BASICS OF MECHATRONICS **Course Code : 314017**

Programme Name/s : **Mechanical Engineering**
Programme Code : **ME**
Semester : **Fourth**
Course Title : **BASICS OF MECHATRONICS**
Course Code : **314017**

I. RATIONALE

Mechanical diploma engineer has to work on various multidisciplinary systems under the umbrella of Mechatronics. The goal of the course is to develop an understanding of basic elements underlying mechatronics systems viz. sensors, actuators, PLC, and control software etc.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Use appropriate sensors, actuators and controller for given mechatronics system(s).

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Identify basic elements of mechatronics system such as sensors, actuators, controllers etc.
- CO2 - Use sensors for different mechatronics systems
- CO3 - Use actuators for different mechatronics systems
- CO4 - Develop PLC program for various mechatronics systems
- CO5 - Use microcontroller for different mechatronics systems

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314017	BASICS OF MECHATRONICS	BOM	AEC	-	-	2	-	2	1	-	-	-	-	-	25	10	25@	10	-	-	50

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Compare traditional system and mechatronics systems with the help of block diagram TLO 1.2 Identify sensor, actuators in the given diagram of the mechatronic system with justification	**Unit - I Fundamental of Mechatronics** 1.1 Introduction : Definition of Mechatronics, Mechatronics in Manufacturing products 1.2 Comparison between Traditional and Mechatronics approach 1.3 Block diagram representation of General Mechatronics system showing various components with suitable example	Chalk board Display charts
2	TLO 2.1 Explain the working of the given sensor TLO 2.2 Select the relevant sensor for the given application TLO 2.3 Differentiate between sensor and transducer TLO 2.4 Explain with sketches working principle of given type of thermal, optical, electric sensors	**Unit - II Sensors and Transducers** 2.1 Sensors and transducers: Definition, difference, classification 2.2 Thermal, optical, electric sensors 2.3 Transducers: Need of transducers, types of transducers: primary, secondary, active, passive, analog and Digital 2.4 Selection criteria of sensor and transducer	Demonstration of actual devices Chalk board NPTEL Video
3	TLO 3.1 Explain with sketches the working of the given Pneumatic actuator with sketch and block diagram TLO 3.2 Explain with sketches the working of the given Hydraulic actuator with sketch and block diagram TLO 3.3 Select the relevant actuator for the given application	**Unit - III Actuators** 3.1 Introduction and Classification of Actuators Need and Scope 3.2 Pneumatic Actuation system: Single and Double acting actuators 3.3 Hydraulic Actuation system: Single and Double acting actuators 3.4 Electric Actuation system: Solenoid, relay, stepper motors	Pneumatic trainer kit Hydraulic trainer kit Video Demonstrations Chalk board

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Explain with the block diagram working of PLC TLO 4.2 Select the PLC for the given application TLO 4.3 Write a simple program using ladder diagram for the given application	**Unit - IV Programmable Logic Controller (PLC)** 4.1 Introduction, definition, PLC block diagram, Manufacturers of PLC 4.2 Power supply, Input/output modules 4.3 Ladder logic symbols 4.4 Basic PLC Ladder logic programming, timers, counters	Chalk board Hands-on activity on PLC trainer kit
5	TLO 5.1 Explain the working of the given microcontroller with block diagrams TLO 5.2 Explain with the circuit diagram interfacing of stepper motor TLO 5.3 Explain with the circuit diagram interfacing of Relay	**Unit - V Microcontroller** 5.1 Comparison of Microprocessor and Microcontroller 5.2 Introduction, architecture, I/O ports 5.3 Interfacing of steeper motor, relay	Chalk board Video Demonstrations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify sensor, transducer and actuator	1	*Identification of Sensors, actuators available in the laboratory	2	CO1
LLO 2.1 Identify PLC and microcontroller	2	*Identification of PLC and microcontroller available in the laboratory	2	CO1
LLO 3.1 Develop ladder diagram for simple application using sensor and actuator LLO 3.2 Execute PLC program for simple application	3	*Development of Ladder diagram and program PLC for simple application using sensor and actuator	2	CO1 CO2 CO3 CO4
LLO 4.1 Develop ladder diagram for logic gates LLO 4.2 Execute PLC program for the logic gates	4	*Verification of Logic gate functions for the given Ladder diagram by using PLC	2	CO4
LLO 5.1 Develop ladder diagram for staircase lighting LLO 5.2 Execute PLC program for staircase lighting	5	Development of Ladder diagram and program PLC for two-way switch logic for staircase lighting	2	CO1 CO2 CO3
LLO 6.1 Develop ladder diagram for Timers and counters LLO 6.2 Execute PLC program for Timers and counters	6	*Development of Ladder diagram and program PLC for Timers and Counters	2	CO4
LLO 7.1 Develop ladder diagram for water level control LLO 7.2 Execute PLC program for water level control	7	Development of Ladder diagram and program PLC for water level control	2	CO1 CO2 CO3 CO4
LLO 8.1 Develop ladder diagram for pedestrian light on off control LLO 8.2 Execute PLC program for pedestrian light on off control	8	Development of Ladder diagram and program PLC for pedestrian light (green/red) toggle control	2	CO1 CO2 CO3 CO4

BASICS OF MECHATRONICS **Course Code : 314017**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 9.1 Develop ladder diagram for temperature control LLO 9.2 Execute PLC program for temperature control	9	*Development of Ladder diagram and program PLC for on/off temperature control	2	CO1 CO2 CO3 CO4
LLO 10.1 Develop ladder diagram for lift/elevator control LLO 10.2 Execute PLC program for lift/elevator control	10	Development of Ladder diagram and program PLC for lift/ elevator control	2	CO1 CO2 CO3 CO4
LLO 11.1 Develop ladder diagram for single acting/double acting pneumatic system LLO 11.2 Execute PLC program for single acting/double acting pneumatic system	11	Development of Ladder diagram and program PLC for single acting/double acting pneumatic system	2	CO1 CO2 CO3 CO4
LLO 12.1 Develop ladder diagram for single acting/double acting Hydraulic system LLO 12.2 Execute PLC program for single acting/double acting hydraulic system	12	Development of Ladder diagram and program PLC for single acting/double acting hydraulic system	2	CO1 CO2 CO3 CO4
LLO 13.1 Develop ladder diagram for door open and close system LLO 13.2 Execute PLC program for door open and close system	13	Development of Ladder diagram and program PLC for door open and close application	2	CO1 CO2 CO3 CO4
LLO 14.1 Develop ladder diagram for material rejection system LLO 14.2 Execute PLC program for material rejection system	14	*Development of Ladder diagram and program PLC for material rejection system	2	CO1 CO2 CO3 CO4
LLO 15.1 Develop 8051 microcontroller program for stepper motor control LLO 15.2 Execute 8051 microcontroller program for stepper motor	15	Development of 8051 microcontroller program for stepper motor control	2	CO1 CO2 CO5
LLO 16.1 Develop 8051 microcontroller program for relay interfacing LLO 16.2 Execute 8051 microcontroller program for relay interfacing	16	*Development of 8051 microcontroller program for relay interfacing	2	CO1 CO2 CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Basic Electro-Pneumatic trainer kit 1) Single acting and double acting pneumatic cylinder 2) Bore size: minimum 8 mm bore 3) Stroke: minimum 15 mm 4) Operating pressure: compressed air up to 4 bar pressure 5) Solenoid: 24V DC connected with trainer kit	11
2	Basic Electro-Hydraulic trainer kit 1) Single acting and double acting hydraulic cylinder 2) Bore size: minimum 12 mm bore 3) Stroke: minimum 40 mm 4) Operating pressure: up to 20 bar pressure5) Solenoid: 24V DC connected with trainer kit	12
3	Door open and close module Electro-pneumatic operated door open and close facility of sensing arrival and departure of person/object within particular distance from door (Pneumatic actuator type: Single/double acting pneumatic cylinder, Bore: 8 mm, Stroke: 15 mm, Medium: Compressed air up to 4 bar pressure, Solenoid valve: +24V DC)	13
4	Raw Material rejection module 1) Raw material rejection module with facility to detect, sort and reject the object 2) The module with IR sensor and Electro-pneumatic actuator controlled by PLC (Pneumatic actuator type: Single/double acting pneumatic cylinder, Bore: 8 mm, Stroke: 15 mm, Medium: Compressed air up to 4 bar pressure, Solenoid valve: +24V DC)	14
5	8051 microcontroller development board (Functional description and interfacing) 1) 16 x 2 characters LCD 2) Seven segment display 3) LED 4) Keypad 5) Steeper motor 6) Relay 7) facility for I/O port expansion	15,16
6	PLC trainer kit 1) Digital input and output: 12 Nos. with toggle switches for applying 24 V DC inputs and outputs 2) Analog input and output: 02 Nos. 3) External power supply: 24V DC	3,4,5,6,7,8,9,10,11,12,13,14
7	Desktop PC/Laptop with PLC software and I/O communication facility: Minimum System Requirements Intel Core i3,4GB RAM, 500 GB Hard Disk.	3,4,5,6,7,8,9,10,11,12,13,14,15,16
8	Tank Level Controller module: Water tank with ability to sense, indicate and control high and low level (Measuring water tank 1 no., Control panel enclosure: Metal frame with accessible front panel Push buttons red and green: 1 no. (each) Indicators red and green: 1 no. (each) Buzzer: 1 no, Manual drain valve: ½", Fluid solenoid valve: 1 no. Supply: 24V DC	7

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table) : NOT APPLICABLE

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Term work (Lab Manual)

Summative Assessment (Assessment of Learning)

- End semester practical examination

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	-	3	3	1	-	3			
CO2	3	-	2	2	1	-	2			
CO3	3	-	2	2	1	-	2			
CO4	3	-	2	2	1	-	2			
CO5	3	-	2	2	1	-	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Bolton, W	Mechatronics	Pearson Education, New Delhi, 2017, ISBN: 978-81-317-3253-3
2	Petruzella, F. D.	Programmable Logic Controllers	Tata McGraw Hill, New Delhi, 2024, ISBN: 978-0-07-337384-3
3	Ghosh, A. K.	Introduction to Instrumentation and Control	Prentice Hall of India, New Delhi, 2004, ISBN: 81-203-1626-6
4	Majumdar, S.R.	Pneumatics systems Principles and maintenance	Tata McGraw Hill, New Delhi,2013, ISBN: 978-0-07-463748-7
5	Majumdar, S.R.	Oil Hydraulic system- Principle and maintenance	Tata McGraw Hill, New Delhi,2013, ISBN: 978-0-07-463748-7
6	Rajput, R. K.	A Textbook of Mechatronics	S. Chand and Company New Delhi, 2022, ISBN: 978-81-219-2859-5

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=J_KoRp8SnoE&t=14s	Types of Sensors
2	https://www.youtube.com/watch?v=UrST-2yu8zQ	Lecture 1 : Introduction to Mechatronics (NPTEL course Mechatronics)
3	https://www.youtube.com/watch?v=YlmRa-9zDF8	Introduction to hydraulic system
4	https://www.youtube.com/watch?v=1lbdwPfFegY	Relay System
5	https://www.youtube.com/watch?v=5q7YasmwXCs&t=377s	Pneumatic Control : Festo Didactics

BASICS OF MECHATRONICS **Course Code : 314017**

Sr.No	Link / Portal	Description
6	https://www.youtube.com/watch?v=-MLGr1_Fw0c&t=121s	Working of Solenoid Valves - Basics actuator control valve working principle
7	https://www.youtube.com/watch?v=eyqwLiowZiU	Working of Stepper Motor work.
8	https://www.youtube.com/watch?v=qQoHQ0b-d1U	Tank Level Control with PLC ladder Logic animated PLC Programming tutorials for beginners

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students