

# GUJARAT TECHNOLOGICAL UNIVERSITY

## MECHANICAL (CAD/CAM) (08)/ MECHANICAL (MACHINE DESIGN) (09)

MECHATRONICS

SUBJECT CODE: 2710809

M.E. 1<sup>ST</sup> SEMESTER

**Type of course:** Engineering Science

**Prerequisite:** Zeal to learn the subject

**Rationale:** This syllabus is formed to create knowledge in Mechatronic systems and impart the source of concepts and techniques, which have recently been applied in practical situation. It gives a framework of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	PA (V)		PA (I)			
					ESE	OEP	PA	RP		
4	0	2	5	70	30	20	10	20	0	150

**Content:**

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	<b>Introduction:</b> Introduction to Mechatronics, need and applications, elements of mechatronic systems, role of mechatronics in automation, manufacturing and product development.	4	10
2	<b>Sensors and Feedback Devices:</b> Importance of sensors in Mechatronics, Static and Dynamic characteristics of sensors, errors and output impedance of sensors, transducers for measurement of displacement, strain, position, velocity, noise, flow, pressure, temperature, humidity, vibration, liquid level, vision sensors.	12	20
3	<b>Control Elements and Actuators:</b> On/off push buttons, control relays, thermal over load relays, contactors, selector switches, solid state switches. Mechanical actuators – types of motion, gear trains, belt and chain drives, screw rods, Electrical actuators, solenoids, DC drives and AC variable frequency drives, AC and DC motors, servomotors, stepper motors, linear motors. Hydraulic and Pneumatic controls, functional diagram - control valves, cylinders and hydro motors.	12	20
4	<b>Computational Elements and Controllers:</b> Basic concepts of control systems – open loop, closed loop, semi closed loop control system, block and functional diagrams controllers for robotics and CNC, linear and rotary encoders, timers, counters, microprocessors and microcontrollers: architecture and pin details, introduction to PLC, simple programs for process control application based on relay ladder logic-Supervisory Control and Data Acquisition Systems (SCADA) and Human Machine Interface (HMI).	12	20
5	<b>Interfacing System:</b> Introduction to interfacing of different hard wares in industry, need for	06	15

	networks in industrial plants, hierarchy and structure of networking, RS 232 based network, Ethernet, TCP/IP, MAP/TOP.		
6	<b>Applications of Mechatronic Systems:</b> Introduction to factory automation and integration, design of simple Mechatronics systems, Case studies based on the application of mechatronics like Pick and place Robot, Conveyor based material handling system, Mechatronics Control in automated Manufacturing, Data Acquisition, autotronics, bionics and avionics.	07	15

### Reference Books:

1. Introduction to Mechatronics Appu Kuttan K.K.Oxford University Press
2. Mechatronics: Integrated Mechanical Electronic Systems Ramchandran K P, Vijayaraghavan G K, Balasundaram, M S.Wiley India.
3. Measurement Systems Design and applications Doebelin E.O., McGraw Hill
4. Mechatronics : Principle, Concepts and Applications Mahalik N.P. McGraw Hill.
5. Fundamentals of Programmable Logic Controllers, Sensors and Communications Jon Stenersons Prentice Hall, 2004.
6. Mechatronics Bolton W. Pearson Education.
7. Computer Control of Manufacturing Systems Yorem Koren McGraw Hill.
8. Introduction to Mechatronic Design J E Carryer, R M Ohline and T W Kenny Pearson

### List of Experiments:

Experiments should be designed to include the contents of the syllabus. The experiments may also include simulation using Matlab or equivalent platform.

1. Control the single acting and double acting cylinders using pilot valves.
2. Continuous reciprocating of single acting and double acting cylinder using pilot valves.
3. Design a pneumatic circuit for sequencing.
4. Actuation of single acting cylinder using ON and OFF delay timer.
5. Servo motor control using open loop and close loop system.
6. Run the stepper motor at different speed and different direction.
7. PLC control of sequencing circuit using PLC ladder diagram.

### Open Ended Problems:

1. Design and Simulate Hydraulic circuit for Excavator (3 - Cylinders).
2. Design Circuit for LIFT using PLC.
3. Control the rotational movement of Windmill using stepper motor

### Course Outcome:

After learning the course the students should be able to

1. Students would understand be able to apply fundamentals of mechatronics for various mechanical systems.
2. Students would be able to use various types of sensors and controllers.
3. Students would be able to analyse hydraulic and pneumatic systems.