AC – 20/5/2025
Item No. –6.57 (N) 4

As Per NEP 2020

University of Mumbai

Syllabus for MDM offered by Automation and Robotics Engineering Vertical – 2 (Not to offer for Automation & Robotics Engg., Mechanical & Automation and Mechatronics Engg. Students)		
Faulty of Engineering		
Board of Studies in Mechanical Engineering		
Second Year Programme in Minor (Automation and Robotics Engineering)		
Semester	IV	
Title of Paper (Theory)	Sem.	Total Credits 4
Basic Elements of Automation	IV	3
Title of Paper (Lab)		Credits
Basic Elements of Automation Lab	IV	1
From the Academic Year	2025-26	

Program Structure for MDM offered by Automation and Robotics Engineering
UNIVERSITY OF MUMBAI (With Effect from 2025-26)

SEMESTER IV to SEMESTER VII

Course Code	Course Description	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits
2034211	**Basic Elements of Automation**	3	–	--	3	–	–	3
2034212	**Basic Elements of Automation Lab**	–	2	–	–	–	1	1
2035211	**Sensors Actuators and Interfacing**	3			3			3
2035212	**Sensors Actuators and Interfacing Lab**	-	2	-	-	-	1	1
2036211	**Robotics and Automation System**	3	–	--	3	–	–	3
2036212	**Robotics and Automation System Lab**	-	2	-	-	-	1	1
2037211	**Automation and AI Lab**	-	2*+2	--	--	--	2	2
Total		**9**	**10**	--	**9**	--	**5**	**14**

* Two hours of practical class to be conducted for full class as demo/discussion
#Institute shall offer a course for MDM from other Engineering Boards.

Course Code	CourseDescription	Examination Scheme							
		Internal Assessment Test (IAT)			End Sem. Exam Marks	End Sem. Exam Duration (Hrs)	Term Work (Tw)	Oral & Pract.	Total
		IAT-I	IAT-II	Total (IAT-I) + IAT-II)					
2034211	**Basic Elements of Automation**	20	20	40	60	2	--	--	100
2034212	**Basic Elements of Automation Lab**	--	--	--	--	--	25	--	25
2035211	**Sensors Actuators and Interfacing**	20	20	40	60	2	--	--	100
2035212	**Sensors Actuators and Interfacing Lab**	--	--	--	--	--	25	25	50
2036211	**Robotics and Automation System**	20	20	40	60	2	--	--	100
2036212	**Robotics and Automation System Lab**	--	--	--	--	--	25	25	50
2037211	**Automation and AI Lab**	--	--	--	--	--	50	25	75
Total		**60**	**60**	**120**	**180**	**6**	**125**	**75**	**400**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2034211	Basic Elements of Automation	3	--	-	3	--	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2034211	Basic Elements of Automation	20	20	40	60	2	--	--	100

Rationale:

This subject equips students with foundational knowledge of industrial automation by introducing essential electrical, mechanical, pneumatic components, automation circuits, and PLCs, developing skills crucial for modern automated system design and control.

Course Objectives:

1. To study power electronic switches and circuits and their applications.
2. To acquaint with basics of analog and digital circuits for the design of mechanical processes control
3. **Understand the fundamentals of Boolean Algebra** and apply Boolean laws and theorems to simplify logical expressions
4. To understand and design basic automation circuits including motor control with protection and delay features.
5. To study the components and working of pneumatic and electro-pneumatic control systems.
6. To gain practical knowledge of PLC architecture and programming for industrial automation tasks.

Course Outcomes:

1. Illustrate construction, working principles and applications of power electronic switches.
2. Identify rectifiers and inverters for dc and ac motor speed control
3. Apply Boolean algebra and logic gate knowledge to analyze and simplify logic expressions.
4. Design and implement automation circuits for motor control with safety and timing features.
5. Explain and apply pneumatic and electro-pneumatic components in automation systems.
6. Develop and simulate PLC programs using ladder logic and other programming formats for control applications.

Prerequisite:

Students should have basic knowledge of Physics ,Mathematics, Fundamentals of Electrical and Electronics Measurements

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic knowledge of Physics ,Mathematics, Fundamentals of Electrical and Electronics Measurements		
I	Semiconductor Devices:	Review of diodes, V-I characteristics and Applications of: rectifier diode, zener diode, LED, photodiode; SCR V-I characteristics, UJT triggering circuit, turning-off of a SCR (preliminary discussion), basics of Gate Turn	7	CO1

		Off (GTO), Structure and V-I characteristics of Triac (modes of operation not needed) and Diac, Applications of Triac-Diac circuit; Characteristics of Power BJT, power MOSFET, IGBT; Comparison of SCR, Triac, Power BJT, power MOSFET, IGBT		
II	Phase controlled rectifiers and Bridge inverters:	Full wave controlled rectifier using SCR's (Semi controlled, fully controlled) with R load only, Block diagram of closed loop speed control of DC motors, Basic principle of single phase and three phase bridge inverters , block diagrams including rectifier and inverter for speed control of AC motors (frequency control only)	6	CO2
III	Digital logic and logic families	Boolean algebra and logic gates. logic families: Logic Levels, Noise Immunity, Fan Out, Propagation Delay, TTL and CMOS logic families, Flip flops: Set Reset(SR), Trigger(T), clocked F/Fs; Registers, Multiplexer and Demultiplexer applications	6	CO3
IV	Automation Circuits	Introductory Principles in Designing Automation Circuits: Latch, Command Circuits for Motor Operation with Thermal Overload Protection, Machine operation with (a) Fault Indication, (b)Starting Delay (c) Stopping Delay, (d) Automatic or Manual control.	6	CO4
V	Pneumatics Electro-pneumatics	Properties of air, Compressors, Filter, Regulator, Lubricator Unit, classification of pneumatic actuators, Air control valves, Quick exhaust valves, directional control valves, non-return valves, logic valves, Electro-pneumatic systems, Dominant OFF and Dominant ON circuit, Counting and timing.	7	CO5
VI	PLC Control	Architecture of PLC, Types of Input & Output modules (AI, DI, DO, AO), Wiring diagram, PLC Basic in structions, Timers & Counters, PLC ladder diagram, FBD and IL	7	CO6
		Total	39	

Text Books:

1. "Industrial Automation Hands-On" by Frank Lamb, McGraw-Hill Education 2013

References:

1. "Introduction to Industrial Automation" Stamatios Manesis, George Nikolakopoulos CRC Press 2018
2. Fluid Power with Applications by Anthony Esposito - Pearson Education 2000.

Online References:

Sr. No.	Website Name
1.	https://youtu.be/tN7iAzVEqa0?feature=shared
2.	https://youtu.be/tw-79FiRYKA?feature=shared
3.	https://onlinecourses.nptel.ac.in/noc25_me58/preview

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

- **Question paper format**

  - Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**

  - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

  - A total of **Three questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	To tal
2034212	Basic Elements of Automation Lab		2	-		1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test	Test 2	Avg. of 2 Tests				
2034212	Basic Elements of Automation Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To study and analyze V-I characteristics and applications of power electronic devices such as SCR, Triac, Diac, and IGBT.
2. To implement and test controlled rectifier circuits and inverter configurations for motor control applications.
3. To design and verify digital logic circuits using Boolean algebra, logic gates, flip-flops, and multiplexers.
4. To design and simulate basic automation circuits such as latching circuits, interlocks, and motor starter circuits with fault indication and time delay features.
5. To study the working principles and components of pneumatic systems including compressors, valves, actuators, and FRL units.
6. To develop and implement ladder logic for controlling basic automation sequences.

Lab Outcomes:

1. To demonstrate the ability to test and interpret the characteristics of power semiconductor devices.
2. To develop rectifier and inverter-based control circuits and analyze their performance with various loads.
3. To construct and verify digital logic circuits and understand the behavior of different logic families and memory elements.
4. To design circuits involving motor starters, latching, interlocks, fault indication, and time delay controls.
5. To build working models using pneumatic actuators, directional control valves, and electro-pneumatic systems integrating electrical control
6. To develop and debug ladder logic programs for sequence control, timing, and interlocking operations.

Prerequisite:

To effectively engage with the laboratory sessions covering *Fundamentals of Electrical and Electronics Measurements*, *Measuring Devices and Instruments* and, *Basics of Automation Systems*

List of Experiments.

Sr No	List of Experiments	Hrs
01	V-I Characteristics of Diode, Zener Diode, and LED	2
02	SCR Characteristics and UJT Triggering Circuit	2
03	Triac and Diac Characteristics with Lamp Control Circuit	2
04	Study and Comparison of Power BJT, MOSFET, and IGBT Characteristics	2
05	Full Wave Controlled Rectifier using SCRs with R Load	2
06	Simulation of DC Motor Speed Control using Closed Loop System	2
07	Design and Analysis of Single Phase Inverter using Power Devices	2
08	Implementation of Flip-Flop Circuits (SR, T, Clocked)	2
09	Multiplexer and Demultiplexer Application Circuits	2
10	Design of Start Delay and Stop Delay Circuits	2
11	Study of Electro-Pneumatic Circuit with Solenoid Valve and Limit Switch Control	2
12	Development of Basic PLC Ladder Logic Program for Motor Control	2
13	Implementation of Timers and Counters in PLC	2
14	PLC-Based Automation of Conveyor or Bottle Filling System	2

Sr No	List of Assignments / Tutorials	Hrs
01	Compare and contrast the characteristics and applications of SCR, Triac, MOSFET, IGBT, and Power BJT.	2
02	Design a full-wave controlled rectifier circuit using SCRs and explain its working with waveforms.	2
03	Implement Boolean expressions using basic logic gates and explain the operation of multiplexers and demultiplexers in digital systems.	2
04	Design and simulate (or draw) an **automation circuit** for motor control using a **latch, thermal overload**, and **start/stop push buttons**.	2
05	Explain with diagrams the working of a basic **electro-pneumatic circuit** including FRL, actuator, DCV, and sensor.	2
06	Develop and simulate a **PLC ladder diagram** for a conveyor system with **start/stop control, timer delay**, and **fault indication**.	2

Assessment :

Term Work: Term Work shall consist of at least 8 to 10 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.