GANPAT UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

Programme	Mechatronics Engineering				
Semester	I		Version	1.0.0.0	
Effective from Academic Year	2025-26		Effective for the batch Admitted in	JULY 2025	
Subject code	1ES1109	Subject Name	Elements of Mechatronics Engineering		

I.TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Type	Course Code	Learning Scheme						Assessment Scheme										
		Actual Contact Hrs./Week			SLH	NLH	Credits	Theory				Practical				Based on SL		Total Marks
		CL	TL	LL				FA-TH	SA-TH	TOTAL		FA-PR	SA-PR	TOTAL		SLA		
								MAX	MAX	MAX	MIN	MAX	MAX	MAX	MIN	MAX	MIN	
DSC	1ES1109	2	-	2	-	4	2	40	60	100	40	30	20	50	20	-	-	150

Abbreviation:	**CL-** Classroom Learning	**TL -** Tutorial Learning	**LL -** Laboratory Learning
	SLH - Self Learning Hours	**NLH -** Notional Learning Hours	**SLA -** Self Learning Assessment
	FA - Formative Assessment (Term work +Mid Sem Exam +Attendance)		**SA -** Summative Assessment

II. PRE-REQUISITES

Zeal to learn.

III. INDUSTRY / EMPLOYER EXPECTED OUTCOMES

1. Understand basic mechatronic system components and their functions.
2. Operate simple sensors, actuators, and control devices.
3. Assist in basic troubleshooting of mechatronic equipment.

IV. COURSE LEARNING OUTCOMES

At the end of the course, students will be able to achieve the following course learning outcomes:

CO1: Understand basic mechatronic systems and their components.

CO2: Identify and explain the working of common sensors and transducers.

CO3: Describe types of actuators and their applications, including mechanical, electrical, pneumatic, and hydraulic.

CO4: Understand PLC structure and write simple ladder logic.

CO5: Recognize emerging trends and perform basic system integration using sensors and controllers.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Name of Unit	Theory Learning outcomes (TLO's) aligned to CO's	Learning Content mapped with Theory Learning outcomes (TLO's) & CO's	Marks	Hours
Unit-1: Introduction to Mechatronic Systems	**TLO 1.1** Define mechatronics and explain its multidisciplinary scope in engineering. **TLO 1.2** List and explain the advantages and limitations of mechatronic systems. **TLO 1.3** Identify and describe real-world industrial applications of mechatronics. **TLO 1.4** Interpret and explain the block diagram of a basic mechatronic system. **TLO 1.5** Identify major components of a mechatronic	**1.1** Definition and Scope of Mechatronics **1.2** Advantages & Disadvantages of Mechatronics **1.3** Applications of Mechatronics in Modern Industry **1.4** Mechatronics Block Diagram and Explanation **1.5** Mechatronics Components and Integration **1.6** Mechatronics Relevance in Industry 4.0 and IoT	12	6

	system and explain their integration. **TLO 1.6** Explain the significance of Industry 4.0 and IoT in the evolution of mechatronic systems.			
Unit-2: Basic Sensors and Transducers	**TLO 2.1** Classify and explain types of sensors and transducers. **TLO 2.2** Identify common sensors used in automation. **TLO 2.3** Explain working principles of selected sensors.	**2.1** Definition of sensors and transducers. **2.2** Classification: contact & non-contact. **2.3** Types: LVDT, Potentiometer, Proximity, Thermistor, Hall effect, LDR, etc.	12	6
Unit-3: Actuators – Mechanical, Electrical, Pneumatic & Hydraulic	**TLO 3.1** Identify different types of actuators. **TLO 3.2** Analyse the role of gears, cams, and linkages. **TLO 3.3** Compare NC, CNC, and DNC systems. **TLO 3.4** Select suitable actuator for application.	**3.1** Mechanical: gears (spur, bevel), cams, linkages. **3.2** Electrical: DC, AC, stepper, servo motors. 3.3 Pneumatic: air cylinders. **3.4** Hydraulic: piston-cylinder system. 3.5 NC, CNC, DNC.	14	8
Unit-4: Programmable Logic Controllers (PLC)	**TLO 4.1** Explain PLC structure and operation. **TLO 4.2** Create basic PLC logic. **TLO 4.3** Apply PLC in automation examples. **TLO 4.4** Know the application of PLC.	**4.1** PLC block diagram and working. **4.2** I/O, memory, processor. **4.3** Ladder logic: AND, OR, NOT, Timers, Counters. **4.4** Applications: Water level, Timer based one application.	12	6
Unit-5: Integration and Emerging Technologies	**TLO 5.1** Describe current trends in Mechatronics. **TLO 5.2** Identify basics of IoT and embedded systems. **TLO 5.3** List steps for simple system integration. **TLO 5.4** Able to build mini-Project with Arduino.	**5.1** IoT, AI, embedded systems (basic concepts). **5.2** Arduino, Raspberry Pi – basic role. **5.3** Project integration concept (sensor + controller + actuator). **5.4** Mini project planning.	10	4

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL

Sr. No.	Practical/Laboratory Learning Outcome (LLO)	Practical Titles	Relevant COs
1	**LLO 1.1** Identify mechatronic system components.	Identification of sensors, actuators, controllers.	CO1
2	**LLO 2.1** Observe and explain sensor outputs.	Testing of LVDT, proximity sensor, thermistor.	CO2

3	**LLO 2.2** Measure physical quantities using sensors.	Displacement & temperature sensor interfacing.	CO2
4	**LLO 3.1** Demonstrate mechanical actuators.	Model of gear mechanism, cam-follower.	CO3
5	**LLO 3.2** Test electrical actuators.	Operation of DC motor, stepper motor.	CO3
6	**LLO 3.3** Demonstrate pneumatic and hydraulic systems.	Air cylinder and hydraulic piston operation.	CO3
7	**LLO 4.1** Simulate simple ladder logic.	PLC programming using simulation tools.	CO4
8	**LLO 4.2** Apply PLC to small automation task.	Create a program for bottle filling/traffic light.	CO4
9	**LLO 5.1** Integrate sensors and actuators.	Mini integration using Arduino or PLC.	CO5

VII. SUGGESTED MICRO PROJECT / ASSIGNMENTS / ACTIVITIES FOR SELF LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

VIII. LIST OF INSTRUMENTS / EQUIPMENT / TRAINER BOARD

1.	Mechatronics Trainer Kit (includes basic sensors, actuators, PLC modules)
2.	Basic Sensors Set (LVDT, Potentiometer, Proximity Sensors, Thermistor, Hall Effect Sensor, LDR)
3.	Mechanical Actuators Set (Gears, Cams, Linkages)
4.	Electrical Motors (DC Motor, AC Motor, Stepper Motor, Servo Motor)
5.	Pneumatic Actuator Trainer (Air Cylinder and Valve Setup)
6.	Hydraulic Actuator Trainer (Piston-Cylinder System)
7.	PLC Trainer Board with I/O Modules and Programming Software
8.	Arduino / Raspberry Pi Starter Kit with Sensor and Actuator Modules
9.	Signal Conditioning Trainer Kit (Amplifiers, Filters, Converters)
10.	DC Regulated Power Supply, Multimeter, CRO (Cathode Ray Oscilloscope) or DSO (Digital Storage Oscilloscope)

IX. LIST OF REFERENCE BOOKS

Sr.No.	Title	Author	Publication
1.	Mechatronics: Principles and Applications	Godfrey C. Onwubolu	Elsevier
2.	Introduction to Mechatronics and Measurement Systems	David G. Alciatore, Michael B. Histand	McGraw-Hill
3.	Sensors and Transducers	D. Patranabis	Prentice Hall India
4.	Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering	W. Bolton	Pearson Education
5.	Programmable Logic Controllers (PLC)	W. Bolton	Newnes
6.	Industrial Automation and Control	Frank D. Petruzella	McGraw-Hill
7.	Fundamentals of Pneumatics and Hydraulics	Majumdar	McGraw-Hill
8.	Arduino Projects for Beginners	John Baichtal	Apress

X. LINK OF LEARNING WEB RESOURCE	
1.	NPTEL - Basic Electronics (IIT Kharagpur) — Fundamental concepts of electronics and introduction to mechatronics.
2.	Industry 4.0 Concepts – YouTube — Videos explaining Industry 4.0 basics and automation trends.
3.	Electronics Tutorials - Sensors — Overview of sensor types, working principles, and applications.
4.	YouTube - Working of PN Junction Diode — Detailed explanation of PN junction diode operation for sensor basics.
5.	CircuitBread Tutorials — Beginner-friendly lessons on electronic components and ICs.
6.	YouTube - Actuators Explained — Videos covering different types of actuators used in mechatronics.
7.	NPTEL - Pneumatics and Hydraulics Lectures — Basic course on pneumatic and hydraulic actuator systems.
8.	PLC Basics - YouTube Playlist — Tutorials on PLC structure, ladder logic programming, and applications.
9.	NPTEL - Automation and Control Systems — Course on automation, control systems, and PLC fundamentals.
10.	IoT and Embedded Systems - NPTEL — Introduction to IoT concepts and embedded system basics.
11.	Arduino Basics Tutorials — Official Arduino tutorials for beginners to learn microcontroller programming.
12.	Raspberry Pi for Beginners - YouTube — Introductory videos on Raspberry Pi hardware and projects.

XI. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	Introduction to Mechatronics	CO1	10	5	5	2	12
2	Basic Sensors & Transducers	CO2	08	4	5	3	12
3	Actuators	CO3	10	5	6	3	14
4	PLCs	CO4	08	4	5	3	12
5	Emerging Technologies	CO5	04	2	3	5	10
		Grand Total	40	20	24	16	60

XII. COs AND POs AND PSOs MAPPING

Course outcome (Cos)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	2	3	2	2
CO2	3	3	2	3	1	2	2	3	3	2
CO3	3	3	3	3	1	2	2	3	3	2
CO4	3	3	3	3	1	3	2	3	3	3
CO5	3	2	2	3	2	3	3	3	3	3

Legends: - 3- High 2-Moderate/Medium 1-Slight/Low 0-None