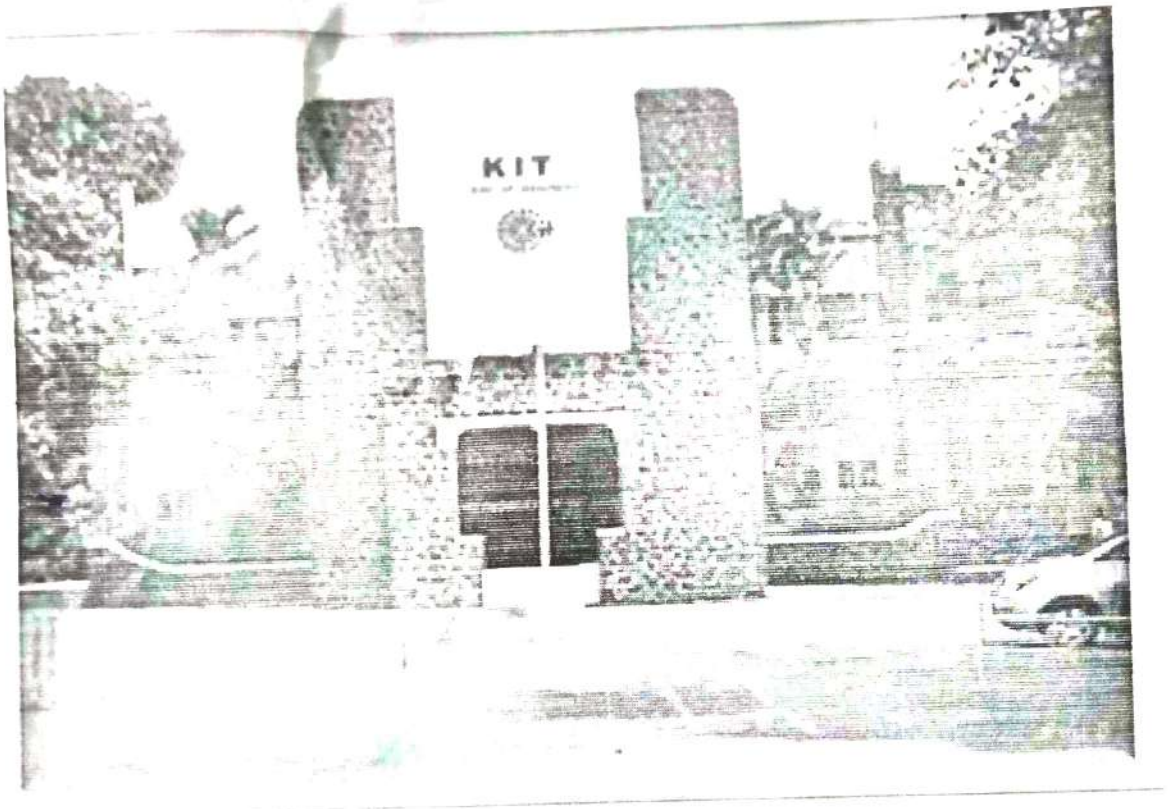
Kolhapur Institute of Technology's
College of Engineering
(Empowered Autonomous), Kolhapur



Department of Mechanical Engineering

Curriculum and Syllabus for

Final Year

B. Tech. Mechanical Engineering

Scheme: 2026-27 (As Per NEP)

P.B. Mutalik
Academic Coordinator

Dr. U. S. Bhapkar
Head
Department of Mechanical Engg.
Kolhapur Institute of Technology's
College of Engineering (Autonomous)
Kolhapur

Mechanical Engineering Department

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

SEMESTER VII

Sr. No.	Category	Course Code	Course Name	L	T	P	Hrs. / Week	Credits	Evaluation Scheme			
									Component	Marks		
										Max	Min	
1	PC	UMEPC0701	Industrial Automation and Robotics	3	0	0	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
2	PC	UMEPC0702	Advanced Manufacturing Engineering	3	0	0	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
3	PC	UMEPC0703	HVAC and Refrigeration Systems	3	0	0	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
4	PEC	UMEPE071*	Program Elective-III	3	0	0	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
5	OE	UMEOE072*	Open Elective- III	2	0	0	2	2	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
6	PC	UMEPC0731	Industrial Automation and Robotics Laboratory	0	0	2	2	1	ISE	25	10	
									ESE(OE)	25	10	
7	PC	UMEPC0732	HVAC and Refrigeration Laboratory	0	0	2	2	1	ISE	25	10	
									ESE(POE)	25	10	
8	RM	UMEIL0771	Project-I	0	0	8	8	4	ISE	50	20	
									ESE(OE)	50	20	
9	MM	UMEMM074*	Multi Disciplinary Minor	3	0	0	3	3	ESE	100	40	
Total:							**29**	**23**	**Total Marks: 800 Total Credit: 23**			

PROGRAM ELECTIVE-III

Sr. No.	Course Code	Course Name	L	T	P	Hrs. / Week	Credits
1	UMEPE0711	Design of Mechanical Systems	3	0	0	3	3
2	UMEPE0712	Engineering Management	3	0	0	3	3
3	UMEPE0713	Enterprise Resource Planning	3	0	0	3	3
4	UMEPE0714	Thermal Management and Electronic Packaging	3	0	0	3	3
					Total:	**3**	**3**

Multi Minor Courses

Track: Major in Mechanical Engineering with Minor in Artificial Intelligence and Machine Learning

Sr. No.	Course Code	Course Name	L	T	P	Hrs. / Week	Credits
5	UMEMM0741	Machine Learning	3	0	0	3	3

Multi Minor Courses

Track : Major in Mechanical Engineering with Minor in Electrical and Electronics Technology

Sr. No.	Course Code	Course Name	L	T	P	Hrs. / Week	Credits
5	UMEMM0742	Internet of Things	3	0	0	3	3

Multi Minor Courses

Track : Major in Mechanical Engineering with Minor in Automotive Technology

Sr. No.	Course Code	Course Name	L	T	P	Hrs. / Week	Credits
5	UMEMM0743	Vehicle Management System	3	0	0	3	3

SEMESTER VIII

Sr. No.	Category	Course Code	Course Name	L	T	P	Hrs. / Week	Credits	Evaluation Scheme			
									Component	Marks		
										Max	Min	
1	PEC	UMEPE081*	Program Elective-IV	3	0	0	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
2	PEC	UMEPE081*	Program Elective-V	3	0	0	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
3	RP	UMEIL0871	Project-II	0	0	8	8	4	ISE	50	20	
									ESE(OE)	50	20	
4	OJT	UMEIL0872	Internship	0	0	12	12	6	ISE	75	30	
									ESE(OE)	75	30	
5	CC	UMECC0831	Co-Curricular Activities-IV	0	0	2	2	1	ISE	50	20	
Total:							**28**	**17**	**Total Marks: 500 Total Credit: 17**			

PROGRAM ELECTIVE-IV

Sr. No.	Course Code	Course Name	L	T	P	Hrs. / Week	Credits
1	UMEPE0811	Six Sigma in Quality Management	3	0	0	3	3
2	UMEPE0812	Industrial Engineering	3	0	0	3	3
3	UMEPE0813	Advanced Energy Technology	3	0	0	3	3
4	UMEPE0814	Operations Research	3	0	0	3	3
Total:						**3**	**3**

PROGRAM ELECTIVE-V

Sr. No.	Course Code	Course Name	L	T	P	Hrs. / Week	Credits
1	UMEPE0815	Advanced Composites	3	0	0	3	3
2	UMEPE0816	Industry 5.0	3	0	0	3	3
3	UMEPE0817	Cryogenics	3	0	0	3	3
4	UMEPE0818	Process Equipment Design	3	0	0	3	3
Total:						**3**	**3**

Emerging Minor Courses

Track: Emerging Minor in Green Technology

Sr. No.	Course Code	Course Name	L	T	P	Hrs. / Week	Credits
5	UMEMN0761	Energy Storage Systems	2	0	0	2	2

B Tech Honors (Core Engineering Domain) (Robotics)

Sr. No.	Course Code	Course Name	L	T	P	Hrs. / Week	Credits
5	UMEHN0711	Mini Project	0	0	4	4	2

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Course Code:	UMEPC0701	**L**	**T**	**P**	**Credit**
Course Name:	Industrial Automation and Robotics	**3**	**0**		**3**
Course Pre-Requsites:	Manufacturing Processes,Basic electronics &electrical,Basic Sciences				
Course Description:	This course gives knowledge about the automation and Robotics.It also describes the emerging trends in Automation and robotics				

Course Learning Objectives:

CLO1	To understand basic terminologies and concepts associated with Hydraulics and Pnuematics
CLO2	To study various automation prinicples
CLO3	To study forward and inverse kinematics behind the robots.
CLO4	To study the various different platforms for robot programming.

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

COs	**CO Statement**	**Level**	**Descriptor**
CO1	**Explain** the fundamental concepts of fluid power systems	II	Understand
CO2	**Define** Automation How newer Automation tools can be used to solve engineering Problems	I	Remember
CO3	**Apply** forward and Inverse kinematics principles to simulate and verify robot configurations for given joint inputs.	III	Apply
CO4	**Build** program logically for given set of conditions and programe the robot	VI	Create

CO-PO Mapping:

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

Assessment Scheme:

Sn No	**Assessment**	**Weightage**	**Marks**	Remarks
1	In Semester Evaluation 1 (ISE1)	10%	**10**	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	**30**	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	**10**	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	**50**	100% course contents

Course Contents:

Unit No.	**Unit Content**	**No. of Lectures**
1	**Unit 1:-Introduction to Fluid Power:** General Layout of a Hydraulic and Pneumatic System.Comparison of Hydraulic and Pneumatic Systems.Advantages , Disadvantages and applications of Fluid Power. ISO/JIC symbols of various elements of fluid power systems.	7
2	**Unit2:-Introduction to Automation** Automated manufacturing systems, Fixed /programmable/ flexible, Automation, Need of automation, Basic elements of automated systems- Power, program and control. Low-cost automation, Economic and social aspects of automation, Advanced automation functions, Levels of automation. **B)Assembly Automation:** Types and configurations and their applications, Parts delivery at workstations, Various vibratory and non-vibratory devices for feeding and orientation, Product design for automated assembly	8
3	**Unit 3:- Forward Kinematics** **A Spatial descriptions and transformations:-** Description Position, orientation and frames. Transformation matrices and their arithmetic, link and joint description, Mapping : Changing descriptions to frame to frame, Operations: Translation, Rotation and transformation Denavit-Hartenberg parameters, frame assignment to links, direct kinematics, Frame Assignments and DH Parameter table to RPR ,PUMA robot	8
4	**Unit 4:-Manipulator Kinematics** Link Description, Link connection description, convention for affixing Frames to links, Actuator Space, Joint space, Cartesian space, Frames with standard names.	8

Unit No.	Unit Content	No. of Lectures
5	**Unit 4:- Inverse kinematics:-** Kinematics redundancy, kinematics calibration, inverse kinematics, solvability, algebraic and geometrical methods. Velocities and Static forces in manipulators:- Jacobeans, singularities, static forces, Jacobean in force domain. Dynamics:- Introduction to Dynamics , Trajectory generations.(Theoretical Treatment Only)	7
6	**Unit6:-Robot Programming Languages** Robot Languages-Classifications, Structures- VAL language commands, motion control, hand control, program control, pick and place applications, palletizing applications using VAL, Robot welding application using VAL program-WAIT, SIGNAL and DELAY command for communications using simple applications. VAL-II programming-basic commands, applications-Human & Robot interaction aspect.	7

Text Books:	
Sr. No.	
1	John J. Craig, Introduction to Robotics (Mechanics and Control), Addison-Wesley, 2nd Edition, 2004
2	Mikell P. Groover et. Al., Industrial Robotics: Technology, Programming and Applications,McGraw – Hill International,
3	Automation, Production Systems and Computer Integrated Manufacturing, M.P. Groover,Pearson Education.
4	Programming Robots with ROS: A Practical Introduction to the Robot Operating System 1st Edition, by Morgan Quigley (Author), Brian Gerkey (Author), William D. Smart, O'Reilly Media; 1st edition (16 November 2015)
5	"Oil hydraulics Systems", S. R. Mujumdar, Tata McGraw Hill Publication
6	"Pneumatic Systems", S. R. Mujumdar- Tata McGraw Hill Publication.

Reference Books:	
Sr. No.	
1	Robot Programming A Guide to Controlling Autonomous Robots by Cameron Hughes, Tracey Hughes,Que Publishing.
2	Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy by Lentin Joseph ISBN 1484234049, 978-1484234044

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Course Code:	UMEPC0702	**L**	**T**	**P**	**Credit**
Course Name:	Advanced Manufacturing Engineering	**3**		**-**	**3**
Course Pre-Requsites:	Basics Knowledge of Manufacturing Processes, Machine Tools, Materials Engineering, Basics of CAD/CAM.				
Course Description:	This course introduces students to modern, non-conventional manufacturing processes, advanced machining techniques, and the integration of digital technologies in manufacturing. It focuses on processes that overcome the limitations of conventional machining.				

Course Learning Objectives:

CLO1	Understand fundamentals of non-conventional machining like AJM, WJM/AWJM, and USM .
CLO2	Develop the ability to choose and justify suitable advanced processes (chemical, electrochemical, and thermal energy-based methods such as ECM, EDM, LBM, EBM, PAM), with respect to productivity, surface quality, safety, and shop-floor feasibility.
CLO3	Understand Additive Manufacturing workflows by learning CAD-to-STL preparation, slicing, selection of AM processes (SLA/FDM/SLS/LOM), and post-processing.
CLO4	Understand Industry 4.0 and sustainable manufacturing practices by relating CIM/FMS/CAPP, IoT-enabled smart factories, sensors, digital twins, and green manufacturing ideas.

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	Select appropriate mechanical, chemical, or thermal energy based non-conventional processes for hard-to-machine materials.	III	Apply
CO2	Select process parameters for non-conventional machining to achieve desired Material Removal Rates (MRR) and surface finish.	III	Apply
CO3	Develop the workflow for Additive Manufacturing, from CAD modeling and STL slicing to post-processing.	III	Apply
CO4	Explain Industry 4.0 including smart factories and sustainable manufacturing practices.	II	Understand

CO-PO Mapping:

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

Assessment Scheme:

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

Course Contents:

Unit No.	**Unit Content**	No of lectures
1	**Introduction to Non-conventional Machining** a) Overview: Classification of manufacturing processes; Need for non-conventional machining; Comparison between conventional and non-conventional processes. b) Mechanical Energy Based Processes: Working principle, construction of equipment, and process parameters of 1) Abrasive Jet Machining (AJM): Mechanism of material removal, variables affecting MRR (stand-off distance, abrasive flow rate, mixing ratio), nozzle design, and safety aspects. 2) Water Jet & Abrasive Water Jet Machining (WJM/AWJM): High-pressure pumps, intensifiers, orifice materials, and applications in cutting composites. 3) Ultrasonic Machining (USM): Magnetostrictive and piezoelectric transducers, horn/sonotrode design, slurry delivery systems, and machining of brittle materials like glass and ceramics	7 Hrs

2	**Chemical and Electrochemical Machining** a) Chemical Machining (CHM): Steps in CHM (cleaning, masking, etching, de-masking); types of maskants (cut-and-peel, photo-resist); chemical milling and blanking, advantages, limitation and applications. b) Electrochemical Machining (ECM): Theory of electrolysis, ECM equipment, advantages, limitation and applications. c) Electrochemical Grinding (ECG). electrolyte properties (conductivity, pH, flow rate), advantages, limitation and applications.	8 Hrs
3	**Thermal Energy Based Processes** a) Electric Discharge Machining (EDM): Mechanism of metal removal, dielectric fluid, electrode materials, and spark erosion circuits, process parameters, advantages, limitation and applications. b) High Energy Beam Machining: Principles and applications of Laser Beam Machining (LBM), Types of lasers (Solid-state like Nd:YAG vs. Gas lasers like CO2), beam focusing optics, process parameters, advantages, limitation and applications. c) Electron Beam Machining (EBM) Vacuum requirements for EBM, process parameters, advantages, limitation and applications. d) Plasma Arc Machining (PAM), gas selection for PAM, process parameters, advantages, limitation and applications.	7 Hrs
4	**Advanced Forming and Joining** a) High Energy Rate Forming (HERF) (construction, working principle, advantages, limitations, applications): Explosive forming, Electro-hydraulic forming, and Electromagnetic forming, b) Advanced Welding: Friction Stir Welding (FSW) (construction, working principle, advantages, limitations, applications): Ultrasonic Welding, and Electron Beam Welding (EBW). c) Micro-Manufacturing: Introduction to MEMS and micro-machining.	8 Hrs
5	**Additive Manufacturing (3D Printing)** a) Fundamentals: Introduction to Rapid Prototyping; Liquid-based, Powder-based, and Solid-based systems. CAD model preparation, conversion to STL format, slicing software, and support structure generation, Process parameters, advantages, limitation and applications. b) Processes (with construction, working principle, advantages and limitations): Stereo-lithography (SLA), Fused Deposition Modeling (FDM), Selective Laser Sintering (SLS), and Laminated Object Manufacturing (LOM). c) Post-processing: Removal of supports, surface finishing, and heat treatment for stress relief in metal 3D printed parts. d) Applications: Rapid Tooling, aerospace and medical sectors.	8 Hrs
6	**Industry 4.0 and Smart Manufacturing** a) Concept of Industry 4.0, Role and application of Industry 4.0 in smart manufacturing. b) Computer Integrated Manufacturing (CIM): Flexible Manufacturing Systems (FMS). Computer-Aided Process Planning (CAPP) c)Sustainability: Green manufacturing practices, energy consumption analysis of non-conventional vs. conventional processes, d) Recent technological advances in smart manufacturing: 1.Smart Factory, Role of IoT, Artificial Intelligence, and Big Data in manufacturing; Predictive maintenance and Cyber-Physical Systems. 2.Smart Systems: Sensors for tool wear monitoring, Industrial Internet of Things (IIoT), and Digital Twins.	7 Hrs

Text Books:	
Sr. No.	
1	Modern Machining Processes – *P.C. Pandey and H.S. Shan* (Tata McGraw-Hill)
2	Modern Machining Processes P. C. Pandey, H. S. Shan — McGraw-Hill
3	Advanced Machining Processes V. K. Jain — Allied Publishers Pvt. Ltd.
4	Manufacturing Science–Amitabha Ghosh and Asok Kumar Mallik (East-West Press).
5	Non-Conventional Machining – *P.K. Mishra (Narosa Publishing House).*
Reference Books:	
Sr. No.	
1	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing – Ian Gibson, David Rosen, and Brent Stucker (Springer).
2	Industry 4.0: The Industrial Internet of Things – *Alasdair Gilchrist (Apress).*
3	Automation, Production Systems, and Computer-Integrated Manufacturing Mikell P. Groover — Pearson Education (India imprint available). (Pearson Education)
4	3D Printing and Additive Manufacturing: Principles and Applications Chee Kai Chua, Kah Fai Leong — World Scientific Publishing.

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Course Code:	UMEPC0703	**L**	**T**	**P**	**Credit**
Course Name:	HVAC and Refrigeration system	**3**	**0**	**0**	**3**
Course Pre-Requsites:	Applied Thermodynamics,Heat & Mass Transfer				
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 Learning Objectives:

CLO1	Study basic refrigeration cycles and Psychrometry
CLO2	Performance Evaluation of Refrigeration and Air Conditioning Systems
CLO3	Enable the students to analyze and solve refrigeration related problems by applying principles of mathematics, science and engineering.
CLO4	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	Understand fundamental principles and components of refrigeration and air conditioning processes	2	Understand
CO2	Apply knowledge of mathematics, science, and engineering for the needs in refrigeration and air conditioning	3	Apply
CO3	Analyze different refrigeration and air conditioning systems with their applications	4	Analyse
CO4	Evaluate refrigeration and air-conditioning systems under different conditions.	5	Evaluate

CO-PO Mapping:

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

Assessment Scheme:

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

Course Contents:

Unit No.	**Unit Content**	**No. of Lectures**
1	**Unit 1:Basic Refrigeration Cycles:** Carnot cycle, Reversed Carnot cycle,heat pump working and comparison with refrigerator, Simple Vapor compression cycle,P-h chart,Types of Vapour Compression Cycles, effect of change in discharge pressure, sunction pressure, subcooling, suction vapor superheating, Calculations and performance of above cycles(Numericals), Actual vapor compression cycle,	8
2	**Unit 2: Refrigeration Equipment & Vapor Absorption System:** Types of Compressor, Condenser, Evaporator, Expansion devices, and selection,different controls and accessories, use of insulation, its types and applications. chart, analysis of system. **Vapor Absorption System** vapor absorption system, Aqua Ammonia, Lithium Bromide VAS, Coefficient of Performance, Comparison with Vapor Compression cycle	8

3	**Unit 3. Multi pressure System, Refrigerants and cryogenics:** Multi pressure System: Removal of flash gas, Flash inter-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.Refrigeranrt charging process Cryogenics: Introduction to cryogenic engineering and cryocollers	8
4	**Unit 4: Psychrometry and Air conditioing Systems:** Psychrometric properties of air, study of Psychrometric charts, Psychrometric Processes, Representation of actual air conditioning process on Psychrometric charts and calculations, Comfort: Thermal exchange between human body and environment,factors affecting comfort, effective temperature, comfort chart,	8
5	**Unit 5: Design of air conditioning system,** Classification of Air conditioning systems :Window A/C System, Split A/C System, Ductable Split A/C System, Package A/C System, Central Air-Conditioning System, Chilled Water System, All water System, Direct Refrigerant System,load analysis,ADP, Coil condition line, sensible heat factor, bypass factor, GSHF, ESHF (Numerical treatment).	7
6	**Unit 6: Heating and Cooling Load Calculation:** Sources of Heat, Heat Load Formula, Heat gain through Walls Roof Glass ,Windows, Lights, Equipments, People etc., Ventilation Requirements, Infiltration Gains, Heat Load Estimate, Selection of Diffusers & Grilles,Duct – Definition, Classification and Types of Duct,Aspect ratio	7

Text Books:

Sr. No.	
1	C. P. Arora ,―Refrigeration and Air conditioning‖, Tata McGraw Hill Education Private Limited , third edition,2008
2	Roy J. Dossat ―Principles of Refrigeration‖, Pearson, fourth edition, 2007
3	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
2	Shan K. Wang, “Handbook of air conditioning and refrigeration” McGraw-Hill international
3	ASHRAE Hand Book

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Course Code:	UMEPC0731			**P**	**Credit**
Course Name:	Industrial Automation and Robotics Lab			**2**	**1**
Course Pre-Requsites:	Manufacturing Processes,Basic electronics &electrical,Basic Sciences				
Course Description:	This course gives knowledge about the automation and Robotics.It also describes the emerging trends in Automation and robotics				

Course Learning Objectives:

CLO1	To understand basic terminologies and concepts associated with Hydraulics and Pnuematics
CLO2	To study various automation prinicples
CLO3	To study forward and inverse kinematics behind the robots.
CLO4	To study the various different platforms for robot programming.

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	**Construct and demonstrate hydraulic and pneumatic circuits.**	III	Apply
CO2	**Experiment with various robot anatomy configurations**	III	Apply
CO3	**Make use of various programming tools to program robot**	III	Apply
CO4	**Analyze** problem logically for given set of conditions and programe the robot	IV	Analyze

CO-PO Mapping:

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

Assessment Scheme:

Sn No	**Assessment**	**Weightage**	**Marks**	Remarks
1	In Semester Evaluation (ISE)	50%	**25**	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	End Semester Examination (ESE)(OE)	50%	**25**	100% course contents

Course Contents:

Unit No.	**Unit Content**	**No. of Hours**
1	Experiment No 1:-Preparation of following circuits on hydraulic circuit trainer;	2
2	Experiment No 2:-Preparation of following circuits on pneumatic circuit trainer	2
3	Experiment No 3 :- Demonstration of various Robot Anatomy and Configurations	2
4	Experiment No 4 :- Robot teaching using Teach Pendant for point to point and continuous path application	2
5	Experiment No 5 :- Demonstration on Different End Effectors	2
6	Experiment No 6 :-Robot Simulation for Pick and Place Application using software/Introduction to MATLAB Robot Operating System using MATLAB	2
7	Experiment No 7 :-Integration of robot for colour vision system	2
8	Experiment No 8 :-Automatic pick and place operation using six axis robot	2
9	Experiment No 9 :-Object sorting using six axis robot	2
10	Experiment No 10 :-Industrial visit to study Mechatronic system, application and submission of visit report.	2

Text Books:

Sr. No.	
1	John J. Craig, Introduction to Robotics (Mechanics and Control), Addison-Wesley, 2nd Edition, 2004
2	Mikell P. Groover et. Al., Industrial Robotics: Technology, Programming and Applications,McGraw – Hill International, 1986.
3	Automation, Production Systems and Computer Integrated Manufacturing, M.P. Groover,Pearson Education.
4	Programming Robots with ROS: A Practical Introduction to the Robot Operating System 1st Edition, by Morgan Quigley (Author), Brian Gerkey (Author), William D. Smart, O'Reilly Media; 1st edition (16 November 2015)
5	"Oil hydraulics Systems", S. R. Mujumdar, Tata McGraw Hill Publication
6	"Pneumatic Systems", S. R. Mujumdar- Tata McGraw Hill Publication.

Reference Books:

Sr. No.	
1	Robot Programming A Guide to Controlling Autonomous Robots by Cameron Hughes, Tracey Hughes,Que Publishing.
2	Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy by Lentin Joseph ISBN 1484234049, 978-1484234044

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Course Code:	UMEPC0732	**L**	**T**	**P**	**Credit**
Course Name:	HVAC and Refrigeration Lab	**0**		**2**	**1**
Course Pre-Requsites:	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 Learning Objectives:

CLO1	To enable the students to perform the experiment and analyze results based on principles of mathematics, science and engineering.
CLO2	To prepare students to use modern tools and techniques in HVAC.
CLO3	To train students with effective communication skill to demonstrate refrigeration/air conditioning theories
CLO4	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	Analyse
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	PSO1	PSO2	PSO3
CO1	3	2	2									2		
CO2		2		3									1	1
CO3	2											2		

Assessment Scheme:

SN	**Assessment**	**Weightage**	**Remark**
1	ISE	100%	

Course Contents:

Expt No.	**Experiment Name**	**No. of Sessions**
1	Experiment No. 1: Demonstration and study of accessories and controls used in refrigeration system	**2**
2	Experiment No 2: Trial on vapour compression refrigeration system.	**2**
3	Experiment No 3: Demonstration of various Tools used for Refrigeration Tubing operations Like Flaring, Swaging, Bending, Brazing	**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 Heat Pump tutor	**2**
7	Experiment No 7: Trial on Ice plant tutor	**2**
8	Experiment No 8: Detailed load calculations and equipment selection for a building / Cold Storage	**2**
9	Experiment No 9: Visit to Cold storage / Ice factory/refrigeration plant/Air conditioning system	**2**

Text Books:	
Sr. No.	
1	C. P. Arora ,—Refrigeration and Air conditioning‖, Tata McGraw Hill Education Private Limited , third edition,2008
2	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

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

Department of Mechanical Engineering

Course Code:	UMEIL0771			**P**	**Credit**
Course Name:	Project-I			**8**	**4**
Course Pre-Requsites:	Students shall have the knowledge of: • Fundamentals and Applications in Mechanical Engineering, • Professional Communication, • Research Methodology				
Course Description:	Project-I is designed to provide students with an opportunity to initiate an independent or group-based engineering project by applying knowledge gained throughout the Mechanical Engineering program. This course focuses on problem identification, literature review, research gap analysis, and preparation of a structured research plan under the guidance of a faculty supervisor. Students will work individually or in small groups to develop technical competence, research aptitude, project planning skills, and professional ethics required for engineering practice. The course represents the initiation phase of the final year project, forming the foundation for detailed analysis, experimentation, modelling, and implementation to be carried out in Project II in an academic, industrial, or research environment.				

Course Learning Objectives:

CLO1	
CLO2	Develop collaborative skills to present ideas clearly and coherently.
CLO3	Formulate new scientific questions that came up during project performance.
CLO4	Learn on their own to evaluate ideas and take appropriate actions.

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Identify and clearly define a real-world mechanical engineering problem based on societal, industrial, or research needs.	IV	Analyze
CO2	Conduct a comprehensive literature review and analyze existing solutions to develop feasible concepts using engineering principles.	V	Evaluate
CO3	Prepare detailed project methodology including system design, calculations, modeling, and simulations.	VI	Create
CO4	Demonstrate teamwork, project planning, time management, and professional ethics and Communicate project proposals effectively through written reports and oral presentations.	III	Apply

CO-PO Mapping:

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

Assessment Scheme:

Sn No	Assessment	Weightage	Marks	Remarks
1	In Semester Evaluation (ISE)	50%	**50**	Assessment of 50 Marks is based on at least two Internal Oral and/or Poster Presentations.
2	End Semester Examination (ESE)(OE)	50%	**50**	Assessment of 50 Marks is based on Project/ Viva-voce/ Oral Examination.

Course Contents:

	Unit Content	
	Course Content: **The work to be completed shall consist of:** • Literature Review, Research Gap and Content. • Objectives and Motivation. • Research Design, Process, Methodology, Data Collection. • Development and evaluation of links across different areas. • Pre-tests, Results, Discussions, Findings and Limitations. **Term work:** The internal assessment and evaluation shall be based on at least two presentations highlighting following points: • Theoretical background and literature review, • Significance and relevance, • Proposed objectives, work plan and research design, • Extent of work performed and findings of the research work, • Interdisciplinary approach, • Application utility and • Social, economic, technical aspects. The internal assessment and evaluation for per batch shall be done by a committee consisting of the Head of the Department, two Senior Faculty Members (Subject Experts) of the Department, Research Supervisor and Co-Research Supervisor (if any). Each project batch shall submit soft copies and hard copies of their research synopsis and progress report duly signed by the Research Supervisor, Co-Research Supervisor (if any), two Senior Faculty Members (Subject Experts) of the Department, Head of the Department and Head of the Institution to the Research Supervisor, Co-Research supervisor (if any), Department and Examination Section.	

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

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Course Code:	UMEPE0711	**L**	**T**	**P**	**Credit**
Course Name:	Design of Mechanical Systems	**3**			**3**

Course Pre-Requsites:	Applid Mechanics,Kinematics of Machines, Design of Machine elements.
Course Description:	Design of Mechanical Systems is offered as Program Elective III at the 7th semester of Mechanical Engineering undergraduate programme; consists of six units. The first unit consists of Aesthetic and Ergonomics consideration in Design. Second unit discusses various Automobile Transmission Systems. Third units deals with Design of Flyweel. The Fourth unit focuses on various I C Engine componant Design and Fifth unit deals with Conveyor Design and sixth unit is of Optimum Design. This course intends to build the competency in the students to design complete mechanical system as compared to Design of component alone.

Course Learning Objectives:

CLO1	Understand the importance of Aesthetics, Ergonomics, and Human factors in Mechanical System Design.
CLO2	Design transmission elements such as Clutches and Breaks
CLO3	Design of Flywheels.
CLO4	Design critical components such as Pistons, Piston Rings, Connecting Rods.
CLO5	Design Conveyor for Material handling
CLO6	Understand the concepts of Optimization in Mechanical Design

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	**Explain** the fundamentals of mechanical system design	II	Understand
CO2	**Identify** parameters required for design of mechanical systems .	III	Apply
CO3	**Determine** the design parameters of mechanical systems.	V	Evaluate
CO4	**Design** of mechanical systems.	VI	Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	1								1	1	1
CO2	3	2	1	2								1	1	1
CO3	3	2	1	2								1	1	1
CO4	3	2	2	2								1	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	**Aesthetic and Ergonomic consideration in Design :** Basic types of product forms, Designing for appearance, shape, Concept of unity- concept of order with variety -concept of purpose style and environment Aesthetic expressions. Ergonomic considerations- Relation between man, machine and environmental factors. Design of displays and controls. Practical examples of products or equipments using ergonomics and aesthetic design principles.	**6**
2	**Design of Automobile Transmission Systems :** Design consideration in brakes, Band, Internal expanding shoe, External contracting shoe. Thermal consideration and rating of brakes. Design requirement of friction clutches, Selection criteria. Torque transmitting capacity of single plate, Multidisc clutch, Cone clutch and Centrifugal clutch.Introduction to Transmission systems [Manual transmission, Automatic transmission,Semi-automatic transmission,Continuously-variable transmission (C.V.T.)]	**8**
3	**Design of Flywheel :** Design of flywheel - Fundamental equation of motion - Torque analysis, Disk and rimmed flywheels, Stresses in flywheel, rim and spokes - Design of disc and rimmed flywheels for various applications - Standard dimensions of flywheels.	**8**

4	**Design of I. C. Engine Components :** Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, Design of cylinder liners, Design of piston and piston pins, Piston rings, Design of connecting rod.	**8**
5	**Design of Conveyor :** Design of belt and chain conveyors – Power requirement, Selection of belt and chain, Design of tension take up unit, Idler pulley.	**8**
6	**Optimum Design:** Objectives of optimum design- Johnsons Method of Optimum Design (MOD), Adequate and optimum design. Primary, Subsidiary and Limit equations Optimum design with normal specifications of simple machine elements like tension bar, transmission shaft, helical spring. Introduction to optimum design with Langrange Multiplier, Introduction to Design for Manufacturing.	**7**

Text Books:

Sr. No.	
1	"Design of machine element", V.B.Bhandari, Tata Mc- Graw Hill Publication, 3rd Edition.
2	"Mechanical Engineering Design", Shigley and C.R.Miscke, Tata Mc- Graw Hill Publication.
3	"Mechanical Design Analysis", M.F.Spotts, Prentice Hall Publication.
4	"Design of Machine Tools", S.k. Basu and D.K. Pal Oxford and IBH Publication, 6th Edition.
5	"Machine Tools Design", N.K. Mehta, Tata Mc- Graw Hill Publication, 5th Edition.

Reference Books:

Sr. No.	
1	"Handbook of Gear Design",Jitin Maitra,Tata Mc-Graw Hill Publication.
2	"Machine Design", Black P.H.and O.Eugene Adams, Tata Mc- Graw Hill Publication.
3	"Process Equipment Design", M.V.Joshi , Macmillal Publication, 3rd Edition.
4	"Mechanical System Design",S.P.Patil, Jaico Publication House,New Delhi,2nd Edition.
5	"Principles of Machine Tool", Sen. Bhattacharya, New Central Book Agency.

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Course Code:	UMEPE0712	**L**	**T**	**P**	**Credit**
Course Name:	Engineering Management	**3**			**3**
Course Pre-Requsites:	Basic knowledge of engineering concepts and general awareness of organizational and professional practices				
Course Description:	Course comprises of Introduction to Principles of Management & Organizational Structure,Human Resource Management & Industrial Relations,Operations & Production Management ,Marketing Management,Financial Management ,Project Management and Entrepreneurship Development				

Course Learning Objectives:

CLO1	To understand the fundamental principles of management, organizational structures, HR functions, motivation theories, leadership styles, and key labor laws
CLO2	To apply basic operations, production planning, inventory, quality management, and marketing concepts to solve practical problems in engineering and business scenarios.
CLO3	To apply fundamental financial, project management, and entrepreneurship principles to evaluate projects, prepare budgets, and develop business plans for engineering ventures.

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	Explain the basic concepts, functions and evolution of management, organizational structures, human resource practices, motivation, leadership, and relevant labour laws.	II	Understand
CO2	Apply fundamental production, operations, inventory, quality, and marketing management techniques to solve practical engineering and business problems.	III	Apply
CO3	Make use of financial and project management principles, including budgeting, capital investment evaluation, and business plan preparation, to develop feasible engineering projects and entrepreneurial ventures.	III	Apply

CO-PO Mapping:

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

Assessment Scheme:

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

Course Contents:

Unit No.	**Unit Content**	**No. of Lectures**
1	**Unit 1: Principles of Management & Organizational Structure** Concept, Definition,objective and importance of Management,Role of engineers as managers,Functions of management: Planning, Organizing, Staffing, Directing, Controlling,Levels of Management,Evolution of management thought:F.W.Taylor's Principles of Scientific Management, Henry Fayol's 14 principles of management ,Types of organizational structures:Line, Staff, Functional, Matrix	7
2	**Unit 2: Human Resource Management & Industrial Relations** Human Resource Management functions,Manpower planning,Recruitment and selection,Training and development,Performance appraisal,Motivation theories:Maslow, Herzberg, McGregor, Leadership styles and communication, Introduction to labour laws in India	7

3	**Unit 3: Operations & Production Management** Production Systems: Job,Batch,Mass,Continuous production,Plant location and layout,Production Planning & Control: Basics of Forecasting,Functions of PPC,Introduction to aggregate planning,Introduction toWork study,Inventory management:Inventory,EOQ,ABC analysis,JIT,Lean manufacturing, Total Qulaity Management	8
4	**Unit 4: Marketing Management** Marketing Concepts,Marketing Vs Selling,Marketing Environment,Market Research,Market segmentation, Marketing Mix(4Ps),Advertising	8
5	**Unit 5: Financial Management** Introduction to Financial Statements,Cost concepts and classifications, Break Even Analysis,Capital Budgeting Techniques: Meaning, Importance, Payback period, NPV, Working Capital,Sources of Finance	8
6	**Unit 6: Project Life Cycle Management and Entrepreneurship Development** Introduction to Project Management, Types of Projects,Project life cycle,Entrepreneur meaning, Difference between entrepreneur and manager,competencies,Business plan preparation,Introduction to SME's,MSME & Start ups	7

Text Books:

Sr. No.	
1	Engineering Management, A. K. Gupta, S. Chand & Co Publication
2	Industrial Engineering & Management, O. P. Khanna,Dhanpat Rai & Co Publication
3	Industrial Engineering & Management,N. V. S. Raju, Cengage Learning India Publication

Reference Books:

Sr. No.	
1	Principles of Management,Harold Koontz &Cyril O'donnell, McGraw-Hill Publication
2	Essentials of Management by Joseph J. Massie, Pearson Publication
3	Organizational Behaviour by Stephen P. Robbins, Pearson Publication
4	Entrepreneurship Development by Vasant Desai, Himalaya Publishing House Publication
5	Engineering Project Management-Parameshwar P Iyer-Vikas Publishing House Pvt Ltd
6	Financial Management by Prasanna Chandra, published by CFM-McGraw-Hill,Publication

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Course Code:	UMEPE0713	**L**	**T**	**P**	**Credit**
Course Name:	Enterprise Resource Planning	**3**	**0**	**0**	**3**
Course Pre-Requsites:	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 Learning Objectives:

CLO1	To elaborate basics and importance of ERP and related technologies.
CLO2	To explain the students the business modules of ERP.
CLO3	To explain the ERP Implementation process.
CLO4	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 Level**	**Descriptor**
CO1	Explain the basics of ERP and related information technologies	II	Understand
CO2	Explain the business modules of ERP and select the appropriate module depending on the volume of industry	III	Apply
CO3	Summarize the implementation process of ERP package.	II	Understand
CO4	Explain the ERP market and the emerging technologies in ERP	II	Understand

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2													
CO2	2	2										2	2	
CO3	2													
CO4	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	Introduction to ERP: Introduction, Business Functions and Business Processes, Role of the Enterprise, Evolution, Reasons for the growth of ERP market, Advantages, Reasons for failure of ERP. Benefits of ERP-Reduction of lead time, On time shipment, Reduction in cycle time, Improved resource utilization, Better customer satisfaction, Input supplier performance, Increased flexibility.	7
2	ERP and Related Technologies Data warehousing, Data mining, OLAP, Business Process Reengineering (BPR), Management Information System (MIS), Supply Chain Management (SCM), Decision Support System (DSS), Executive Information System (EIS),Customer relationship Management (CRM), Business Intelligence (BI), ERP and Security.	8
3	ERP Modules Introduction and study of Business modules like Finance, Mfg. and Production, HR, Plant Maintenance, Quality and Material Management, Sales and Distribution.	7
4	ERP Implementation Basics and Life cycle Challenges to successful ERP Implementation, Objectives of ERP Implementation, Different Phases of ERP Implementation:-Pre-evaluation Screening, Package evaluation, Project planning, Gap Analysis, Reengineering, Customization, Implementation Team Training, Testing, Going live, End User training, Post Implementation.	8

5	ERP Implementation Process ERP Deployment models, ERP Implementation Methodologies, Organization of the ERP Project Team, Success and Failure factors of the ERP Implementation.	8
6	ERP Market and Emerging technologies Brief account of ERP market, various ERP packages like SAP, BAAN, Oracle, QAD, PeopleSoft etc, Cloud based ERP, Integration of IOT and Machine learning in ERP, ERP career roles.	7

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", Venkateshswara, 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: 978-0-557-01291-6.
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. K. , PHI, New Delhi.

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Course Code:	UMEPE0714	**L**	**T**	**P**	**Credit**
Course Name:	Thermal Management and Electronic Packaging	**3**			**3**
Course Pre-Requsites:	Fluid Mechanics, Heat Transfer				
Course Description:	The continuing trend toward miniaturization and high power density electronics results in a growing interdependency between different fields of engineering. In particular, thermal management has become essential to the design and manufacturing of most electronic systems. The course details how engineers can use intelligent thermal design to prevent heat-related failures, increase the life expectancy of the system, and reduce emitted noise, energy consumption, cost, and time to market. Appropriate thermal management can also create a significant market differentiation, compared to similar systems. Since there are more design flexibilities in the earlier stages of product design, it would be productive to keep the thermal design in mind as early as the concept and feasibility phase. The course provides the basic knowledge necessary to understand and solve simple electronic cooling problems. Also experimental and numerical techniques and tools that are used in a typical thermal design process. This course can help all engineers to develop the necessary expertise in thermal management of electronics and move a step closer to being a multidisciplinary engineer.				

Course Learning Objectives:

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	Explain fundamentals of thermal management and packaging of electronics	II	Understanding
CO2	Analyze the performance of thermal management of electronic devices	III	Analyzing
CO3	Estimate the rate of heat transfer at specified thermal conditions.	IV	Evaluating

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3											2		1
CO2		3		2										
CO3		3					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	Introduction: Semiconductor Technology Trends, Temperature-Dependent Failures, Importance of Heat Transfer in Electronics, Thermal Design Process	7
2	Thermal Resistance Network: Thermal Resistance Concept, Series Thermal Layers, Parallel Thermal Layers, General Resistance Network, Thermal Contact Resistance, Thermal Interface Materials, Spreading Thermal Resistance, Thermal Resistance of Printed Circuit Boards (PCBs).	8
3	Thermal Packages: Importance of Packaging, Packaging Types, Thermal Specifications of Microelectronic Packages, Package Thermal Resistance Network, Parameters Affecting Thermal Characteristics of a Package.	8
4	Fundamentals of Heat Transfer: Fin theory: Heat Sink Thermal Resistance, Effectiveness, and Efficiency, Heat Sink Manufacturing Processes. Convection: Normalized Boundary Layer Equations. Forced and natural convection for flow over and across different geometrical configurations, Fans and Pumps, Plate-Fin Heat Sinks. Radiation: Fundamental laws and definition, Radiation Heat Transfer from a Plate-Fin Heat Sinks.	8

5	Experimental Techniques and Thermal Design: Flow Rate Measurement Techniques, System Impedance Measurement, Fan and Pump Curve Measurements, Velocity Measurement Methods, Temperature Measurement Techniques, Acoustic Noise Measurements, Importance of Experimental Measurements in Thermal Design.	8
6	Advanced Cooling Techniques: Heat Pipes, Liquid Cooling, Thermoelectric Coolers, Electro-hydrodynamic Flow, Synthetic Jet, microchannel cooling.	6

Text Books:

Sr. No.	
1	Heat Transfer- Thermal Management of Electronics, Younes Shabany, CRC Press, Indian Edition
2	Heat Transfer: A Practical Approach, Yunus A. Cengel , McGraw-Hill Higher Education; 2 edition
3	Fundamentals of Heat & Mass Transfer ,7th Edition, Frank P. Incropera, Wiley.

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.
3	Thermal Management in Electronic Component using Jet Impingement, Anwarullah Mohammed, Mohammed Asadullah Thakur, LAP Lambert Academic Publishing

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Course Code:	UMEMM0741	**L**	**T**	**P**	**Credit**
Course Name:	Machine Learning	**3**	**0**	**0**	**3**
Course Pre-Requsites:	This course requires the basic knowledge of the following: 1. Basics of Python Programming 2. Basics of Mathematics and Statistics				
Course Description:	Students need to develop the skills required for Machine Learning Technologies with use of Python to analyze data, create beautiful visualizations, and problem solving using powerful machine learning algorithms. Machine learning heavily relies on mathematics, statistics, and programming expertise to develop and fine-tune algorithms. Data science requires a multidisciplinary skill set that includes knowledge of statistics, programming, data manipulation, and subject matter expertise.				

Course Learning Objectives:

CLO1	To revise the basics of Machine learning.
CLO2	To explain the basics of Model analysis and Feature engineering.
CLO3	To explain the basics of Supervised Learning and Unsupervised learning algorithms.
CLO4	To explain the applications and the advancements in the field of Machine Learning.

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	Explain the basic concepts of Machine learning.	II	Understand
CO2	Apply the Machine learning algorithms for Classification and regression problems.	III	Apply
CO3	Explain the basics of Unsupervised ML and Artificial Neural networks.	II	Understand
CO4	Illustrate the advancements in Machine learning process and its applications.	II	Understand

CO-PO Mapping:

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

Assessment Scheme:

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

Course Contents:

Unit No.	**Unit Content**	**No. of Lectures**
1	Introduction to Machine Learning Types of human learning, What is Machine learning? Terminology of Machine learning,Types of Machine learning- Supervised, unsupervised, semi-supervised and reinforcement learning.Supervised Vs Unsupervised Applications of Machine learning,	4
2	Model Preparation, Evaluation and feature engineering Types of data in machine learning, Exploring structure of data, Data preprocessing, model selection and training (for supervised learning), Model representation and interpretability, Evaluating machine learning algorithms and performance enhancement of models. Feature Engineering, Feature transformation, Feature sub set selection, Principal component analysis.	9
3	Supervised Learning - Regression Introduction to Regression, Regression algorithms, Simple linear regression, Multiple linear regresion, Polynomial regression model, Logistic regression, Maximum likelihood estimation. Performance Metrics.	9
4	Supervised Learning - Classification Classification model and learning steps, Classification algorithms: Naïve Bayes classifier, k-nearest Neighbour (kNN), Decision tree, Support Vector machines, Random forest.	8
5	Unsupervised Learning and Artificial neural networks Applications of unsupervised learning, Clustering and its types, partitioning method: k means and k-medoids, Hierarchical clustering , Density-based methods- DBSCAN Biological neuron, Artificial neuron, Activation functions, architecture of neural network, Perceptron, Learning process in ANN, Back propogation.	9

6	Introduction to Deep learning, overview of reinforcement learning, Agentic AI - Introduction and Application, case-study of ML applications: Image recognition, speech recognition, Email spam filtering, Online fraud detection.	6

Text Books:	
Sr. No.	
1	Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly, 2nd Edition,2018.
2	WesLey J. Chun, “Core Python Programming”, Second Edition, Pearson Education, 2010.
3	Machine Learning with Python - an approach to applied ML, by Abhishek Vijayvargia, BPB publications
4	Practical Machine Learning by Sunila Gollapudi Packt Publishing Ltd
5	Machine Learning by Tom M. Mitchell, McGraw Hill Education; First edition

Reference Books:	
Sr. No.	
1	Aurelien Geron , “ Hands on Machine Learning with Scikit -learning , Keras & Tensorflow “,Concepts , Tools & Techniques to build Intelligent systems
2	Andreas Muller, “Introduction to Machine Learning with Python: A Guide for Data Scientists”, 1st Edition, O’Reilly Media, 2017.
3	Rajiv Chopra, Machine Learning, Khanna Book Publishing 2021

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

Department of Mechanical Engineering

Course Code:	UMEMM0742	**L**	**T**	**P**	**Credit**
Course Name:	Internet of Things	**3**			**3**
Course Pre-Requsites:	Basic understanding of electronics, sensors, and computer fundamentals.				
Course Description:	This course introduces the fundamental concepts of the Internet of Things (IoT) with emphasis on its architecture, components, communication, and applications relevant to mechanical engineering. Students will learn how sensors, embedded systems, communication networks, cloud platforms, and data analytics work together to build IoT systems. The course also highlights industrial and real-world applications such as smart manufacturing, condition monitoring, predictive maintenance, and smart infrastructure, providing a foundation for advanced studies and projects in IoT and Industry 4.0.				

Course Learning Objectives:

CLO1	Introduce students to the basic concepts, architecture, and components of Internet of Things (IoT) systems.
CLO2	Provide foundational knowledge of sensors, embedded systems, and communication technologies used in IoT.
CLO3	Familiarize students with cloud platforms, data handling, and visualization in IoT applications.
CLO4	Expose students to real-world and industrial IoT applications relevant to mechanical engineering and Industry 4.0.

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	Explain the fundamental concepts, architecture, and components of Internet of Things (IoT) systems.	II	Understand
CO2	Identify suitable sensors, embedded platforms, and communication technologies for basic IoT applications.	III	Apply
CO3	Apply IoT concepts to simple real-world and mechanical engineering application scenarios.	III	Apply
CO4	Illustrate the use of cloud platforms and data visualization techniques in IoT systems.	II	Understand

CO-PO Mapping:

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

Assessment Scheme:

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

Course Contents:

Unit No.	**Unit Content**	**No. of Lectures**
1	Introduction and definition of Internet of Things (IoT). Evolution and growth of IoT. Application areas of IoT such as smart manufacturing, smart cities, healthcare, energy, transportation, and agriculture. Characteristics of IoT systems. Concept of "Things" in IoT. IoT system stack and basic architecture. Overview of enabling technologies including sensors, embedded computing, cloud computing, communication technologies, data analytics, and user interfaces. Challenges and limitations of IoT. Different levels of IoT systems.	7
2	Introduction to sensors and sensor interfacing concepts. Classification of sensors used in IoT applications. Overview of commonly used sensors such as temperature, gas, ultrasonic, light, motion, GPS, and pH sensors. Basic understanding of actuators used in IoT systems. Role of microcontrollers in IoT. Overview of popular IoT development boards such as Arduino, NodeMCU, ESP32, and Raspberry Pi. Conceptual understanding of analog and digital signals. Basic idea of interfacing sensors and controlling devices through web-based interfaces.	8
3	Introduction to communication in IoT systems. Basics of data transmission in IoT. Overview of wired and wireless communication technologies. Introduction to IoT messaging protocols. Conceptual understanding of MQTT protocol. Overview of short-range wireless technologies such as Bluetooth Low Energy (BLE) and Wi-Fi. Introduction to addressing and identification in IoT. Basic concepts of Internet Protocols including IPv4 and IPv6.	7

4	Introduction to cloud computing. Role of cloud in IoT systems. Benefits and challenges of integrating IoT with cloud platforms. Introduction to fog and edge computing concepts. Data storage and data flow in IoT systems. Basic understanding of IoT dashboards and data visualization. Introduction to IoT platforms and services.	7
5	Introduction to data analytics in IoT. Types of data generated by IoT systems. Basic concepts of data analysis and visualization. Introduction to machine learning in IoT. Overview of supervised and unsupervised learning. Introduction to Industrial Internet of Things (IIoT). IoT applications in manufacturing, machine condition monitoring, predictive maintenance, energy management, and smart factories. Industry-based case studies.	8
6	Overview of application development in IoT. IoT-based applications in healthcare, transportation, logistics, water quality monitoring, smart warehouses, smart retail, and safety systems. Introduction to IoT security. Basic security requirements and challenges in IoT systems. Overview of common security threats and protection measures. Ethical, privacy, and societal concerns related to IoT. Basic IoT devices troubleshooting, Introduction to emerging trends in IoT such as AI-enabled IoT, Digital Twins, smart robotics, autonomous systems, and future scope of IoT in mechanical engineering.	8

Text Books:

Sr. No.	
1	Internet of Things, Shriram K. Vasudevan, Abhishek S. Nagarajan, RMD Sundaram, Wiley India
2	Internet of Things: A Hands-On Approach, Arshdeep Bahga & Vijay Madisetti, Universities Press / VPT
3	Internet of Things: Architecture and Design Principles, Raj Kamal, McGraw Hill Education

Reference Books:

Sr. No.	
1	hnologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert
2	Getting Started with the Internet of Things, Cuno Pfister, O'Reilly Media
3	Arduino Cookbook, Michael Margolis, O'Reilly Media

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

Department of Mechanical Engineering

Course Code:	UMEMM0743	**L**	**T**	**P**	**Credit**
Course Name:	Vehicle Management System	**3**	**-**	**-**	**3**
Course Pre-Requsites:	Automobile Engineering, I. C. Engine, Applied Thermodynamic, Electric and Hybrid Technology, Basic Mechanical Engineering.				
Course Description:	This course discusses the fundamental concepts and analysis of hybrid and electric vehicles. This course discusses the various EV subsystems such as electric motors, energy storage devices, charging technology etc. Analytical exercises in vehicle dynamics, battery parameters and charging technology are included as a preparatory base for designing an EV.				

Course Learning Objectives:

CLO1	To make students familiar with various basic systems of a modern automobile technology.
CLO2	To familiarize students with advanced automotive electronic systems influencing vehicle performance.
CLO3	To make students aware about latest trends in transportation towards a safe, pollution free and fully automatic vehicle.
CLO4	To empower students to face the real life automotive usage with greater confidence.

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	Explain engine and vehicle management system components and functions.	II	Understand
CO2	Describe fuel injection, ignition, and emission control systems.	II	Understand
CO3	Apply electronic control principles to engine and emission systems.	III	Apply
CO4	Analyze sensor data and control strategies in vehicle management systems.	IV	Analyze

CO-PO Mapping:

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

Assessment Scheme:

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

Course Contents:

Unit No.	**Unit Content**	**No. of Lectures**
1	**Introduction to Vehicle Management** Overview of Vehicle Management Systems (VMS), Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines and in the other parts of the automobile.	7
2	**Sensors** Inductive, Hall effect, hot wire, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, air mass flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, crash, exhaust oxygen level, knock, engine temperature, manifold temperature and pressure sensors.	9
3	**SI Engine Management** Three way catalytic converter, conversion efficiency versus lambda. Layout and working of SI engine management systems like Bosch L-Jetronic and LH-Jetronic. Group and sequential injection techniques. Working of the fuel system components. Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel control maps, open loop control of fuel injection and closed loop lambda control. Electronic ignition systems and spark timing control. Closed loop control of knock.	7

4	**CI Engine Management** Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valves.	8
5	**Fault Diagnosis** On board diagnostics System for passenger cars and light duty, trucks and heavy duty vehicle, Fuel injection pump, testing in Line fuel injection pumps, testing, helix and port controlled distributor injection pumps, Emission control legislation.	7
6	**Vehicle management system** ABS system, its need, layout and working. Electronic control of suspension – Damping control, Electric power steering, Supplementary Restraint System of air bag system – crash sensor, seat belt tightening. Cruise control. Vehicle security systems- alarms, vehicle tracking system. Vehicle control units, On board diagnostics. Collision avoidance Radar warning system.	7

Text Books:

Sr. No.	
1	Understanding Automotive Electronics William B Ribbens, SAE 1998.
2	Automobile Electronics by Eric Chowanietz SAE.
3	Kripal Singh, Automobile Engineering Vol II, Standard Publishers Distributors, Tenth Edition , 2007
4	Ribbens W. B., Understanding Automotive Electronics, Newness.
5	NBOSCH, Automobile Handbook, Bentley publishers.

Reference Books:

Sr. No.	
1	Robert Bosch, Diesel Engine Management, SAE Publications.
2	Brady R. N., Automotive computers and Digital Instrumentation, A Reston Book, Prentice Hall, Eagle Wood Cliffs, New Jersey.
3	Newton, Steeds and Garrett, The Motor Vehicle, Butterworths International Edition, 11th Edition, 1989

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

Department of Mechanical Engineering

Course Code:	UMEIL0871			**P**	**Credit**
Course Name:	Project-II			**8**	**4**
Course Pre-Requsites:	Project–II builds upon Project–I and requires students to implement, test, and optimize mechanical systems, so they must have Solid engineering knowledge, Analytical & design skills, Hands-on tool & fabrication skills, Ability to work in teams, communicate, and manage projects				
Course Description:	Project II represents the execution, analysis, and completion phase of the final year undergraduate project in Mechanical Engineering. In this course, students apply engineering knowledge, research methodology, and analytical skills to systematically investigate, analyze, and solve a real-world engineering problem identified during Project Phase – I. Working individually or in small groups under the guidance of a research supervisor, students undertake detailed technical work involving experimentation, modelling, simulation, data analysis, and interpretation of results. The course emphasizes professional practices such as project planning, documentation, ethical conduct, teamwork, and effective communication. The outcome of this phase is a complete project thesis, supported by oral and/or poster presentations, demonstrating students' readiness for professional practice, research, or higher studies.				

Course Learning Objectives:

CLO1	Develop and fabricate a mechanical system/process to meet functional and safety requirements.
CLO2	Apply engineering analysis and experiments to assess system performance
CLO3	Use modern tools for testing, validation, and optimization.
CLO4	Prepare reports, present results, and demonstrate teamwork, ethics, and project management

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	Design, fabricate, and/or implement the proposed mechanical system or process to meet specified requirements.	VI	Create
CO2	Apply advanced engineering analysis and experimental methods to evaluate system performance.	V	Evaluate
CO3	Use modern manufacturing, testing, and measurement tools for validation and optimization.	IV	Analyse
CO4	Prepare a comprehensive technical report and deliver a professional project presentation demonstrating engineering competence.	III	Apply

CO-PO Mapping:

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

Assessment Scheme:

Sn No	**Assessment**	**Weightage**	**Marks**	Remarks
1	In Semester Evaluation (ISE)	50%	**50**	Assessment of 50 Marks is based on at least two Internal Oral and/or Poster Presentations
2	End Semester Examination (ESE)(OE)	50%	**50**	Assessment of 50 Marks is based on Project/ Viva-voce/ Oral Examination.

Course Contents:

Unit Content

Course Content:

The work to be completed shall consist of:

1. Project Implementation: Fabrication, assembly, material selection, and system integration.
2. Analysis & Testing: Performance evaluation using simulations and experiments.
3. Validation & Optimization: Use of CAD/CAM, FEA, sensors, and troubleshooting tools.
4. Project Management & Professional Skills: Planning, documentation, reporting, presentations, teamwork, and ethics.
5. Final Review & Submission: Incorporating feedback and submitting final report and presentation.

Term work:

The internal assessment and evaluation shall be based on at least two presentations highlighting following points:

- Theoretical background and literature review,
- Significance and relevance,
- Proposed objectives, work plan and research design,
- Extent of work performed and findings of the research work,
- Interdisciplinary approach,
- Application utility,
- Social, economic, technical aspects and
- Limitations and future scope.

The internal assessment and evaluation for per batch shall be done by a committee consisting of the Head of the Department, two Senior Faculty Members (Subject Experts) of the Department, Research Supervisor and Co-Research Supervisor (if any). Each project batch shall submit soft copies and hard copies of their thesis duly signed by the Research Supervisor, Co-Research Supervisor (if any), two Senior Faculty Members (Subject Experts) of the Department, Head of the Department and Head of the Institution to the Research Supervisor, Co-Research supervisor (if any), Department and Examination Section. For a pass in a Project/ Viva-voce/ Oral Examination, a student shall secure a minimum of 40% of the maximum marks prescribed for the End Semester Examination.

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

Department of Mechanical Engineering

Course Code:	UMEIL0872	**L**	**T**	**P**	**Credit**
Course Name:	Internship			**12**	**6**
Course Pre-Requsites:	Students should be able to communicate effectively and work well in a team. She/he should be able to demonstrate professional, reliable and a strong work ethic, this includes being punctual, taking initiative and being able to manage time effectively.				
Course Description:	The Industry Internship Program offers students the opportunity to gain practical experience and insight into the professional world within their chosen field. Throughout the internship experience, students will engage in meaningful projects, tasks, and assignments designed to develop industry-specific skills, enhance professional competencies, and foster personal growth. Under the guidance of experienced mentors and supervisors, students will have the opportunity to explore various aspects of the industry, gain exposure to industry trends and practices, and contribute to organizational goals.				

Course Learning Objectives:

CLO1	To apply theoretical knowledge gained in the classroom to real – world industry (Hands on experience.)
CLO2	To develop professional skills such as communication, teamwork, time management, problem-solving and adaptability (Professional Development).
CLO3	To expose students to the operations, practices and culture of a specific industry.
CLO4	To engage students to work on real projects, this will develop problem solving skills, creativity, and the ability to deliver tangible results.
CLO5	To encourage students to analyze problems, evaluate options and make decisions in real world.

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

COs	**CO Statement**	**Level**	**Descriptor**
CO1	Apply theoretical concepts and academic knowledge gained in the classroom to practical.	III	Applying
CO2	Develop industry specific skills such as technical skills, research skills, analytical skills, or communication skills.	VI	Creating
CO3	Demonstrate the ability to identify, analyze and solve problems encountered in the workplace.	II	Understanding
CO4	Interpret effectively through various channels, such as written reports, oral presentation, emails or meetings	II	Understanding
CO5	Demonstrate overall growth and development as a professional integrating academic	II	Understanding

CO-PO Mapping:

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

Assessment Scheme:

SN	**Assessment**	**Weightage**	**Marks**	**Remark**
1	In Semester Evaluation 1 (ISE1)	50%	75	presentation, industry review and project/ case study report evaluation etc.
2	In Semester Evaluation 2 (ISE2)	50%	75	presentation, industry review and project/ case study report evaluation etc.
3	OE	100%		

Course Contents:		
	Guidelines for Internship	
	As per the approved academic structure and internship policy defined by college, students will be allowed to take internships during the 8th semester of B.Tech program. Students must have to complete all the ISE activities of 8th Semester using LMS (Learning Management System). It will be mandatory to all students (including internship students) to appear for the Mid Semester Exam (MSE) and End Semester Exams (ESE). Failing to do so, you will not be considered for the award of B. Tech degree. There will not be any extension/exemption from MSE and ESE exams. The rest of the rules and regulations related to academics and exam are all applied as it is.	

	The department holds the final authority to accept or reject the internship offered to students. Department will check the credibility of the organization offering the internship to students. If the department finds the internship is unworthy, then students will not be allowed to join the organization.	
1	Orientation and company Introduction • Introduction to the host company, its mission, values, and organizational structure. • Overview of the departments relevant to mechanical engineering. Familiarization with safety protocols, facilities, and resources.	
2	Departmental Rotation • Rotations through different departments or teams within the company. • Exposure to various functions such as marketing, operations, research and development, finance, etc. • Observe daily tasks, workflows, and project management processes.	
3	Project Assignments: Assignments aligned with the intern's field of study or interests. • Real-world projects with defined objectives, deliverables, and timelines. • Opportunities to work independently or collaborate with teams on cross-functional projects.	
4	Mentorship and Guidance: • Assignment of a mentor or supervisor to provide guidance, support, and feedback. • Regular check-ins and one-on-one meetings to discuss progress, challenges, and learning goals.	
5	Performance Evaluation: • Regular performance evaluations based on predefined criteria and objectives. • Feedback from supervisors, mentors, and peers on technical skills, teamwork, and professionalism.	
6	Final Presentation and Report: • Culminating presentation and report showcasing the intern's accomplishments, projects, and key leanings. • Presentation to company executives, department heads, and/or internship college mentor. • Recommendations for improvements or insights gained during the internship.	

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

Department of Mechanical Engineering

		L	T	P	Credits
Course Code:	UMECC0831				
Course Name:	Co -Curricular Activities-IV	---	---	2	1

Course Pre-Requsites:	This course is open to all second-year engineering students interested in enhancing their personal and professional development through co-curricular activities.
Course Description:	Co-Curricular activities are an integral part of curriculum which provides educational activities to the students and thereby help in broadening their experiences. Co-Curricular activities can be defined as the activities that enhance and enrich the regular curriculum during the normal college hours. All Co-Curricular activities are organized with specific purpose which may according to the nature and form of activities. This course introduces students to a variety of co-curricular activities aimed at enhancing their professional and personal development within the field of engineering and technology. Through practical projects, competitions, workshops, and community engagement, students will develop teamwork, leadership, communication, and technical skills essential for success in their careers.

Course Learning Objectives:

CLO1	To encourage students to showcase their intellectual and independent thinking skills.
CLO2	To imbibe a sense of confidence and managerial capabilities among students.
CLO3	To promote the ability to work in team, organize and analyse available resources.
CLO4	To build responsiveness among students about the social and cultural responsibilities.

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

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

CO-PO Mapping:

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

Assessment Scheme:

Assessment	Weightage (Marks)
ISE	50

ISE: Assessment is based on the student's participation in various Co-Curricular Activities and Guidelines given in "Rules for Assigning Activity Points: Activity – Event Grade Point Scheme" Policy Document.

Course Guidelines

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

Course Structure: (Refer Rules for Assigning Activity Points: Activity – Event Grade Point Scheme)

Sr. No.	Initiatives	Criteria, Activities and Assignments
1	Introduction to Co-	Orientation, Induction, Course Overview
2	National Initiatives Participation	Participation, Achievement Levels and Assigned Activity Points in NCC, NSS, Unnat Bharat/
3	Sports and Games Participation	Participation, Achievement Levels and Assigned Activity Points in Sports and Games
4	Cultural Activities Participation	Participation, Achievement Levels and Assigned Activity Points in Music, Performing Arts,

5	Professional Self Initiatives	Events/Quiz/Paper Contest/Project Contest / Model Making etc. 2. MOOC/ NPTEL/ SWAYAM/ Coursera etc. 3.Competitions/ Events Conducted by Professional Societies (ISTE, IEI, CSI, IEEE, IETE, SAE, ISRO-IIRS, SWE, ISHRAE, ASM, ISNT etc.) 4. Attending Full time Conference/ Seminars/ Exhibitions/ Workshop/ STTP Conducted at IITs/ NITs/ Reputed Institutes/ Universities 5. Attending Full time Conference/ Seminars/ Exhibitions/ Workshop/ STTP Conducted at KITCoEK 6. Paper Presentation in National/ International Conference of High Repute 7. Poster Presentation in National/ International Conference of High Repute 8. Paper Publication in National/ International Journal of High Repute 9. Industrial Training/ Internship (at least for 04 Weeks)
6	Entrepreneurship and Innovation	Participation, Achievement Levels and Assigned Activity Points in 1.Prototype Developed and Tested 2.Awards for Products Developed 3.Innovative Technologies Developed and Used by Industries 4.Got Funding from Government/ Industry for Innovative Ideas 5.Patent-Filed/ Published/ Approved/ Licensed 6.Social Innovations
7	Leadership & Management of Clubs/ Activities	Participation, Achievement Levels and Assigned Activity Points in 1.Elected Student Representative of Student Council (University Representative, General Secretary, Cultural, Sports, NSS Secretary, Ladies Representative, Academic Toppers, Invitee Members) 2.Office Bearer of Professional Society Chapter (ISTE, IEI, CSI, IEEE, IETE, SAE, ISRO-IIRS, SWE, ISHRAE, ASM, ISNT etc.) 3.Office Bearer of Institute Level Student Club (Developer Student Club, Gaganvedhi, Walk With World, Team Mavericks, Cultural Club, Aura, Amateur Write Club, Rotaract Club of KIT Sunshine, Women Development and Gender Equality Cell, Shourya, Lead India etc.) 4.Office Bearer of Departmental Student Association 5.Office Bearer of ECell, Digital Content Lab etc. 6.Student Ambassador for Mayura AICTE IDEA Lab/ NIDHI iTBI etc. 7.Editorial Board Member of Annual Magazine 8.Editorial Board Member of E-Newsletter 9.Member of Governance Committee/ Statutory Committee
8	Culminating Event and Reflection	Final Presentations, Course Reflection, Documentation, Assessment and Evaluation

Participation Levels:

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

Approval Documents:

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

Grading scheme

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

Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur					
Department of Mechanical Engineering					
Course Code:	**UMEPE0811**	**L**	**T**	**P**	**Credit**
Course Name:	**SIX SIGMA IN QUALITY MANAGEMENT**	**3**	--	--	**3**
Course Pre-Requsites:	Basic understanding of input output processes, Fundamental stastistical tools, Analytical thinking, Excel, Python				
Course Description:	Six-Sigma will focus on detailed strategic and operational issues of process improvement and variation reduction. Six-sigma is a measure of quality that strives for near perfection. It is a disciplined, data-driven approach for eliminating defects (driving towards six standard deviations between the mean and the nearest specification limit) in any process-from manufacturing to transactional and from product to service.				

Course Learning Objectives:

CLO1	Identify project selection and evaluation criteria.
CLO2	Plan and execute six sigma projects
CLO3	Form and effectively lead a six-sigma project team.
CLO4	Apply DMAIC (Define, Measure, Analyze, Improve, and Control) and various six sigma tools in process and quality improvement.

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

COs	CO Statement	Blooms Level	Descriptor
CO1	Explain advantages and challenges of the Six methodology	L2	Understanding
CO2	Identify proper tools to address and to lead on production issues in their organisations.	L2	Understanding
CO3	Describe the methodologies of various tools of six sigma methodology.	L2	Understanding
CO4	Problem solving skills that can be immediately applied in real world projects.	L3	Analyzing

CO-PO Mapping:

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

Assessment Scheme:

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

Course Contents:

Unit No.	Unit Content	No. of Lectures
1	QUALITY (DEFINE) : Quality Management: Basics and Key Concepts, Fundamentals of Total Quality Management, Cost of quality, Quality concepts and definition, History of continuous improvement, Voice of customer, Quality Function Deployment (QFD), Management and Planning Tools, Six Sigma Project Identification, Selection and Definition, Project Charter and Monitoring, Process characteristics and analysis, Process Mapping: SIPOC	7
2	MEASURE : Data Collection and Summarization, Process capability concepts & analysis, Measures and Indices, Non-normal process capability analysis	6
3	ANALYZE :Hypothesis testing: Fundamentals, Hypothesis Testing Correlation and Regression Analysis, Regression Analysis: Model Validation, ANOVA (eg One-Way ANOVA), Failure Mode Effect Analysis (FMEA)	8
4	IMPROVE :Introduction to Design of Experiment, Randomized Block Design, Factorial Design, Fractional Factorial Design, Taguchi Method, Illustrative Application	8
5	CONTROL :Acceptance Sampling: Key Concepts, Seven QC Tools, Statistical Process Control: Key Concepts, Control Charts for Variables, Operating Characteristic (OC) Curve for Variable Control charts, Control Charts for Attributes, Minitab Application	8
6	SIX SIGMA IMPLEMENTATION CHALLENGES :Six Sigma Project Identification, Selection and Definition, Process Mapping: SIPOC, Design for Six Sigma (DFSS), Case study	7

Text Books:	
Sr. No.	
1	Roderick A. Munro and Govindarajan Ramu and Daniel J. Zrymiak, The certified six sigma Green Belt Handbook, ASQ Quality
2	T. M. Kubiak and Donald W. Benbow, The Certified Six Sigma Black Belt Handbook, Pearson Publication.
3	Forrest W. Breyfogle III, Implementing Six Sigma, John Wiley & Sons, INC.
4	Evans, J R and W M Lindsay, An Introduction to Six Sigma and Process Improvement, CENGAGE Learning.
5	Howard S. Gitlow and David M. Levine, Six Sigma for Green Belts and Champions, Pearson Education, Inc.
6	Montgomery, D C. Design and Analysis of Experiments, Wiley.
7	Mitra, Amitava. Fundamentals of Quality Control and Improvement, Wiley India Pvt Ltd.
8	Montgomery, D C. Statistical Quality Control: A modern introduction, Wiley.
Reference Books:	
Sr. No.	
1	Joseph M. Juran and A. Blanton Godfrey, Juran's Quality Handbook- The Complete Guide to Performance Excellence
2	Dr. Genichi Taguchi, Dr. Subir Chowdhury , Taguchi's Quality Engineering Handbook, Wiley Online

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Course Code:	**UMEPE0812**	**L**	**T**	**P**	**Credit**
Course Name:	**Industrial Engineering**	**3**			**3**
Course Pre-Requsites:	Manufacturing Processes, Operations Research/Basic Statistics				
Course Description:	This course equips students with principles of industrial systems, productivity optimization, work study, planning & control, quality and modern industrial practices such as smart manufacturing — blending Mechanical Engineering with industrial analytics and management.				

Course Learning Objectives:

CLO1	Introduce students to the concepts, scope, and importance of Industrial Engineering in improving productivity and efficiency of industrial systems.
CLO2	Develop the ability to analyze and improve manufacturing and service systems using Industrial Engineering tools such as facility planning, work
CLO3	Enable students to apply Production Planning and Control techniques for effective resource utilization and smooth operation of production systems.
CLO4	Equip students with analytical skills by applying Operations Research techniques for solving industrial decision-making problems.
CLO5	Provide exposure to quality management, maintenance strategies, and reliability concepts for enhancing operational efficiency and sustainability.
CLO6	Familiarize students with modern industrial practices including Industry 4.0 concepts, digital manufacturing, and smart production systems, while

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	Apply Industrial Engineering principles such as productivity improvement, facility	L3	Apply
CO2	Use Production Planning & Control and Operations Research techniques for effective	L4	Analyze
CO3	Apply quality, maintenance, and modern industrial practices (including Industry 4.0	L5	Evaluate

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	-	-	-	1	-	-	3	2	1
CO2	2	3	2	2	3	-	-	-	-	-	-	2	3	1
CO3	2	2	2	-	3	2	3	1	-	-	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	**Introduction to Industrial Engineering & Productivity :-** Definition, scope, role of IE in industry,	6
2	**Facilities & Plant System Design**:- Production systems; plant location factors; types of plant layout (process, product, fixed, combination); material handling principles and equipment; lean layout basics.	8
3	**Work Study & Ergonomics :-** Work system design; work study techniques; method study charts (flow, string, multiple activity); work measurement (time study, standard time, work sampling); ergonomics	8
4	**Production Planning & Control:-** PPC objectives & functions; forecasting methods; routing, scheduling, sequencing; master schedules; dispatching; shop floor control; corrective actions.	7
5	**Operations Research Tools :-** Linear programming formulation; Simplex method; Transportation & Assignment problems; Queuing basics; Project scheduling using PERT/CPM.	8
6	**Quality, Maintenance & Modern IE Practices :-** Statistical Quality Control (control charts); reliability basics; maintenance planning; introduction to industry 4.0/smart factory and digital manufacturing	8

Text Books:

Sr. No.	
1	Industrial Engineering and Production Management- M. Telsang, S. Chand Publication, ISBN 81 219 1773 5.
2	Work Study- O. P. Khanna, Dhanpat Rai Publications, New Delhi.
3	Industrial Organisation & Engg. Economics- Banga & Sharma, Khanna Publishers, 2001, ISBN 81-7409-078-9
4	Principles & Practices of Management- Chabra T. N., Dhanpat lal & compony
5	Industrial Engineering and Production Management- Mahajan M., Dhanpat Rai and Sons Publishers, 2005, ISBN-81-7700-
6	Production and Operations Management — K. Aswathappa & K. Shridhara Bhat, Himalaya Publishing House
7	Operations Research — H. A. Taha, Pearson / Prentice Hall.

Reference Books:

Sr. No.	
1	H. B. Maynard and others, "Industrial Engineering Handbook", IVth edition McGraw Hill Publications, ISBN 0-07-
2	"Introduction to Work Study", ILO Universal Pub. Co, B'bay,ISBN 81 85027 06
3	Ralph M. Barnes, "Motion and Time Study: Design and Measurement of Work" J. Wiley& Sons.
4	Koontz Harold and Weihrich Heinz, "Essentials of management", 7ed, Tata McGraw Hill publishing, 2008, ISBN 0-07-
5	Luthans f., "Organizational Behaviour", McGraw-Hill Company, 2008, ISBN 81-317-05021.

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Course Code:	UMEPE0813	**L**	**T**	**P**	**Credit**
Course Name:	Advanced Energy Technology	**3**	**-**		**3**
Course Pre-Requsites:	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 Learning Objectives:

CLO1	Acquire the knowledge of renewable sources of energy and utilization
CLO2	Enable the student to estimate the potential of energy sources.
CLO3	Study various power stations , Performance and economic analysis
CLO4	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	Understanding
CO2	Make use of Renewable energy for power generation	III	Applying
CO3	Analyze the utilization of solar, wind energy etc	IV	Analyzing

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3						2					2		
CO2	3						2					2		
CO3		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 .	7 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)	8 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.	8 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)	7 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 conservationa 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 .	7 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, New Delhi ,2000.
7	Principles of Solar Engineering, D.Y.Goswami, F.Kreith and J.F.Kreider, Taylor and Francis,Philadelphia, 2000..

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Department of Mechanical Engineering

Course Code:	UMEPE0814	**L**	**T**	**P**	**Credit**
Course Name:	Operations Research (Program Elective-IV)	**3**		**-**	**3**
Course Pre-Requsites:	Preliminary knowledge of Linear Algebra (matrices, vectors, linear equations) and Engineering Mathematics				
Course Description:	Course Description: Operations Research explores mathematical techniques for optimizing processes and making informed decisions. Topics include mathematical modeling, optimization techniques (such as linear programming), decision analysis under uncertainty, simulation, queuing theory, inventory management, and supply chain optimization. Emphasis is on practical applications through case studies and hands-on exercises. Students develop problem-solving skills applicable across various domains.				

Course Learning Objectives:

CLO1	Understand and apply fundamental concepts of Operations Research
CLO2	Analyze and solve optimization and scheduling problems
CLO3	Evaluate strategic decisions through game theory, decision theory,
CLO4	Develop and interpret project networks using CPM and PERT techniques, calculate critical paths, estimate project durations, and optimize project timelines.

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

COs	**CO Statement**	**Level**	**Descriptor**
CO1	Demonstrate the applicability of LPP techniques such as Graphical method, Simplex , Transportation and Assignment to the Industrial problems	II	Undersatnd
CO2	Apply OR techniques such as Project management, Sequencing Theory for Decision making in Manufacturing industry	III	Apply
CO3	Construct mathematical models for real life cases using game theory and replacement model	III	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2										2	2	2	
CO2	2	1								2	2	2	2	
CO3	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	**Introduction to Operations Research (OR)**: History and development of Operations Research, Modeling in OR, Scope, Application of Operations Research, Linear Programming Problem: Formulation of problem, graphical solution, simplex procedure for maximization and minimization,	6 Hrs
2	**Transportation, assignment and sequencing model:** **Transportation Problem (TP):** Mathematical formulation of TP, methods to obtain initial basic feasible solution, TP without degeneracy and with degeneracy **Assignment Problem (AP)**: Mathematical formulation of AP, variations of AP, Travelling salesman problem: Sequencing Problem: Assumptions in sequencing, processing of n jobs on two machines, processing of n jobs on three machines and processing of n jobs on m machines.	8 Hrs
3	**Replacement model:** Introduction, replacement of items that detoriates replacement of items whose maintenance and repair cost increases with time ignoring value of money and replacement of items whose maintenance and repair cost increases with time considering value of money, replacement of items that fail suddenly group replacement	6 Hrs

4	**Games theory**: Minimax (Maxmin) criterion for optimality, characteristics of game, dominance principles, 2X2 game-arithmetic and algebraic method, 2Xn and mX2 game-graphical method and method of sub-games, 3X3 game-method of matrices, iteration method and applications of games theory	6 Hrs
5	**Decision Theory:** Introduction, Pay off table, Opportunity loss or regret table, Decisions under uncertainty, Laplace criterion, Maximin or Minmax principle, Maximax or Minimin principle, Hurcuilicz principle, Decisions under risk–maximum likelihood criteria, Expectation principle, Expected opportunity loss or expected regret decision trees.	6 Hrs
6	**Network Model:** **CPM** – Construction of networks, critical path, Forward and backward path, Floats and their significance, **PERT** – Time estimates, Construction of networks, Probability of completing projects by given date, Crashing.	8 Hrs

Text Books:	
Sr. No.	
1	S. D. Sharma, Himanshu Sharma, "Operations research: Theory, Methods and Applications", Fifteenth edition, Kedar Nath Ram Nath, Meerut
2	Premkumar Gupta, D. S. Hira, "Operations research", revised edition, S. Chand & Company Pvt. Ltd

Reference Books:	
Sr. No.	
1	Hamdy A Taha, "Operations research-An introduction", Nineth edition;2011, Pearson
2	Maurice Saseini, Arhur Yaspan and Lawrence Friedman, "Operations research: methods and problems", Literary Licensing
3	Encyclopedia of Operations Research and Management Science, Saul I. Gass & Michael C. Fu, Springer (Springer New York, NY)
4	Introduction to Operations Research, Frederick S. Hillier & Gerald J. Lieberman, McGraw-Hill
5	Operations Research: Principles and Practice – Ravindran, Phillips & Solberg (John Wiley & Sons)

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Department of Mechanical Engineering

Course Code:	UMEPE0815	**L**	**T**	**P**	**Credit**
Course Name:	Advanced Composites	**3**			**3**
Course Pre-Requsites:	Acquaintance with the basic concepts of Structural Mechanics, Materials Sciences				
Course Description:	This course provides an in-depth study of advanced composite materials, focusing on their design, manufacturing, and performance in engineering applications. Topics include the structure-property relationships of polymer, metal, and ceramic matrix composites, fiber reinforced composites, nanocomposites, and hybrid systems. Students will explore advanced fabrication techniques such as lay-up, filament winding, pultrusion, and additive manufacturing. Emphasis is placed on mechanical behavior, failure mechanisms, damage				

Course Learning Objectives:

CLO1	Explain the classification, constituents, and properties of advanced composite materials.
CLO2	Apply micromechanical and macromechanical models to estimate composite properties.
CLO3	Analyze the influence of fiber orientation, volume fraction, and matrix type on composite performance.
CLO4	Design a composite laminate for a specific engineering application considering mechanical and environmental constraints.

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

COs	**CO Statement**	**Level**	**Descriptor**
CO1	Identify and explain types of advanced composites and their applications	I, II	&
CO2	Apply mechanical analysis and evaluate failure mechanisms of composites.	III, IV	Analyzing
CO3	under various loading conditions.	IV, VI	Creating
CO4	considering material selection, performance,	V, VI	Evaluating &

CO-PO Mapping:

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

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	7
2	Classification of Composites	6
3	Polymer Matrix Composites- Thermoset Composite manufacturing- Layup	7
4	Mechanical properties in composites, the rule of mixtures for elastic constants,	9
5	Cement matrix composites, Steel Reinforced Concrete, Pre-stressed concrete,	8
6	Synthesis of Graphene- Bottom-up approaches, Top-down approaches. Surface	8

Text Books:

Sr. No.	
1	Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West
2	Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3	Composite Materials: Engineering and Science, Matthews F.L., and Rawlings
4	E BOOK: https://www.elsevier.com/books/composite materials/rogoff/978-1-4377-7871-7
5	E BOOK: https://www.elsevier.com/books/composite materials-technology/klinghoffer/978

Reference Books:

Sr. No.	Hand Book of Composite Materials-ed-Lubin.
1	Composite Materials – K. K. Chawla.
2	Composite Materials Science and Applications – Deborah D.L. Chung.
3	Mechanics of Composite Materials and Structures, Madujeet Mukhopadhyay, ISBN: 9788173714771 | Year: 2004
4	Mechanics of Composite Materials, Autar K. Kaw, 1997, CRC Press, New York
5	R.M. Jones, Mechanics of Composite materials, Mc Graw- Hill Kogakush Ltd., Tokyo,

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Course Code:	UMEPE0816	**L**	**T**	**P**	**Credit**
Course Name:	Industry 5.0	**3**			**3**
Course Pre-Requsites:	Basic knowledge of manufacturing processes, Fundamentals of automation and production systems, Introductory understanding of computers and programming concepts, Basic awareness of mechanical engineering systems and industrial practices.				
Course Description:	This course introduces Industry 5.0 with a focus on human-centric, sustainable, and smart manufacturing. It covers human–machine collaboration, advanced manufacturing technologies, and future trends relevant to mechanical engineering applications.				

Course Learning Objectives:

CLO1	To introduce the fundamental concepts, evolution, and significance of Industry 5.0 in modern manufacturing systems.
CLO2	To provide knowledge of human–machine collaboration, smart manufacturing technologies, and the role of artificial intelligence in mechanical engineering applications
CLO3	To develop understanding of sustainable, resilient, and human-centric manufacturing practices aligned with Industry 5.0 principles

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	Explain the concept of Industry 4.0 and Industry 5.0	II	Understand
CO2	Apply Industry 5.0 technologies such as human–machine collaboration, smart manufacturing, and artificial intelligence to mechanical engineering systems.	III	Apply
CO3	Apply AI and ML concept and industry 5.0 principles to mechanical engineering problems	III	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2			2		2			1		2		
CO2	2	3	3		3							3	2	
CO3	2	2	3	2	3	1	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 to Industry 4.0 Evolution from Industry 1.0 to Industry 4.0,Demand dimensions for Industry 4.0, Role of autmation in mechanical engineering, Application of Industry 4.0 in manufactring industries, Challenges and Opportunities in Industry 4.0	7
2	Introduction to Industry 5.0 Evolution of industry: Industry 1.0 to Industry 5.0 ,Limitations of Industry 4.0,Concept and definition of Industry 5.0,Human-centric manufacturing, Role of engineers in Industry 5.0, Comparison: Industry 4.0 vs Industry 5.0, Applications of Industry 5.0 in mechanical engineering.	8
3	Human–Machine Collaboration Role of humans in smart manufacturing, Collaborative robots (Cobots) – basics, Human–robot interaction, Safety in human–machine collaboration, Ergonomics and workplace design, Case studies of human–machine systems, Benefits and challenges of collaboration	7
4	Smart Manufacturing Overview of smart manufacturing, Internet of Things (IoT) in manufacturing, Sensors and actuators in mechanical systems, Cyber-Physical Systems (CPS), Digital twins – basic concept, Smart factories and production lines, Industrial examples of smart manufacturing	8

5	Artificial Intelligence and Data in Industry 5.0 Basics of Artificial Intelligence (AI), Machine learning concepts (introductory), Role of data in manufacturing, Predictive maintenance, Quality control using AI, Decision-making support systems, AI applications in mechanical engineering	8
6	Future Trends and Applications of Industry 5.0 Future of manufacturing industries, Industry 5.0 and society, Ethical and social considerations, Skill requirements for future engineers, Industry 5.0 in automotive and aerospace sectors, Future scope of Industry 5.0	7

Text Books:	
Sr. No.	
1	Industry 4.0: Industrial Revolution of the 21st Century, by Elena G. Popkova, Yulia V. Ragulina, Aleksei V. Bogoviz
2	Augustine, P. (2019). The industry use cases for the Digital Twin idea. In Advances in Computers
3	Groover, M. P., Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson Education
4	Breque, M., De Nul, L., & Petridis, A., Industry 5.0: Towards a Sustainable, Human-Centric and Resilient European Industry, European Commission Publications
Reference Books:	
Sr. No.	
1	Kagermann, H., Wahlster, W., & Helbig, J.,Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0, Acatech, Germany.
2	Gilchrist, A., Industry 4.0: The Industrial Internet of Things, Apress.
3	Vaidya, S., Ambad, P., & Bhosle, S.,Industry 4.0 – A Glimpse, Procedia Manufacturing.

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Course Code:	UMEPE0817	**L**	**T**	**P**	**Credit**
Course Name:	CRYOGENICS	**3**			**3**
Course Pre-Requsites:	Basics of thermodynamics and Refrigeration system				
Course Description:	This subject introduce cryogenic engineering to the students, student will understand basic concepts of refrigeration, cryogenic and liquefaction process along with storage and transportation of cryogenic liquids.				

Course Learning Objectives:

CLO1	To learn basic concepts about cryogenics
CLO2	To learn about refrigeration and liquefaction process
CLO3	Understand principles of ultra-low temperature systems and their applications
CLO4	Enable to analyze handling and storage of cryogenic liquids and its application

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	Illustrate the basic principles of cryogenic systems	II	Understand
CO2	Explain refrigeration and liquefaction processes	II	Understand
CO3	Apply principles of ultra-low temperature and their applications	III	Apply
CO4	Analyze storage systems used in cryogenic applications	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				2								2		1	2
CO3		2													2
CO4	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	**Insight of Cryogenics:** Basic definition and Principle of cryogenics, Properties of Cryogenic fluids, Material properties at Cryogenic.	7
2	**Refrigeration and Liquefaction:** Simple Linde cycle, Carnot Liquefaction Cycle, Joule Thomson Effect, Pre-cooled Joule Thomson cycle, dual- pressure cycle, Simon helium liquefier, classical cascade cycle, mixed refrigerant cascade cycle.	8
3	**Ultra-low-temperature refrigerators:** Definition and Fundamentals regarding ultra-lowtemperature refrigerators, Equipment associated with low-temperature systems, Various Advantages and Disadvantages.	7
4	**Different refrigeration cycle and cryocoolers:** Stirling cycle refrigerators, pulse tube Refrigerators, regenerators used in cryogenic refrigerators, magnetic refrigerators, Hydrogen and LNG systems, and cryocoolers.	7
5	**Storage and Handling of Cryogenic Refrigerants:** Cryogenic dewar, Storage and transfer systems, Insulation, Various types of insulation typically employed, Polyurethane Foams (PUFs) and Polystyrene Foams (PSFs), Vacuum insulation etc,.	8

6	**Application of Cryogenic System:** Broad Applications of Cryogenic Refrigerants in real world engineering systems. Like Space Programs – Superconductivity - Cryo Metallurgy – Medical Applications.	8

Text Books:

Sr. No.	
1	Fundamentals of Cryogenic Engineering, Mamata Mukhopadhyay, PHI, 2010
2	Cryogenic Engineering, Thomas Flynn, CRC, 2004
3	Arora and Domukundwar, Refrigeration and Air-conditioning, Dhanpat Roy & Co., 2018.
4	Cryogenics: A Textbook, S. S. Thipse, Narosa Publishing House, 2013 (Reprinted/Distributed by Alpha Science International), ISBN-13: 978-8184871715, New Delhi, India
5	Fundamentals of Cryogenic Engineering, Rohit Manglik, EduGorilla Publication, 2023, Lucknow, India.

Reference Books:

Sr. No.	
1	J. G. Weisend, The Handbook of Cryogenic Engineering, CRC Press, 1998.
2	R. B Scott.,Cryogenic Engineering, Van Nostrand and Company Inc., 1985.
3	Randall F. Barron, Cryogenic Systems, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 1985.
4	Cryogenic Technology and Applications, A. R. Jha, Butterworth-Heinemann, 2005
5	Cryogenic Engineering - Fifty Years of Progress, Timmerhaus et. al., Springer, 2007

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

Department of Mechanical Engineering

Course Code:	UMEPE0818	**L**	**T**	**P**	**Credit**
Course Name:	Process Equipment Design	**3**	**0**	**0**	**3**
Course Pre-Requsites:	Basic mechanical engineering, Theory of machines, Design of Machine Elements				
Course Description:	This course provides a comprehensive foundation in the design, analysis and testing of pressure vessels and piping systems used in process and mechanical industries. It introduces the general design procedure, applicable design codes and standards, material properties, allowable stresses, and safety considerations essential for reliable equipment design. The course covers the mechanical design of fired and unfired pressure vessels, storage tanks and various end closures, with reference to IS and ASME codes. Emphasis is placed on the design of vessel supports for both vertical and horizontal configurations, considering static and dynamic loads. The fundamentals of pipe design, including materials, layouts, design calculations and practical considerations, are discussed in detail. The course also addresses stress analysis, inspection methods, pressure testing techniques, piping fabrication practices and an introduction to modern piping software. Overall, the course equips students with the theoretical knowledge and practical understanding required for safe, efficient and code-compliant design of pressure vessels and piping systems.				

Course Learning Objectives:

CLO1	To explain the fundamental concepts of pressure vessel and piping design, including design procedures, material properties, allowable stresses, and safety factors
CLO2	To apply IS and ASME codes and standards for the mechanical design of pressure vessels, storage tanks, piping systems, and process equipment.
CLO3	To analyze stresses, loads, and design considerations of pressure vessels, end closures, supports and piping under static and dynamic conditions
CLO4	To evaluate inspection, testing and safety requirements such as visual inspection, non-destructive testing and pressure testing methods.
CLO5	To design safe, reliable and efficient pressure vessels, piping systems and related process equipment in compliance with industry standards.

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	Explain the principles, terminology, material behavior and safety considerations involved in pressure vessel and piping design.	II	Understand
CO2	Apply IS and ASME codes to perform mechanical design calculations for pressure vessels, storage tanks, pipes and process equipment.	III	Apply
CO3	Analyze stresses, loads and failure considerations in pressure vessels, end closures, supports and piping under static and dynamic operating conditions.	IV	Analyze
CO4	Determine the design parameters of pressure vessel and pipes in accordance with industry codes, safety requirements and testing standards.	V	Evaluate

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3													
CO2	2	3										3		
CO3	2	3										2		
CO4	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	**Introduction** General design procedure, Design codes, design and allowable stress, Static and rotary equipments, Factor of safety, Design wall thickness, Corrosion allowance, Weld joint efficiency factor, standard and specification for pressure vessel, Design of simple vessels of different configurations. General proportions and layout.Mechanical properties of material.	6
2	**Design fired and unfired Pressure Vessels** Introduction, Classification of pressure vessels. Design fired and unfired pressure vessels. Introduction to IS and ASME pressure vessel codes and standards. Mechanical design of Storage Tank Classification of the storage tank as per IS-803.	9
3	**Design end closures of pressure vessels** Deign flat head and formed head of vessels, design different types of formed head like plain formed head, torispherical dished head, semi elliptical dished head, hemispherical head, conical head.	8
4	**Design supports of pressure vessels** Different types of pressure vessel supports, types of tall vertical vessels, Design considerations of pressure vessel supports vertical and horizontal.	8
5	**Fundamentals of Pipe Design** Introduction of pipes, types if pipe, materials of pipe, terms of pipe and its equipments, layout and drawings, design calculations and consideration of pipe.	8
6	**Stress analysis and Testing of Pipe** Introduction, types of stress, static and dynamic load, visual inspection, liquid penetration, hydraulic and pneumatic pressure testing, piping fabrication and its supports, introduction of piping software	6

Text Books:

Sr. No.	
1	Mahajani V.V. and Umbrani S.B., Process Equipment Design, Macmillan Publishing India Ltd., Fourth edition.
2	Dr Shrikant D Dawande, Process Equipment Design, volume 2, Denett publishing, seventh edition.
3	M.V. Joshi, V. V. Mahajani, Process Equipment Design, Macmillan India

Reference Books:

Sr. No.	
1	Pressure Vessel Design Manual, Dennis Moss
2	Introduction to Process Engineering and Design" by S B Thakore and B I Bhatt, Tata McGraw Hill, 1 I Edition, 2007
3	R. K. Shah and D. P. Sekulic, Fundamentals of Heat Exchangers Design, John Wiley & Sons, 2003.
4	Saunders E.A.D., Heat Exchangers - Selection, Design and Construction, Longman Scientific & Technical, 1998

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

Department of Mechanical Engineering

Course Code:	UMEMN0761	**L**	**T**	**P**	**Credit**
Course Name:	Energy Storage System	**2**			**2**
Course Pre-Requsites:	Basic knowledge of thermodynamics, Heat Transfer and Material Science.				
Course Description:	This course provides a comprehensive overview of various energy storage technologies, focusing on their principles, applications, and performance characteristics. It covers electrical, thermal, mechanical, and chemical energy storage systems, emphasizing their role in sustainable energy systems.				

Course Learning Objectives:

CLO1	To provide a fundamental understanding of the necessity and technical parameters of diverse energy storage technologies.
CLO2	To impart knowledge on the working principles and design parameters of mechanical and thermal energy storage systems.
CLO3	To familiarize students with electrochemical storage, specifically battery chemistries and fuel cell technologies used in electric vehicles.
CLO4	To enable students to analyze the integration of energy storage with renewable energy sources and its economic feasibility.

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

COs	**CO Statement**	**Blooms Level**	**Descriptor**
CO1	Classify various energy storage systems and compare the functionality of different type of energy storage system.	II	Understand
CO2	Explain the operational mechanisms of thermal and mechanical storage systems.	II	Understand
CO3	Students will be able to analyse the performance of different thermal energy storage systems.	IV	Analyze
CO4	Students will be able to select the appropriate energy storage solutions for renewable energy integration.	III	Apply

CO-PO Mapping:

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

Assessment Scheme:

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

Course Contents:

Unit No.	**Unit Content**	**No. of Lectures**
1	Introduction to Energy Storage: Basic requirement of energy storage, classification of energy storage systems, performance parameters, applications of energy storage. Energy storage and the smart grid. Environmental impacts of energy storage.	8
2	Mechanical and Thermal Energy Storage: Different types of Mechanical and Thermal Enegy Storage, Magnetic Energy Storage, Detailed study of Pumped Hydro Energy Storage, Compressed Air Energy Storage, Flywheels. Sensible and latent thermal Energy Storage system Phase Change Materials (PCM).	7
3	Electrochemical and Electrical Storage: Battery chemistries (Lead-acid, Li-ion, VRFB), Hydrogen Storage, Battery storage and Management System (BMS), Fuel cells and Capacitors: principles, types, performance characteristics, and applications. Hybrid energy storage systems, battery-supercapacitor.	7

4	Energy Storage System Integration and Applications: Integration of energy storage into renewable energy systems (solar, wind), energy storage for grid stabilization, microgrids, electric vehicles, and portable electronics, economic analysis of energy storage systems. Energy storage for off grid applications.	8

Text Books:

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

Reference Books:

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

Title of the Course: Mini project	**L**	**T**	**P**	**Credit**
Course Code: UMEHN0751	**-**	**-**	**2**	**1**

Course Pre-Requisite: Fundamentals of Robotics, Sensors, Motors, and Design, Basic fundamentals of Thermal &Manufacturing Processes.

Course Description:
Mini project aims to give exposure to the students to practical knowledge and real life problems

Course Objectives:
To understand the working of industry
To apply the theoretical knowledge to real life problems
To learn to prepare and present the report

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Cognitive**	
		level	**Descriptor**
CO1	**Explain** the need of various Sensors, actuators, Controllers and End effectors for the robots	II	Understand
CO2	**Use** the sensors, actuators Controllers and end effectors for the robot under considerations	III	Apply
CO3	**Compare** the results for the various actuator, sensors and controllers for the robot under considerations	IV	Analyze
CO4	**Classify** the various results of the robot under considerations	V	Evaluate
CO5	**Design and Develop** the Robotics systems for the problem under consideration	VI	Create

CO-PO Mapping:

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

Assessments :
Teacher Assessment:

ESE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.
ESE(O.E) : a) Submission of dissertation report
b) Viva-voce of project

Assessment	Marks
ESE(O.E)	100

Course Contents:

1. Students can preferably identify a problem
2. Fabrication of product/ testing setup of an experimentation unit/ apparatus/ small equipment, in a group.
3. Experimental verification of principles used in Mechanical Engineering Applications.
4. Critical analysis of any design or process for optimizing the same.
5. Software development for particular applications. The subject content of the mini project shall be from emerging/ thrust areas, topics of current relevance. The completion of work, the submission of the report and assessment should be done at the end of Part-I (Semester I only).
6. Mini project diary shall be maintained by each group. Students shall be evaluated for the Mini project at the end of VII th semester.
7. Students are expected to use any programming language for coding.

Report Format:

Report should be of 30 to 50 pages (typed on A4 size sheets).

a) For standardization of the Project reports the following format should be strictly followed.
b) Page Size: Trimmed A4
c) Top Margin: 1.00 Inch
d) Bottom Margin: 1.32 Inches
e) Left Margin: 1.5 Inches
f) Right Margin: 1.0 Inch
g) Para Text: Times New Roman 12 Point. Font
h) Line Spacing: 1.5 Lines
i) Page Numbers: Right Aligned at Footer. Font 12 Point. Times New Roman
j) Headings: Times New Roman, 14 Point, Bold Face

Certificate: All students should attach standard format of Certificate as Described by the department. Certificate should be awarded to batch and not to individual student.

Index of Report:

I. Certificate should have signatures of Guide, Head of Department and Principal/Director
II. Title Sheet
III. Certificate
IV. Acknowledgement
V. Table of Contents.
VI. List of Figures
VII. List of Tables
VIII. References: References should have the following format For Books: "Title of Book", Authors, Publisher, and Edition