbulent kinetic energy and dissipation, The κ - ϵ model, Advantages and disadvantages of κ - ϵ model, More two-equation models: RNG κ - ϵ model and κ - ω model, Reynolds stress model (RSM),Large eddy Simulation (LES),Direct numerical simulation (DNS)	7
Text Books:		
Sr. No.		
1	H. K. Versteeg & W. Malalasekera, An Introduction to Computational Fluid Dynamics, Longman Scientific & Technical.	
2	John D. Anderson Jr., Computational Fluid Dynamics, McGraw Hill Book Company.	
3	J. Blazek, Computational Fluid Dynamics: Principles and Applications, Elsevier.	
Reference Books:		
Sr. No.		
1	S. V. Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill.	
2	T. J. Chung, Computational Fluid Dynamics, Cambridge University Press.	
3	J. H. Ferziger and M. Peric, Computational Methods for Fluid Dynamics, Springer.	
4	John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Taylor & Francis.	



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

Department of Mechanical Engineering

Course Code:	UMEE0624	L	T	P	Credit
Course Name:	Total Quality Management	3			3
Course Pre-Requisites:	Knowledge of industrial management and Statistics				
Course Description:	Course describes about the basics of quality management such as customer-focused, organization-wide philosophy for long-term success, emphasizing continuous improvement through strategy, data, and communication, involving all employees to enhance quality, reduce waste, and meet customer needs, using tools like Six Sigma, benchmarking, and quality management systems (like ISO)				

Course Objectives:

1	Understand core principles such as customer focus, continuous improvement, employee involvement, process approach
2	Enabling students to apply quality tools (like 5S, SPC, Cause-Effect diagrams) and practical application,
3	Implement process improvements by understanding Quality Management Systems (QMS)
4	Fostering a quality culture, ultimately leading to enhanced organizational performance, reduced defects, and increased customer satisfaction.

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Define quality, customer, supplier	I	Remember
CO2	Illustrate statistical tools and techniques	II	Understand
CO3	Explain advance management tools for Quality control	II	Understand
CO4	Apply Hands on skills in problem solving and controlling and improvement of quality.	III	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1							2				1	1		
CO2	2	3	2	2								1	2		
CO3	2	2	2		1				2			1	2		
CO4	2	2	2	2	1							1	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 in hrs.
1	Basic concepts of Quality and TQM - Introduction to Quality, Evolution of Quality, Quality Definition, Dimensions of Quality, Introduction to TQM, Basic Concepts of TQM, TQM Framework (Elements of TQM), Principles of TQM, Barriers to TQM Implementation, Introduction to Quality Gurus, W. Edwards Deming, Joseph M. Juran, Philip Crosby, Cost of quality (COQ or Quality Costs)	6
2	Customer Satisfaction and Employee involvement- Understanding Customer Satisfaction, customers, Customer's Perception of Quality, Identifying Customer Needs, Customer Complaints (Customer Feedback); Understanding Employee involvement, Motivation, Employee Empowerment, Team and Team Work.	8
3	TQM Principles and Leadership:- Principles, Characteristics or Behaviours of Quality Leaders, Leadership Styles for Effective Leaders, Requirements of Effective Leadership, Deming's 14 Points for Management, Role of Senior Management (Role of TQM Leaders), Leading Practices for Leadership, Quality Council, Strategic Quality Planning	6
4	Supplier Partnership And Quality Circles- Principles of Customer/Supplier Relations, Supplier Partnering, Supplier Sourcing, Supplier Selection, Supplier Certification, Supplier Rating. Defining Quality Circles, Characteristics of Quality Circles, Structure of Quality Circle, Process of Quality Circle Operation.	7

5	TQM Tools and Techniques- introduction to Seven Basic Tools of Quality, Flow Chart, Check Sheet (Data Collection Sheet, Histogram, Pareto Diagram, Cause and Effect Diagram (or Fishbone Diagram), Scatter Diagram, Control Chart. Defining Benchmarking, Types of Benchmarking, Benchmarking Process, Benefits of Benchmarking	7
6	Advanced concepts- Introduction to FMEA, Six-Sigma, QFD, TPM, Kaizen, 5S, Introduction to ISO-9001:2015 Quality Management System	8

Text Books:

Sr. No.	
1	Dale H. Besterfield, —Total Quality Management, Pearson Education Asia
2	Jain K. C., —Total Quality Management and Business Process Transformation, Khanna Publishers, 2009 Edition
3	Dr. V. Jayakumar, Dr. R.Raju, —Total Quality Management, Lakshmi Publications- Chennai.
4	Rose, J.E. Total Quality Management, Kogan Page Ltd. 1993.
5	John Bank, The essence of total quality management, Prentice Hall, 1993.

Reference Books:

Sr. No.	
1	J M Juran, FM Gryana, “Quality planning and analysis”, Tata McGraw Hill
2	D. H. Besterfield et al., —Total Quality Management”, Prentice Hall.
3	Philip B Crosby, —Quality is free”, Mentor/ new American library.
4	Ishikawa K., —What is Total Quality Control? The Japanese way”, Prentice Hall.
5	Armand V Feigenbaum, —Total Quality Control, McGraw Hill

Kolhapur Institute of Technology's College of Engineering Kolhapur (Autonomous)																
Department of Mechanical Engineering																
Course Code:		UMEE0625										L	T	P	Credit	
Course Name:		Entrepreneurship Development										3	0	0	3	
Course Pre-Requisites:		Genuine interest in development of entrepreneurial mindset. Planning competency and global awareness.														
Course Description:		Familiarize students with fundamentals of entrepreneurship, study government support organizations for entrepreneurs, study the process of starting the industry besides studying the ecosystem available for new entrepreneurs														
Course Objectives:																
1	To develop conceptual understanding of the topic among the students and comprehend the environment of making															
2	To develop the ability of analyzing and understanding business situations in which entrepreneurs act and to master															
Course Outcomes:		After the completion of the course the student will be able to														
COs	CO Statement										Blooms Level		Descriptor			
CO1	Relate the concept of Entrepreneurship and describe the role of entrepreneurship within society										I		Remember			
CO2	Explain Market research, Survey, Project report, business finance										II		Understand			
CO3	Make use of marketing, sales, operations and accounting activities										II		Understand			
CO4	Apply entrepreneur inputs for starting and establishing business										III		Apply			
CO-PO Mapping:																
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	1												1			
CO2	2	2										1	2			
CO3	1	2										1	1			
CO4	2	1				2			2		2	1	2		1	
Assessment Scheme:																
SN	Assessment					Weightage		Remark								
1	In Semester Evaluation 1 (ISE1)					10%		based on presentation of Innovative Idea/ Business case presentation								
2	Mid Semester Examination (MSE)					30%		Assessment is based on 50% of course content (Normally first								
3	In Semester Evaluation 2 (ISE2)					10%		based on presentation of Innovative Idea/ Business case presentation								
4	End Semester Examination (ESE)					50%		Assessment is based on 100% course content with 60-70% weightage								
Course Contents:																
Unit No.	Unit Content												No. of Lectures			
1	Entrepreneur and Market Research Introduction to Entrepreneurship, Profile of the Entrepreneur, Market Gap / Opportunity Analysis, Market Research Methods, Defining the Focal Market: Market Research, Rural Industrialization in Retrospect, How to Develop Rural Entrepreneurship, NGOs, Women Entrepreneurship												8			
2	Project Identification, Selection and Management Meaning of Project, Project Identification, Project Report, Specimen of a Project Report, Network Analysis, Common Errors in Project Report												7			
3	Business Finance Need for Financial Planning, Sources of finance, Capital Structure, Term-loan, Sources of Short-Term Finance, Capitalization, Venture capital, Export Finance, Institutional Finance To Entrepreneurs, Government Support To Entrepreneurs, Business lifecycle, Break even.												7			
4	Marketing & Sales Marketing - Basics, Marketing Strategy and Brand Positioning, Plans and Execution Techniques, Marketing Analytics, Online Marketing Sales -Understanding Sales, Pitching Techniques, Sales strategies, Inside Sales v/s Outside Sales, Request for Proposal(RFP)												7			
5	Operation Management Techniques of materials, production, manpower resources management, Process Analysis, Productivity, Quality . Crisis management, study process, reasons of failure												7			

6	Costing and Accounting Direct and Indirect costs, Financial appraisal, Financial projection, Income tax, Profit and loss account, Balance sheet, Goods and Service tax, letter of credit, over draft, Excise Tax and Export process.	6
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Text Books:

Sr. No.	
1	Roy Rajeev, Entrepreneurship Oxford Latest Edition
2	E. Gordon & K. Natarajan Entrepreneurship Development Himalaya 2008
3	Coulter Entrepreneurship in Action PHI 2nd Edition
4	Ram Chandran, „Entrepreneurial Development“, Tata McGraw Hill, New Delhi
5	Saini, J. S., „Entrepreneurial Development Programmes and Practices“, Deep & Deep Publications (P)
6	Poornima M Charantimath, “Entrepreneurship development small business enterprises”, Pearson, 2013
7	Developing New Entrepreneurs - Entrepreneurship Development Institute of India, Ahmedabad
8	Handbook of New Entrepreneurs
9	Management of Small Scale Industry - Vasant Desai (Himalaya Publication)
10	Entrepreneurship Playing to Win- Gordon Betty (Taraporwala & Co.)
11	Motivating Economic Achievement- David C. McClelland, David G. Winter
12	Industrial Maharashtra- Facts, Figures and Opportunities (M.I.D.C. Mumbai)
13	Project Planning & Entrepreneurship Development - T. R. Banga
14	Dynamics of Entrepreneurial Development & Management- Vasant Desai
15	S.S.I. and Entrepreneurship- Vasant Desai (Himalaya Publication)
16	Petersen and Lewis : Managerial Economics, 4/e, Pearson/PHI, 2002
17	Managerial Economics, Ahuja. H.L, S. Chand, New Delhi.
18	M.L. Trivedi: Managerial Economics, Tata Mc-Graw Hill, New Delhi 2004
19	Ramachandran, and Kakani, —How to Analyze Financial Statements, Tata McGraw Hill
20	Palat, Raghu, —How to Read Annual Reports and Balance Sheets, JAICO Publishing House
21	Dash A.P., —Financial Wisdom – Finance for Non-Finance Executives, Biztantra ISBN 978-81-7722-378-1
22	Martin M.J., Managing Innovation and Entrepreneurship in Technology based Firm, John Wiley, 1994
23	Ettlie J.E., Managing Technology Innovation, John Wiley & Sons, 2000
24	Christensen C. M. and Raynor, M. E., The Innovator’s Solution: Creating and Sustaining Successful Growth, Boston
25	The Startup Playbook: Secrets of the Fastest-Growing Startups From Their Founding Entrepreneurs by David Kid
26	Creativity, Inc.: Overcoming the Unseen Forces That Stand in the Way of True Inspiration by Ed Catmull
27	Bhargava, S. (2003). Transformational leadership: Value based management for Indian Organizations (Ed.). New
28	Cardullo, M. W. P. E. (1999). Technological entrepreneurship: Enterprise formation, financing, and growth. Engla
29	Hisrich, R. D. & Peters, M. P. (2001). Entrepreneurship: Starting, developing, and managing a new enterprise (5th

Reference Books:

Sr. No.	
1	P. C. Jain Handbook For New Entrepreneur Oxford Latest Edition
2	S. S. Khanka Entrepreneurial Development S. Chand Latest Edition
3	Thomas W. Zimmerer & Norman M. Scarborough
4	Essentials of Entrepreneurship and small business management PHI 4th Edition
5	Dr. Vidya Hattangadi Entrepreneurship Himalaya 2007
6	Vasant Desai Small Scale Industries and Entrepreneurship
7	Badhai, B „Entrepreneurship for Engineers“, Dhanpat Rai & co. (p) Ltd.
8	Gupta and Srinivasan, „Entrepreneurial Development“, S Chand & Sons, New Delhi
9	Drucker, F. Peter, “Innovation and Entrepreneurship, Harper business, 2006
10	Motivating Economic Achievement- David C. McClelland, David G. Winter

11	Harvard Business Review on Innovation (Collection of articles), Harvard Business School Press, 2001
12	Harvard Business Review on Entrepreneurship (Collection of articles), Harvard Business School Press, 1999
13	Rogers, E.M., Diffusion of Innovations, Fifth Edition, New York: Simon and Schuster, 2003
14	Kanungo, R. N. (1998). Entrepreneurship and innovation: Models for development (Ed., Vol.2). New Delhi: Sage
15	Van Nostrand. Verma, J. C., & Singh, G. (2002). Small business and industry: A handbook for entrepreneurs. New
16	Richard A Brealy & Steward C Myres. Principles of Corporate Finance, McGraw Hills, 7th Edn,2004
17	Prasanna Chandra, Financial Management: Theory and Practice, Tata McGraw Hills, 6th Edn, 2004
18	I.M. Pandey & Ramesh Bhat, "Cases in Financial Management", Tata McGraw-Hill, New Delhi



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

Department of Mechanical Engineering

Course Code:	UMEE0626	L	T	P	Credit
Course Name:	Computer Integrated Manufacturing	3			3
Course Pre-Requisites:	Knowledge of basic manufacturing processes				
Course Description:	It is the study of manufacturing planning, integration and implementation of automation. It contains Computer Aided Manufacturing (CAM), studies of Concurrent Engineering, Group Technology, Computer Aided Process Planning and Flexible Manufacturing Systems and Networking concepts				

Course Objectives:

1	To understand the basic concepts of computer aided manufacturing, design and engineering and concept of group technology
2	To understand the subsystems in CIMS, such as computer aided process planning, flexible manufacturing, production management, quality control and material handling, and their integration
3	To understand the role of database management and communication systems in integration
4	To understand different data acquisition techniques.

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Explain the link between Automation and CIM	II	Understand
CO2	Make use of computer in Manufacturing and design process	III	Apply
CO3	Develop part family classification code using the concept of group technology.	III	Apply
CO4	Apply knowledge of computer aided process planning and flexible manufacturing in manufacturing processes.	III	Apply
CO5	Relate artificial intelligence in manufacturing.	II	Understand
CO6	Select appropriate networking topology for given application	III	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2											1	2		
CO2	2	2	2									1	2		
CO3	2		3									1	2		
CO4	2	2	2									1	2		
CO5	2	2											2		
CO6	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	Basic Concept of CIMS: Scope, islands of automation, architecture of CIM, information flow in CIM, elements of CIM, benefits, limitations, obstacles in implementation Planning for CIMS, need for planning, Phases of CIM implementation, incremental implementation and one time implementation, CIM benchmarking, Economic and social justification of CIM.	6
2	Product Design and CAD, application of computers in design, CAM – manufacturing planning and control, scope of CAD / CAM and CIM, Concurrent engineering, Design for manufacturing and assembly, Case studies on Concurrent engineering, Design for manufacturing and assembly.	6

3	a) Group Technology: Concept, design and manufacturing attributes, part families, composite part, methods of grouping, PFA, classification and coding system- OPITZ, Relevance of GT in CIM, GT and CAD, benefits and limitations of GT. b) Computer Aided Process Planning and Control: need, retrieval and generative type CAPP, role of CAPP in CIM. c) Computer Aided Production Planning and Control: Computer integrated production management system, Role of computers in aggregate planning, master production schedule, shop floor control, materials requirement planning, and capacity planning, manufacturing resource planning and enterprise resource planning	8
4	Flexible Manufacturing Systems, Transfer lines, Assembly Lines in CIMS: Concept, flexible & rigid manufacturing, manufacturing cell and FMS structure, types, components of FMS, Distributed Numerical Control (DNC), Building Blocks of FMS, Flexible Assembly System, Transfer Lines, concept, applications, benefits, Automates assembly lines, Design for assembly.	6
5	Applications of Artificial Intelligence and Machine Learning in Manufacturing: Concept of smart machines, SmartCorrect, Autonomous decision making Introduction to smart material handling devices and storage system	6
6	a) Data Acquisition and Database Management Systems: (a) Data acquisition system, type of data, automatic data identification methods, bar code technology, machine vision. (b) Data and database management system, database design requirements, types of DBMS models- hierarchical, network and relational models and their applications b) Communication in CIMS: Role of communication in CIMS, requirements of shop floor communication, types and components of communication systems in CIM, Networking concepts, network topology, access methods, ISO-OSI reference model for protocols, MAP/TOP, TCP/IP.	8

Text Books:

Sr. No.	
1	Automation, Production systems and Computer Integrated Manufacturing, 3/e - M.P. Groover (PHI or Pearson Education)
2	Computer Integrated Design and Manufacturing - Bedworth, Henderson & Wolfe, (McGraw Hill)
3	Principles of Computer Integrated Manufacturing - S. Kant Vajpayee, (PHI)
4	CAD / CAM Principles and Applications - P.N. Rao (Tata McGraw Hill)
5	CAD/CAM/CIM, 3/e – Radhakrishnan, Subramanayam & Raju (New Age International)
6	MAP/TOP Networking : Foundation of CIM – Vincent Jones (McGraw Hill)

Reference Books:

Sr. No.	
1	Performance Modeling of Automated Manufacturing Systems, 2/e - Viswanadham, N & Narahari, Y. (EEE) (PHI)
2	CIM Handbook - Teicholtz & Orr (McGraw Hill) Computer Integrated Manufacturing, 2/e - James A. Rehg, H. W. Kraebber, (Pearson Education)
3	COMPUTER INTEGRATED MANUFACTURING, ALAVUDEEN, A., VENKATESHWARAN, N. PHI Learning Pvt. Ltd., 200
4	Computer Integrated Manufacturing & Computer Aided Manufacturing, Sushil Kumar Choudhary, Walnut Publication
5	CAD/CAM/CIM, P. Radhakrishnan, S. Subramanyan, New Edge International Limited



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

Department of Mechanical Engineering

Course Code:	UMEO0602	L	T	P	Credit
Course Name:	Advance Energy Technology	3			3
Course Pre-Requisites:	Basic Physics, Chemistry, Basic Mechanical Engg				
Course Description:	The course will cover following topics Solar , wind ,biomass ,tidal energy and prospective , efficient use of primary energy sources, different power plants, Energy management				

Course Objectives:

1	Acquire the knowledge of renewable sources of energy and utilization.
2	Enable the student to estimate the potential of energy sources.
3	Study various power stations , Performance and economic analysis
4	Understand the new trends in power and energy sectors

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Demonstrate need of different energy sources and their importance	II	Understand
CO2	Make use of Renewable energy for power generation	III	Apply
CO3	Analyze the utilization of solar, wind energy etc	IV	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3						2						2		
CO2	3						2						2		
CO3	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 to Renewable Energy sources -Environmental degradation due to energy production and utilization, primary and secondary pollution-air, thermal and water, depletion of ozone layer, global warming, biological damage due to environmental degradation, pollution due to thermal power stations and their control, Energy management and marketing, Energy audit .	6 Hrs
2	Unit 2:--- Introduction to Solar Energy , Solar potential, Solar radiation spectrum, Solar radiation geometry (Numerical on angle of incidence only), Solar radiation data, ,Solar Collectors (Flat plate, evacuated tube, Cylindrical parabolic, Concentrating paraboloid), Graphical representation of efficiency of various Collectors , Testing of Solar flat plate collectors – BIS code (No numerical), Thermal Energy storage (Introduction and types)	7 Hrs
3	Unit 3:--- Photovoltaic cell Operating Principle of Photovoltaic cell concepts, Photo-cell materials, Cell module array, Series and parallel connections, Maximum power point tracking, Design of standalone system with battery and AC or DC load (Descriptive Treatment), Applications, Introduction, Principle and operation of fuel cells, classification and types of fuel cell. Fuel for fuel cells, Application of fuel cells.	7 Hrs
4	Unit 4:---Wind Energy Wind parameters and wind data, Power from wind, Site selection, Wind energy conversion systems and their classification, Construction and working of typical wind mill, Introduction to OTEC and Hybrid systems (Diesel-PV, Wind-PV Biomass-Diesel systems)	6 Hrs

5	Unit 5:--- Other Renewable Energy Sources Renewable Energy Sources Biomass: as a source of energy, Classification of biomass, Biomass conversion processes, Biogas plant and its components, Types of biogas plants. Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India. Ocean Energy: Ocean Thermal Energy Conversion, Principles utilization, setting of Ocean Thermal Energy Conversion plants, Comparison with normal thermal power cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics	8 Hrs
6	Unit 6:--- Energy conservation and Energy Management Energy efficiency and energy conservation in boilers, furnaces, HVAC, motors, compressors, etc. solar passive architectural techniques and Green buildings, Energy Conservation and its Importance; Energy Strategy for the Future; The Energy Conservation Act, 2001 and its Feature, Energy Management	6 Hrs

Text Books:

Sr. No.	
1	Non-conventional energy sources by G.D. Rai, Khanna Publishers
2	Solar Energy: Principles of Thermal Collection and Storage by S,P Sukhatme, Tata McGraw Hill
3	Solar Engineering of Thermal processes, J.A.Duffie and W.A.Beckman, 2ndedition, John Wiley, New York, 1991.
4	Handbook of Biogas Technology, Prattek Shilpkar & Deepti Shilpkar

Reference Books:

Sr. No.	
1	Fuel Cells by Bockris and Srinivasan; McGraw Hill
2	Solar Energy: Fundamentals and Applications by H.P. Garg& Jai Prakash, Tata McGraw Hill.
3	Wind Power Technology, Joshua Earnest, PHI Learning, 2014.
4	Non Conventional Energy Resources by S. Hasan Saeed and D. K. Sharma, S. K. Kataria& Sons.
5	Renewable Energy Sources, J W Twidell& Anthony D. Weir. ELBS Pub.
6	Energy Conversion Systems, R D Begamudre, New Age International (P) Ltd., Publishers,



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

Department of Mechanical Engineering

Course Code:	UMEO0603	L	T	P	Credit
Course Name:	Project Management	3			3
Course Pre-Requisites:	Basic concepts of management				
Course Description:	Course comprises of introduction to functions of management, project management, project identification, selection and project planning. It covers concepts of project activities, work breakdown structure, activity duration, resource requirements. It also introduce about project scheduling, project risk management, project costing ,project execution, control and close-out.				

Course Objectives:

1	To define concepts of management, project and project management, project identification and planning
2	To explain various steps in work breakdown structure, resource requirements.
3	To identify elements of project schedules, durations, project risks involved
4	To analyse various aspects of project costing, project execution, control and close-out

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Define concepts related to management, project and project management, project identification and project planning	I	Remember
CO2	Explain basics of work breakdown structure, resource requirements.	II	Understand
CO3	Identify elements of project schedules, project durations, risks involved in project management, computers in project management	III	Apply
CO4	Analyse aspects of project costing, project execution, control and close-out	IV	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1				2					2		3			1	1
CO2				2					2	1	3			1	1
CO3				2					2	1	3			1	1
CO4				2					2	1	3			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: Introduction to Project Management Basic functions of management, Difference between general management & project management, Definition of a project, project management & its need, characteristics, objectives & importance of projects, classification of projects, project management process ,project management life cycle & its phases, roles and responsibilities of project managers, types of project managers	7
2	Unit 2: Project Identification, Selection, Planning Project ideas and sources, steps in project identification process, feasibility studies and types, feasibility report and its contents, financial institutions, project break even point project planning-scope, delivery, resources, budget, quality & risk, forms of organization structures-functional. geographical, product, matrix, pure	7
3	Unit 3: Project Activities, Work Breakdown structure, Activity duration, Resource Requirements Work breakdown structure (wbs)-product oriented and functionally oriented wbs, responsibility chart and responsibility matrix, integrating wbs and organization structure methods for estimating activity duration, determining resource requirements	6

4	Unit 4: Project Scheduling Activity, events, work packages, Gantt chart, network scheduling analysis PERT & CPM: Introduction to project evaluation and review, introduction to critical path method, deciding project duration using network diagram, finding critical path, calculation of earliest start time, latest finish time, slack, total float, free float, three time estimates, variance	8
5	Unit 5: Project Risk Management Introduction, risk, risk management, steps in risk management, Risk Analysis, computers in project management	4
6	Unit 6: Project Costing ,Project Execution, Control, Close-out Elements of cost estimates and budgets of projects, Project execution & Control-conduct project execution and control kick-off, manage cssq (cost, scope, schedule, quality) monitor & control risk. manage project execution ,gain project acceptance, Project close-out, steps for closing the project	8

Text Books:

Sr. No.	
1	Engineering Project Management-Parameshwar P Iyer-Vikas Publishing House Pvt Ltd
2	Project Management- S. Choudhury, - TMH Publishing Co. Ltd, New Delhi
3	Prasanna Chandra, —Projects – Planning, Analysis, Financing, Implementation and Review, Tata McGraw Hill,4th Ed, 1997

Reference Books:

Sr. No.	
1	NYS Project Management Guidebook -Release 2
2	John M Nicholas, —Project Management for business and technology, 2nd edition, Pearson Education Asia, 2001
3	Effective Project Management Robert K. Wysocki, Robert Beck. Jr., and David B. Crane; - John Wiley & Sons
4	Total Project Management- The Indian Context- P. K. Joy, - Macmillan India Ltd., Delhi
5	Project Management in Manufacturing and High Technology Operations- Adedeji Bodunde Badiru, -John Wiley and Sons.
6	Fundamentals of PERT/ CPM and Project Management- S.K. Bhattacharjee; - Khanna Publishers, New Delhi

Kolhapur Institute of Technology's College of Engineering Kolhapur (Autonomous)																
Department of Mechanical Engineering																
Course Code:		UME00604										L	T	P	Credit	
Course Name:		Smart Materials										3			3	
Course Pre-Requisites:		Applied Physics, Materials Engineering, Machine Tools & Process, Manufacturing Processes														
Course Description:		The content of this course covers basics of different smart materials, their potential use in engineering fields. This course is also useful in helping students to learn the use of smart materials to automate the different tasks at micro/nano level workspace and to develop micro/nano system. It will also impart knowledge of nanomaterials, its synthesis and nanocomposites with tailored properties which can be used for several applications.														
Course Objectives:																
1	To study the working principles of various smart materials.															
2	To identify applicability of various smart materials as actuator and sensor.															
3	To study advances in smart materials.															
Course Outcomes:		After the completion of the course the student will be able to														
COs	CO Statement										Blooms Level		Descriptor			
CO1	Classify smart materials and explain their functions										IV		Analyze			
CO2	Explain the smart materials and their uses										II		Understand			
CO3	Make use of different sensors and actuators										III		Apply			
CO4	Recommend suitable material for actuators										V		Evaluate			
CO-PO Mapping:																
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1			1										1			
CO2	1		1										1			
CO3		1	2										1			
CO4			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	Overview of Smart Materials Introduction, Components of smart systems – Sensors, actuators, Transducers, MEMS, Overview of the following materials with focus on synthesis, constitutive/governing relationships, strengths and weaknesses, and applications (both sensing and actuation etc)Piezoelectric Materials, Magnetostrictive Materials, Shape Memory Alloys, Electroactive Polymers Active smart polymers, Shape Memory Alloys (SMA) – Phase Transformations												6			
2	Types of Smart Materials Introduction to HBLS (high bandwidth low strain) generating smart materials- Piezoelectric and Magnetostrictive materials, LBHS (low bandwidth high strain) generating smart materials- Shape memory alloys and electro-active polymer												6			
3	Actuators Based on Smart Materials HBLS based actuators- Piezoelectric actuators- Induced strain actuation model, Unimorph and bimorph actuators, Actuators embedded in composite laminate. Magnetostrictive actuators - Mini actuators, Thermal instabilities, Magnetorstrictive composites, MEMS based actuators. LBHS based actuators: Shape memory alloy based actuators, Electro-active polymer.												8			
4	Sensors Based on Smart Materials Sensors based on HBLS smart materials- Piezoelectric sensors, Magnetostrictive sensors, MEMS sensors, Sensors based on LBHS smart materials- Shape memory alloy based encoders, EAP based sensors												7			
5	Manufacturing techniques for smart materials: Micromanufacturing, high resolution lithography, LIGA process, Generative manufacturing processes such as STL, SLS, SPB, BPM, LOM, SGC, FDM, BIS, BPM, Self-assembly process, Ion beam processes												8			
6	Applications of Smart Material Structural applications of smart materials, Structural acoustic control, and vibration control applications. Aerospace and transportation applications												7			

Text Books:	
Sr. No.	
1	Brian Culshaw, Smart Structures and Materials, Artech House, 2000
2	Gauenzi, P., Smart Structures, Wiley, 2009
3	Michelle Addington and Daniel L. Schodek, Smart Materials and Technologies, Elsevier (2005).
4	A.J. Moulson and J.M. Herbert, Electroceramics: Materials, Properties, Applications, 2nd Ed., John Wiley & Sons, Chichester, West Sussex; New York, 2003 (ISBN:0471497479)
5	G. Gautschi, Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic
6	Emission Sensors, Materials and Amplifiers, Springer, New York, 2002 (ISBN:3540422595)
7	Cady, W. G., Piezoelectricity, Dover Publication
Reference Books:	
Sr. No.	
1	Smart Material Systems and MEMS by Vijay K. Vardhan, K. J. Vinoy, Wiley India M.V. Gandhi and B.S. Thompson, "Smart Materials and Structures", Chapman & Hall, London; New York, 1992 (ISBN: 412370107)
2	G. Gautschi, "Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers", Springer, Berlin; New York, 2002 (ISBN:3540422595)
3	Smart Materials by Mel Schwartz, CRC Press, Taylor & Francis.
4	SenolUtku, "Theory of Adaptive Structures : Incorporating Intelligence into Engineered Products", CRC Press (1998), ISBN: 9780849374319
5	A.V. Srinivasan, "Smart Structures: Analysis and Design", Cambridge University Press, Cambridge; New York, 2001 (ISBN: 0521650267)
6	K. Uchino, "Piezoelectric Actuators and Ultrasonic Motors", Kluwer Academic Publishers, Boston, 1997 (ISBN: 0792398114)
7	G. Engdahl, "Handbook of Giant Magneto strictive Materials", Academic Press, San Diego, Calif.; London, 2000 (ISBN: 012238640X)
8	K. Otsuka and C.M. Wayman, "Shape Memory Materials", Cambridge University Press, Cambridge; New York, 1998 (ISBN: 052144487X)
9	Eric Udd, "Fibre Optic Sensors: An Introduction for Engineers and Scientists", John Wiley & Sons, New York, 1991 (ISBN: 0471830070)
10	André Preumont, "Vibration Control of Active Structures: An Introduction", 2nd Edition, Kluwer Academic Publishers, Dordrecht; Boston, 2002 (ISBN: 1402004966)
11	Jasprit Singh, Smart Electronic Materials: Fundamentals and Applications, Cambridge University Press, 2005.



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

Department of Mechanical Engineering

Course Code:	UMEO0605	L	T	P	Credit
Course Name:	Introduction to Robotics (Open Elective-II)	3			3
Course Pre-Requisites:	Basics of Electrical and Electronics				

Course Description:	This course introduces the stream of robotics. The course is designed to clear the fundamentals of the students related to robot anatomy, grippers, basic concepts along with number systems, and control systems which are essential for learning computations and advanced concepts in robotics.
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Course Learning Objectives:

1	To provide graduates of mechanical engineering with fundamental knowledge in the field of robotics for advanced graduate studies in the area of Robotics.
2	To prepare graduates of mechanical engineering with comprehensive knowledge of Robotics to enable them to apply the relevant knowledge for the learning upcoming advanced subjects in robotics.
3	To introduce graduates of mechanical engineering with anatomy, grippers, control systems, and applications of robotic 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	Demonstrate the fundamentals concepts and knowledge of robotics, grippers, tools used in industrial robots, and control systems.	II	Understand
CO2	Illustrate the robot anatomy, configurations, and applications of the robotic systems.	II	Understand
CO3	Explain the concepts related to the robotics programming	II	Understand
CO4	Explain the concepts related to robot kinematics	II	Understand

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3			2				2		2	3	2	
CO2	2	2	2			2						2		3	
CO3	2	2	2											3	2
CO4	2	2	2											3	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 to Robotics Basic Concepts such as Definition, Industrial Robots, The Laws of Robotics, Socio-Economic aspect of robotisation. Anatomy of Robots, Classifications of Robots, Robot Configurations & types of Work Volume, Technical specifications of Industrial Robot, Spatial Resolution, Accuracy, Repeatability, Degrees of Freedom, Static and Dynamic properties of Robots.	7
2	Unit 2:- Grippers and Sensors for Robots Gripper Designs, Different types of grippers and End effector, Selection of grippers, Degrees of Freedom, End Effectors: Grippers, Tools. Force Analysis of Grippers, Innovative Robotic Grippers. Performance terminology, classification of sensors and transducers, Need of sensors in Robotics. Contact and non-contact type switches and proximity sensors- inductive, capacitive, optical, pneumatic,	7
3	Unit 3:- Drives & Control for Robots Drives:- Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems, Control Systems :- Types of Controllers, Introduction to closed loop control	7
4	Unit 4:- Robot Kinematics & Dynamics Kinematics :- Transformation matrices and their arithmetic, link and joint description, Denavit - Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, Intrduction to Jacobians, and singularities, Intrduction Trajectory generations.(Theoretical treatment only)	7

5	Unit 5:- Robotic Programming Languages Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Introduction to various types such as RAIL and VAL II etc, Features of each type and development of languages for recent robot systems.	7
6	Unit 6:- AI in Robotics and Applications Introduction to Artificial Intelligence, AI techniques, Need and application of AI. Introduction to ChatGPT, Robot Applications: Material transfer and machine loading/unloading, processing operations assembly and inspection. Concepts of safety in robotics, social factors in use of robots	7

Text Books:

Sr. No.	
1	Introduction to Industrial Robotics by Ramachandran Nagarajan Pearson Education India (2016)
2	Fundamentals of Robotics _ Linking Perception to Action (Machine Perception and Artificial Intelligence, 54)-Ming Xie,
3	Fundamentals of robotics _ analysis & control-Robert J. Schilling, Asoke K.Ghosh, Prentice-Hall of India (2003)
4	Fundamentals of Robotics Engineering-Harry H. Poole, Springer Netherlands (1989)
5	Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, Industrial Robotics : Technology, Programming & Applications, McGraw-Hill International, 2011.

Reference Books:

Sr. No.	
1	Introduction to Robotics_ Analysis, Control, Applications- Saeed B. Niku ,Wiley (2010)
2	Introduction to Robotics Mechanics and Control- John J.Craig, 3rd edition-Pearson Education, Inc. (2005)
3	Fundamentals of Robotics- David Ardayfio, CRC Press (1987)
4	Robotics-Control,Sensing, Visionand Intelligence Fu,K.S.;Gonzalez,R.C.and Lee,C.S.G.,McGraw HillIntl.Ed.,ISBN:0-07-100421-1.
5	A Mathematical Introduction to Robotic Manipulation by Richard M. Murray, Zexiang Li, and S. Shankar Sastry



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

Department of Mechanical Engineering

Course Code:	UMEA0601	L	T	P	Credit
Course Name:	Digital Marketing	2			0
Course Pre-Requisites:	General Awareness, Innovative and Creative Mindset, Genuine interest towards startup & Business development				
Course Description:	The course is designed to provide the students suitable management, analytical and people skills specific to the career opportunities in the field of Business Development & Digital Marketing sector. This course has been designed to allow graduates to gain the relevant competencies and skills to give them a competitive advantage in Entrepreneurship development.				

Course Objectives:

1	To develop right understanding about the changing digitalization of business environment and role of various types of organizations.
2	To inculcate managerial and entrepreneurial attitude amongst the learners and helps them to become a successful business leader.
3	To enhance leadership attitude, marketing skills, Applied based business learning exposure to work at different levels in an organization for Business Development
4	To learn how to Plan, budget, and optimize digital marketing campaigns in a simulated landscape leading to development of business.
5	To cultivate right mind-set among students for taking right business decisions in their development of professional business life. ecommend suitable corrective actions for quality improvement.

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Relate the concept of Business Development and Digital marketing describe the role of entrepreneurship within society.	I	Remember
CO2	Classify businesses by type of sector & identify, assess and select digital market opportunities towards business development in various sectors.	II	Understand
CO3	Demonstrate concept of blogging digital payments and social media marketing	III	Apply
CO4	Demonstrate Video advertising and webpage designing	III	Apply

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	50% (50M)	Assignment, Test, Quiz, Seminar, Presentation, etc.
3	In Semester Evaluation 2 (ISE2)	50% (50M)	Assignment, Test, Quiz, Seminar, Presentation, etc.

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	Role of Marketing & Sales Management in Business Growth Difference between Sales & Marketing, Domestic and International Markets and business entry strategies. Market Research & Techniques of Exploring potential Target markets (STP; Segmentation-Targeting-Positioning), Shift from Four P's to Four C's of marketing. Market based pricing and costing, Product life cycle (PLC). B2B & B2C Marketing, Negotiation Skills, Case studies.	7

2	Digital Marketing Introduction What is marketing? What is Digital Marketing?, Understanding Marketing Process, Understanding Digital Marketing Process. Principles of Digital Marketing, Advantages & Disadvantage, Types & Applications of Digital marketing , Sales and marketing in Digital age, Consumer behavior and Digital marketing Increasing Visibility: What is visibility? Types of visibility, Examples of visibility. Visitors Engagement: What is engagement?, Why it is important Examples of engagement	7
3	Social Media Marketing Applications of Social Media: Types of Social Media Marketing, Facebook, Twitter, What’s app etc., YouTube, Instagram, Demonstration and content development, Live Cases Application: Creation of Blogs, Creation of V-log, YouTube Channels (upload) E-Commerce: Introduction to Digital payments, Awareness of mobile banking, Cashless Transaction using various modes like UPI, Wallets, Cards, AEPS, USSD. Digital Media Laws, Block Chain management	7
4	Content Development Pay-Per-Click- Understanding different types of PPC, creating compelling search ads and understand how keywords and search queries work together to display and create advertisements. Basics of Video Advertising; Creating Video Campaigns; Measurement & Optimization; Creating & Managing a YouTube Channel; Targeting Video Campaigns, Creating A Simple Website For Your Business.	7
Text Books:		
Sr. No.		
1	Innovations and Entrepreneurship By Peter Drucker Pub: UBS publishers and Distributors Ltd. New Delhi	
2	Cherunilam, Fransis. (2018). Business Environment. Mumbai: Himalaya Publication.	
3	Poornima M Charantimath, —Entrepreneurship development small business enterprises!, Pearson,2013	
4	Digital Marketing 2.0 by Dr. Rushen Chahal and Prof. Jayanta Chakraborti, Himalaya Publication House,	
Reference Books:		
Sr. No.		
1	Digital Marketing by Vandana Ahuja, Oxford University Press	
2	Marketing Management-a south asian perspective: Kotler Phillip, Keller Kevin Lane, Koshy Abrahamand Jha Mithileshwar, Pearson.	
3	Marketing Management-Ramswamy V. S., Namakumari S., Macmil lion Pub lishers India Ltd.	
4	Sherlekar S.A.-Modern Business Administration and Management; Himalaya PublishingHouse	
5	Digital Marketing for Dummies – Ryan Deiss & Russ Henneberry Covers SEO, PPC, email, and the “Customer Value Journey.”	