NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	M.Tech. in Electronics & Instrumentation Engineering (Robotics and Artificial Intelligence)
Semester:	II
Course Code:	6EI862ME25
Course Title:	Programmable Logic Controller
Course Type:	Elective
Year of introduction:	2025 - 26

L	T	Practical component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1. explain the fundamentals of Programmable Logic Controllers (PLCs) and their applications (BL2)
2. develop PLC programming using various logic and control techniques (BL3)
3. appraise PLC-based automation systems for industrial and robotic application (BL5)
4. design PLC control systems for efficient performance in robotic field. (BL6)

Unit	Contents	Teaching Hours (Total 30)
Unit I	**Introduction to PLCs** Fundamentals of industrial automation and role of PLCs, evolution and need for PLCs in modern automation, basic architecture and working of a PLC system, advantages and disadvantages of PLCs over traditional control systems, PLC selection criteria for different applications.	03
Unit II	**PLC Programming and Logic Development** Introduction to PLC programming languages: Ladder Logic, Functional Block Diagram, and Structured Text, basic logic operations: AND, OR, NOT, XOR, timers and counters: ON/OFF delay, Up/Down counters, arithmetic and data handling functions, implementation of combinational and sequential logic in PLCs, Case study: PLC logic development for robotic pick-and-place operation.	10
Unit III	**PLC Communication and Interfacing** Communication protocols in PLCs: RS232, RS485, Modbus, Profibus, Ethernet, remote monitoring and data acquisition using PLCs, interfacing PLCs with robotic systems and industrial networks, Case study: PLC-based control system for a robotic assembly line.	04
Unit IV	**Advanced PLC Control Techniques** Introduction to PID control using PLCs, motion control applications using PLCs, use of PLCs in safety-critical applications, implementation of control logic in PLC-based control systems, case study: Automated conveyor system controlled via PLC.	05

PLC-controlled robotic arms and mobile robots, industrial automation applications using PLCs, troubleshooting and maintenance of PLC-controlled systems, recent trends in PLCs for robotic applications, case study: PLC implementation for an autonomous robotic warehouse system.

Self – Study:	The self-study contents will be declared at the commencement of semester.
	Around 10% of the questions will be asked from self-study contents.

Suggested Readings/References:

1. Hugh Jack, Automating Manufacturing Systems with PLCs, Pearson.
2. John R. Hackworth, Programmable Logic Controllers: Programming Methods and Applications, Pearson.
3. Frank D. Petruzella, Programmable Logic Controllers, McGraw-Hill.
4. Madhuchhanda Mitra, Programmable Logic Controllers and Industrial Automation, Oxford University Press.

Suggested List of tutorials:

1. Introduction to PLC hardware and software.
2. Understand basic logic operations using ladder logic.
3. Programming and testing of timers and counters.
4. Understand analog input and output interfacing with PLC.
5. Understand motor control using PLC.
6. Programming related to PLC-based traffic light control system.
7. Demonstrate industrial conveyor belt automation using PLC.
8. Understand the methodology for PLC based communication systems.
9. Understand implementation of industrial robot control using PLC.
10. Understand PLC-controlled robotic pick-and-place system.
11. Understand PLC based sorting system on conveyor belt mechanism.
12. Understand application of automated sorting system using PLC.

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. the academic year 2025 - 26 and onwards