D.K.T.E. Society's
Textile and Engineering Institute, Rajwada, Ichalkaranji- 416115

(An Empowered Autonomous Institute Affiliated to Shivaji University, Kolhapur)

NAAC Accredited with A+ Grade, ISO 9001:2015 Certified

DEPARTMENT: Mechanical Engineering

CURRICULUM

Minor in "Industrial Automation"

With effect from 2024-25

BOS Chairman   **Dean Academics**   **Director**

D.K.T.E Society's Textile and Engineering Institute, Ichalkaranji

(An Empowered Autonomous Institute Affiliated to Shivaji University, Kolhapur)

Teaching and Evaluation Scheme for Minor in "Industrial Automation"

Sr. No.	Course Code	Course Title	Semester	Teaching Scheme L	T	P	Contact Hrs/wk	Course Credits	Theory CIE SE-I	SE-II	SEE	Practical CIE	SEE	Total
01	01MEMDL2201	Introduction to Automation	III	2			2	2	25	25	50			100
02	01MEMDP2202	Introduction to Automation Lab	III			2	2	1				50		50
03	01MEMDL2203	Mechatronics	IV	2			2	2	25	25	50			100
04	01MEMDP2204	Mechatronics Lab	IV			2	2	1				50		50
05	01MEMDL2301	Industrial Robotics	V	2			2	2	25	25	50			100
06	01MEMDP2302	Industrial Robotics Lab	V			2	2	1				50		50
07	01MEMDL2303	Control Systems	VI	2			2	2	25	25	50			100
08	01MEMDP2304	Control Systems Lab	VI			2	2	1				50		50
09	01MEMDP2401	Capstone Project	VII			4	4	2				50		50
		Total		8		12	20	14	100	100	200	250		650

L- Lecture   T-Tutorial   P-Practical   SE-I: Semester Examination-I   SE-II: Semester Examination-II
CIE – Continuous in Semester Evaluation   SEE- Semester End Examination

Second Year B. Tech. (Mechanical) (Semester–III)							
Course Code	**01MEMDL2201**		**Course Name**	**Introduction to Automation**			
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
2			2		25	25	50

Course Objectives:

01	To introduce students to automation and basic elements of automated systems.
02	To provide students with knowledge of levels of automation, transfer lines and automated material handling systems.
03	To explain the fundamentals of industrial controllers and sensors used in automation system.
04	To introduce students to various applications of industrial automation in Industrial field.

Course Outcomes:

At the end of the course, students will be able to

01	Students will able to Describe and discuss concepts related to automation, industrial control, PLC, sensors, etc.
02	Students will able to select the appropriate components of automation for the given system.
03	Students will able to select actuators and mechanisms for a given Industrial application for automation.
04	Students will able to analyze the problems with traditional system and suggest solution for the given application for implementation of automation.

Course Contents

Unit I	**< Introduction to Automation >**	**4 Hours**

Basic hydraulics and pneumatics system, Definition of Automation, Automated manufacturing systems, Types of Automation – Fixed/programmable/ flexible, Need of automation, Basic elements of automated systems

Unit II	**< Actuators and mechanisms >**	**4 Hours**

Mechanical Actuation System, Hydraulic & Pneumatic Actuation System, Electrical Actuation System-I, Electrical Actuation System-II, Data Presentation system

Unit III	**< Transfer Lines >**	**4 Hours**

Fundamentals of transfer lines, Configurations, Transfer mechanisms, Applications, System configurations for automated production lines.

Unit IV	**< Automated Material Handling Systems >**	**5 Hours**

Definition and objectives of material handling, Principles, Symptoms of bad material handling, Selection of material handling equipment, Automated Guided Vehicle, Types, Advantages and Limitations, Applications, Introduction to Automated Storage and Retrieval System.

Unit V	**< Industrial Control >**	**5 Hours**

Industrial control systems in process and discrete manufacturing industries, Continuous and discrete control; Computer process control

Unit VI	**< Applications of Industrial Automation in Industry >**	**4 Hours**

Basic Components, Applications, Case studies related to the Automation.

Texts Books:

1	"Automation, Production Systems and Computer Integrated Manufacturing", Groover, M.P., Pearson Education, ISBN: 81-7808-511-9 2nd Edition (2004)

Reference Books:

1	A textbook on Industrial Robotics by Ganesh Hegde, Laxmi Publication
2	Robotic Engineering: An Integrated Approach by Klafter Richard D., Chmielewski Thomas A., Negin Michael, PHL Publications
3	"Mechatronics", W. Bolton, Third Edition, Pearson Education

Supplementary Readings:

Links:

1. https://nptel.ac.in/courses/108105063
2. https://www.youtube.com/watch?v=t6ppwWZUSEc
3. https://archive.nptel.ac.in/courses/112/107/112107298/

Second Year B. Tech. (Mechanical) (Semester–III)					
Course Code	**01MEMDP2202**	**Course Name**	**Introduction to Automation Lab**		
Teaching Scheme				**Evaluation Scheme**	
L	T	P	Credits	**CIE Marks**	**SEE Marks**
--	--	2	1	50	---

Course Objectives:

01	To introduce students to automation and basic elements of automated systems.
02	To provide students with knowledge of levels of automation, transfer lines and automated material handling systems.
03	To explain the fundamentals of industrial controllers and sensors used in automation system.
04	To introduce students to various applications of industrial automation in Industrial field.

Course Outcomes:

At the end of the course, students will be able to

01	Students will able to Describe and discuss concepts related to automation, industrial control, PLC, sensors, etc.
02	Students will able to select the appropriate components of automation for the given system.
03	Students will able to select actuators and mechanisms for a given Industrial application for automation.
04	Students will able to analyze the problems with traditional system and suggest solution for the given application for implementation of automation.

List of Experiments	
1	Study of Automation.
2	Case study on Automation
3	Study of Actuators and mechanisms.
4	Case study on Actuators and mechanisms.
5	Study of Transfer Lines.
6	Case study on Transfer Lines.
7	Study of Automated Material Handling Systems.
8	Case study on Automated Material Handling Systems.
9	Study of Industrial Control.
10	Case study on Industrial Control.
11	Case study on the different applications of Automation in Industry.

Texts Books:

1	"Automation, Production Systems and Computer Integrated Manufacturing", Groover, M.P., Pearson Education, ISBN: 81-7808-511-9 2nd Edition (2004)

Reference Books:

1	A textbook on Industrial Robotics by Ganesh Hegde, Laxmi Publication
2	Robotic Engineering: An Integrated Approach by Klafter Richard D., Chmielewski Thomas A., Negin Michael, PHL Publications
3	"Mechatronics", W. Bolton, Third Edition, Pearson Education

Supplementary Readings:

Links:
1. https://nptel.ac.in/courses/108105063
2. https://www.youtube.com/watch?v=t6ppwWZUSEc
3. https://archive.nptel.ac.in/courses/112/107/112107298/

Second Year B. Tech. (Mechanical) (Semester–IV)							
Course Code	**01MEMDL2203**		**Course Name**	**Mechatronics**			

Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
2			2		25	25	50

Course Objectives:

01	To introduce students to various concepts of Mechatronics and the integration of different branches of engineering in Mechatronics.
02	to make students aware of the recent trends and practices in Mechatronics in manufacturing and service sector for productivity improvement and cost, time and human intervention reduction and comparison with equivalent traditional systems.

Course Outcomes:

At the end of the course, students will be able to

01	Demonstrate multidisciplinary scenario of Mechatronics along with basic elements and terms associated.
02	Describe sensors, digital circuits and signal conditioning.
03	Distinguish between traditional and mechatronics system and appreciate the current advances in Mechatronics.

Course Contents		
Unit I	**< Introduction to Mechatronics >**	**4 Hours**
Introduction to Mechatronics: What is Mechatronics, Advantages, Limitations and Applications, Mechatronics systems, Measurement systems, Control systems, Multidisciplinary scenario, Case studies of Mechatronics systems like pick and place manipulator, handling system, bathroom scales, DSLR, etc.		
Unit II	**< Digital Logic and Fluid Power >**	**4 Hours**
Introduction to Digital logic, Number systems, Logic gates, Applications of logic gates, Boolean Algebra, Introduction to hydraulics and pneumatics, Structure, Advantages and limitations, ISO symbols, Basic components, Applications.		
Unit III	**< Sensors in Mechatronics >**	**6 Hours**
Sensor definition and classification, Performance Terminology, Reed switch, Inductive proximity sensors, Limit valves and pneumatic sensors, Incremental & absolute encoders, Tactile sensor, Potentiometer, LVDT, Capacitive sensors, Hall Effect sensor, Temperature sensors, Selection of sensors.		
Unit IV	**< Signal Conditioning >**	**4 Hours**
Signal conditioning process, Operational amplifier (inverting amplifier, non-inverting amplifier, summing, integrating amplifier), Protection, Filter, Multiplexer		
Unit V	**< ADC, DAC and Interfacing >**	**4 Hours**
Analog to Digital converter (ADC), Digital to Analog converter (DAC), Sample and hold, Interfacing input output ports, Interfacing requirements, buffer, handshaking, polling and interrupts.		
Unit VI	**< Current Advances in Mechatronics >**	**4 Hours**

Traditional Vs Mechatronics Design, Industry 4.0 – Definition, evolution, advantages and limitations, Industry 4.0 Technologies – Internet of Things and Cyber Physical System, Artificial Intelligence, Machine Learning and Big Data

Texts Books:	
1	Mechatronics, Venkatesh Naik, Sunstar Publisher, 2021
2	N.C.Braga, Mechatronics Source Book, Cengage Learning
3	Mechatronics: Integrated Mechanical Electronic System, Ramchandran Willey India

Reference Books:	
1	Mechatronics, W. Bolton, 6th Edition, Pearson Education, 2015, ISBN: 978-1-292-07668-3
2	Mechatronics, N. P. Mahalik, TATA McGraw Hill Edu, 2017, ISBN: 978-0070483743
3	Hydraulics and Pneumatics, Andrw Parr, Jaico Publication House, ISBN: 978-8172241896
4	Quick Start Guide to Industry 4.0: One-stop reference guide for Industry 4.0, Kiran Kumar Pabbathi, Create space Independent Publishing Platform, May 2018, ISBN-10 : 1718978618

Supplementary Readings:

Useful Links:

1. https://www.youtube.com/watch?v=XlJJHyz_ZG8

2. https://www.youtube.com/watch?v=PsBmuR33sMo

3. https://www.youtube.com/watch?v=NjYTzvAVozo

4. https://www.youtube.com/watch?v=TAIYC058w&list=PL_hQO2hWfeKOp7v00Vl7dsIn2sAS5b9P5

Second Year B. Tech. (Mechanical) (Semester–IV)						
Course Code	**01MEMDP2204**		**Course Name**	**Mechatronics Lab**		

Teaching Scheme					Evaluation Scheme	
L	T	P	Credits		CIE Marks	SEE Marks
--	--	2	1		50	---

Course Objectives:

01	To introduce students to various concepts of Mechatronics and the integration of different branches of engineering in Mechatronics.
02	To make students aware of the recent trends and practices in Mechatronics in manufacturing and service sector for productivity improvement and cost, time and human intervention reduction and comparison with equivalent traditional systems

Course Outcomes:

At the end of the course, students will be able to

01	Demonstrate multidisciplinary scenario of Mechatronics along with basic elements and terms associated.
02	Describe sensors, digital circuits and signal conditioning.
03	Distinguish between traditional and mechatronics system and appreciate the current advances in Mechatronics.

List of Experiments	
1	Assignment on Mechatronics systems and case studies
2	Assignment on Digital Logic
3	Introduction to fluid power systems
4	Introduction to sensors and sensor applications
5	Assignment on signal conditioning
6	Assignment on Industry 4.0 Technologies – IoT and CPS.
7	Assignment on AI and ML applications in engineering.
8	Industrial visit.

Texts Books:

1	Mechatronics, Venkatesh Naik, Sunstar Publisher, 2021
2	N.C.Braga, Mechatronics Source Book, Cengage Learning
3	Mechatronics: Integrated Mechanical Electronic System, Ramchandran Willey India

Reference Books:

1	Mechatronics, W. Bolton, 6th Edition, Pearson Education, 2015, ISBN: 978-1-292-07668-3
2	Mechatronics, N. P. Mahalik, TATA McGraw Hill Edu, 2017, ISBN: 978-0070483743
3	Hydraulics and Pneumatics, Andrw Parr, Jaico Publication House, ISBN: 978-8172241896
4	Quick Start Guide to Industry 4.0: One-stop reference guide for Industry 4.0, Kiran Kumar Pabbathi, Create space Independent Publishing Platform, May 2018, ISBN-10 : 1718978618

Second Year B. Tech. (Mechanical) (Semester–V)							
Course Code	**01MEMDL2301**		**Course Name**		**Industrial Robotics**		
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
2			2		25	25	50

Course Objectives:

01	To familiarize robot structures and their workspace and distinguish between different drives.
02	To develop skills in performing kinematic analysis of robot manipulator.
03	To develop knowledge in the Industrial applications of robots.
04	To understand Robot Programming and Modern Robotics.

Course Outcomes:

At the end of the course, students will be able to

01	Identify the components of a robot and distinguish the types of robot configurations
02	Compare and choose drives and grippers for robots.
03	Construct a kinematic model of a manipulator.
04	Understand modern approaches and the basic programming for Robotics.

Course Contents

Unit I	< Fundamentals of Industrial Robots >	4 Hours

Specifications, Robot Anatomy, Criteria for selection, Robotic Control Systems: Drives, Robot Motions, Joint notation scheme, Selection guidelines for typical application, Robot related terminology like Stability, Resolution, Spatial resolution, Accuracy, Repeatability, Compliance.

Unit II	< Robotic Grippers >	6 Hours

Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations, Force analysis of gripper mechanism, Problems on gripper selection.

Unit III	< Robot Kinematics >	4 Hours

Forward Kinematics; Inverse Kinematics and Differences, Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional).

Unit IV	< Drives and Control for Robotics >	4 Hours

Drive - Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system. Control Systems: Types of Controllers, Introduction to closed loop control.

Unit V	< Robot Programming >	4 Hours

Programming approaches for robot, robot programming basics for simple tasks like Pick and place, Sorting, Palletizing and De-palletizing.

Unit VI	< Modern Robotics >	4 Hours

Introduction to modern mobile robots, Swarm robots, Mobile manipulators, Autonomous mobile robots, Need and application of AI, New trends & recent updates in robotics.

Texts Books:

1	"Automation, Production Systems and Computer Integrated Manufacturing", Groover, M.P., Pearson Education, ISBN: 81-7808-511-9 2nd Edition (2004)

Reference Books:

1	"Industrial Robotics, Technology, Programming and Applications", Groover, M.P.; Weiss, M.; Nagel, R.N. and Odrey, N.G., McGraw Hill Intl. Edition., ISBN: 0-07-024989-X
2	"Mechatronics", W. Bolton, Third Edition, Pearson Education
3	Robot Technology Fundamentals", Keramas, James G, Thomson Learning –Delmar ISBN: 981-240-621-2,(1998)

Supplementary Readings:

Links:
1. https://archive.nptel.ac.in/courses/112/105/112105249/
2. https://www.youtube.com/watch?v=rbki4HR41-4
3. https://www.youtube.com/watch?v=Lm2vDuL_gys

Second Year B. Tech. (Mechanical) (Semester–V)						
Course Code	**01MEMDP2302**		**Course Name**		**Industrial Robotics Lab**	
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
--	--	2	1		50	---

Course Objectives:

01	To familiarize robot structures and their workspace and distinguish between different drives.
02	To develop skills in performing kinematic analysis of robot manipulator.
03	To develop knowledge in the Industrial applications of robots.
04	To understand Robot Programming and Modern Robotics.

Course Outcomes:

At the end of the course, students will be able to

01	Identify the components of a robot and distinguish the types of robot configurations
02	Compare and choose drives and grippers for robots.
03	Construct a kinematic model of a manipulator.
04	Understand modern approaches and the basic programming for Robotics.

List of Experiments	
1	Assignment on Industrial Robots.
2	Assignment on Robotic Grippers.
3	Assignment on Robotic Grippers problems.
4	Assignment on Robot kinematics.
5	Assignment on Drives and Control for Robotics.
6	Robot Programming Exercises.
7	Robot Programming Exercises.
8	Robot Programming Exercises.
9	Robot Programming Exercises.
10	Assignment on Modern Robotics.

Texts Books:

1	"Automation, Production Systems and Computer Integrated Manufacturing", Groover, M.P., Pearson Education, ISBN: 81-7808-511-9 2nd Edition (2004)

Reference Books:

1	"Automation, Production Systems and Computer Integrated Manufacturing", Groover, M.P., Pearson Education, ISBN: 81-7808-511-9 2nd Edition (2004)
2	A textbook on Industrial Robotics by Ganesh Hegde, Laxmi Publication
3	Robotic Engineering: An Integrated Approach by Klafter Richard D., Chmielewski Thomas A., Negin Michael, PHL Publications
4	"Mechatronics", W. Bolton, Third Edition, Pearson Education

Supplementary Readings:

Links:

1. https://archive.nptel.ac.in/courses/112/105/112105249/
2. https://www.youtube.com/watch?v=rbki4HR41-4
3. https://www.youtube.com/watch?v=Lm2vDuL_gys

Second Year B. Tech. (Mechanical) (Semester–VI)							
Course Code	**01MEMDL2303**		**Course Name**		**Control Systems**		
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
2			2		25	25	50

Course Objectives:

01	To introduce students to various concepts of process control systems and amalgamation of different engineering branches in them.
02	To make students get introduced to and appreciate various controllers employed in process control.
03	To make students design, analyze, modify if required, validate and implement ladder programs using PLC for various real life problems.

Course Outcomes:

At the end of the course, students will be able to

01	Discuss process control system components, types, significance and applications.
02	Acknowledge and appreciate controllers preferred in process control systems.
03	Design and communicate automated solutions for economic, global and environmental problems for industries through selection of appropriate components and programming instructions.

Course Contents

Unit I	< Introduction to Process Control >	4 Hours

Introduction, Feedback control system, System representation, Modern control systems, Operational notations, Open Loop and Closed Loop, Applications of Automatic Control Systems.

Unit II	< Exploring Control Systems >	4 Hours

Classification of control systems on the basis of component type, System function and system performance, PID controller, Control system hardware, Advantages of advanced control systems.

Unit III	< Arduino >	4 Hours

Defining microcontroller and microprocessor, Difference, Arduino introduction, Arduino board types, Arduino hardware and software, Arduino troubleshooting, Applications of Arduino in engineering

Unit IV	< Raspberry Pi >	4 Hours

Introduction, Difference between Raspberry Pi and Arduino, Components of Raspberry Pi, Advantages and Limitations, Raspberry Pi Generations, Applications, Introduction to python – Advantages, Variables, Packages, Simple programming using python for Raspberry Pi

Unit V	< Introduction to PLC >	5 Hours

Introduction, Definition of PLC, PLC system components, Input-Output module, PLC advantages and disadvantages, Machine control terminology, Physical components Vs. Program components, Disagreement circuit, Majority circuit, Latching circuit, Fail safe circuit, PLC fault finding.

Unit VI	< PLC Programming >	5 Hours

Basic PLC components and other symbols, Fundamentals of ladder diagram, PLC input and output instructions, PLC timer functions – Types, Industrial applications, PLC control functions – Types, Industrial applications, Internal relays.

Texts Books:

1	Programmable logical controller, Hackworth & Hackworth, Pearson Education

2	Programmable logical controller, Reis Webb, Prentice Hall
3	Control System Engineering: R Anand Natarajan, P. Ramesh Babu, SciTech Publication
4	Handbooks for Arduino and Raspberry Pi

Reference Books:

1	Mechatronics, W. Bolton, 6th Edition, Pearson Education, 2015, ISBN: 978-1-292-07668-3
2	Automatic Control Engineering: F.H. Raven (5th ed.), Tata McGraw Hill Publication.
3	Automatic Control Systems: B.C. Kuo, 7thEd, Willey India Ltd. / Prentice Hall Publication
4	Raspberry Pi and Python, Hans-Petter Halvorsen, 2021, The Technical Guy (halvorsen.blog)
5	Exploring Arduino, Jeremy Blum, John Wiley & Sons, Inc., 2013, ISBN: 978-1-118-54936-0.

Supplementary Readings:

Useful links:

1.https://www.youtube.com/watch?v=wrrbXM1YYeQ&list=PLXbLuD5WNA3KlJR5YnO3PLnSetrVzLuSw

2. https://www.youtube.com/watch?v=VGNVFWheeI4

3. https://www.youtube.com/watch?v=s2AKMERnBhQ

4. https://www.youtube.com/watch?v=Y5NgUc_dxlA

Second Year B. Tech. (Mechanical) (Semester–VI)						
Course Code	**01MEMDP2304**		**Course Name**	**Control Systems Lab**		
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
--	--	2	1		50	---

Course Objectives:

01	To introduce students to various concepts of process control systems and amalgamation of different engineering branches in them.
02	To make students get introduced to and appreciate various controllers employed in process control.
03	To make students design, analyze, modify if required, validate and implement ladder programs using PLC for various real life problems.

Course Outcomes:

At the end of the course, students will be able to

01	Discuss process control system components, types, significance and applications.
02	Acknowledge and appreciate controllers preferred in process control systems.
03	Design and communicate automated solutions for economic, global and environmental problems for industries through selection of appropriate components and programming instructions.

List of Experiments	
1	Assignment on Process control
2	Assignment on Arduino
3	Assignment on Raspberry Pi
4	Introduction to PLC
5	PLC programming for simple process control
6	PLC programming based on timers
7	PLC programming based on counters
8	PLC programming using timers, counters and internal relays.

Texts Books:

1	Programmable logical controller, Hackworth & Hackworth, Pearson Education
2	Programmable logical controller, Reis Webb, Prentice Hall
3	Control System Engineering: R Anand Natarajan, P. Ramesh Babu, SciTech Publication
4	Handbooks for Arduino and Raspberry Pi

Reference Books:

1	Mechatronics, W. Bolton, 6th Edition, Pearson Education, 2015, ISBN: 978-1-292-07668-3
2	Automatic Control Engineering: F.H. Raven (5th ed.), Tata McGraw Hill Publication.
3	Automatic Control Systems: B.C. Kuo, 7thEd, Willey India Ltd. / Prentice Hall Publication
4	Raspberry Pi and Python, Hans-Petter Halvorsen, 2021, The Technical Guy (halvorsen.blog)
5	Exploring Arduino, Jeremy Blum, John Wiley & Sons, Inc., 2013, ISBN: 978-1-118-54936-0.

Supplementary Readings:

Useful links:
1.https://www.youtube.com/watch?v=wrrbXM1YYeQ&list=PLXbLuD5WNA3KlJR5YnO3PLnSetrVzLuSw
2. https://www.youtube.com/watch?v=VGNVFWheeI4
3. https://www.youtube.com/watch?v=s2AKMERnBhQ
4. https://www.youtube.com/watch?v=Y5NgUc_dxlA

D.K.T.E Society's Textile and Engineering Institute, Ichalkaranji
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Second Year B. Tech. (Mechanical) (Semester–VII)						
Course Code	**01MDMDP2401**		**Course Name**	**Capstone Project**		
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
		4	2		50	---

Course Objectives:

01	Apply engineering principles and methodologies to solve real-world problems.
02	Collaborate effectively in interdisciplinary teams.
03	Develop project management and time management skills.
04	Communicate technical ideas effectively through oral presentations and written reports.
05	Demonstrate creativity, innovation, and critical thinking in problem-solving.

Course Outcomes:

At the end of the course, students will be able to

01	Demonstrate the ability to apply engineering principles and methodologies to analyze real-world problems and propose innovative solutions.
02	Work effectively in interdisciplinary teams, demonstrating collaboration, leadership, and communication skills to achieve project objectives.
03	Demonstrate creativity, innovation, and critical thinking in problem-solving, exploring alternative solutions, and adapting strategies based on project constraints and feedback.
04	Conceptualize, design, and develop a prototype solution, applying engineering principles, and iterative design methodologies to address identified problems effectively.
05	Plan and conduct testing and validation procedures to assess the functionality, reliability, and performance of the project solution, iteratively refining the design based on feedback and testing results.