09-12-2025 10:42:11 AM

PLC PROGRAMMING AND SCADA **Course Code : 316352**

Programme Name/s : **Mechatronics**
Programme Code : **MK**
Semester : **Sixth**
Course Title : **PLC PROGRAMMING AND SCADA**
Course Code : **316352**

I. RATIONALE

Contemplating the growing demand for expertise in Advanced Automation Systems within modern industries, learning about Programmable Logic Controller (PLC) programming and SCADA will equip the students with the ability to design and implement control systems and skills for real-time monitoring and data acquisition. This knowledge is critical for optimizing industrial processes, enhancing productivity, and ensuring safety by designing, programming, and maintaining PLC & SCADA based systems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences:: Use PLC & SCADA systems for industrial automation.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Interpret the architecture and functions of different elements of PLC.
- CO2 - Execute different PLC ladder programming instructions.
- CO3 - Maintain PLC-based automation systems.
- CO4 - Develop SCADA screen for simple application.
- CO5 - Select advanced automation systems for industry 4.0 compliance.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316352	PLC PROGRAMMING AND SCADA	PPS	SEC	4	-	4	-	8	4	3	30	70	100	40	25	10	25#	10	-	-	150

PLC PROGRAMMING AND SCADA **Course Code : 316352**

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 Explain the significance of industrial automation. TLO 1.2 Classify different types of automation used in mechatronic systems. TLO 1.3 Describe types of controls in industrial automation. TLO 1.4 Explain the function of different elements of PLC with the help of block diagram. TLO 1.5 Describe the concept of sinking and sourcing in PLC. TLO 1.6 Explain the advantages of PLCs in industrial automation.	**Unit - I Basics of PLC** 1.1 Introduction to industrial automation: Need of automation, automation hierarchy, types of automation 1.2 Analog control, Digital control (Supervisory control and Direct digital control) 1.3 Architecture of PLCs: Block diagram, CPU, I/O modules, power supply, memory organization, special I/O modules 1.4 Types of PLCs: Compact and modular PLCs, selection criteria of PLC, concept of redundancy in PLC 1.5 PLC power connection (wiring), concept of sinking and sourcing in PLC 1.6 Advantages of PLCs over traditional/hardwired relay logic	Lecture Using Chalk-Board Presentations Video Demonstrations Flipped Classroom

PLC PROGRAMMING AND SCADA **Course Code : 316352**

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.
2	TLO 2.1 Describe different programming languages used to program PLC. TLO 2.2 Specify appropriate I/O addressing format for the given PLC. TLO 2.3 Explain use of different PLC programming instructions used to write a simple program for performing a given operation. TLO 2.4 Explain the timer and counter instructions with their status bits and waveforms. TLO 2.5 Describe do's and don'ts in the PLC-PC installation procedure.	**Unit - II PLC Programming** 2.1 PLC programming languages: Functional Block Diagram (FBD), Instruction List, Structured text, Sequential Function Chart (SFC), Ladder Programming (Introduction only) 2.2 Basics of ladder programming: PLC I/O addressing formats in ladder logic, relay-type instructions, PLC processor scan cycle 2.3 Programming Timer: Addressing a timer block, status bits, ON delay, OFF delay and reset, retentive timer 2.4 Programming Counter: Addressing a counter block, status bits, UP and DOWN counter, UP-DOWN counter 2.5 Advanced PLC programming: PLC arithmetic/Math instructions, PLC logical instructions, PLC comparison instructions and data handling instruction (Move, Masked Move, Copy, Clear), Analog I/O instructions (Scaling & signal processing) 2.6 Introduction to popular PLC programming software used in industries 2.7 PLC-PC interface, do's and don'ts in PLC installation	Lecture Using Chalk-Board Presentations Video Demonstrations
3	TLO 3.1 Explain basics of Ladder programming for a given Boolean expression. TLO 3.2 Develop Ladder program for simple applications. TLO 3.3 Prepare Ladder program for a given industrial application. TLO 3.4 Describe regular PLC maintenance practices. TLO 3.5 Enlist steps to troubleshoot PLC for a specific application.	**Unit - III PLC Applications and Troubleshooting** 3.1 PLC based simple applications: Ladder programming for latching and seal in circuits, Boolean expressions and logic gates, home automation etc. 3.2 PLC based industrial applications: Motor sequence control, traffic light control, conveyor system, bottle filling plant, car parking, stepper motor control, Elevator control, Electro-hydraulic and electro-pneumatic control, robotic control 3.3 Analog controls: Tank level control, temperature control, pressure control/flow control 3.4 Regular PLC maintenance practices 3.5 Standard steps for PLC troubleshooting	Lecture Using Chalk-Board Presentations Model Demonstration Video Demonstrations Site/Industry Visit

PLC PROGRAMMING AND SCADA **Course Code : 316352**

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 various benefits and applications of SCADA. TLO 4.2 Enlist different SCADA software. TLO 4.3 Explain the architecture of SCADA with the help of sketch. TLO 4.4 Explain the major features of the given communication protocol used for SCADA. TLO 4.5 List the steps in Interfacing of PLC and SCADA system. TLO 4.6 Describe the need and architecture of OPC. TLO 4.7 State the steps in creating simple SCADA screen for a given application.	**Unit - IV SCADA Fundamentals** 4.1 Supervisory Control and Data Acquisition (SCADA): Introduction, need, benefits and typical applications 4.2 Introduction to popular SCADA software used in industries 4.3 SCADA architecture: Types of SCADA architecture, Master Terminal Unit (MTU), Remote Terminal Unit (RTU) 4.4 Network topologies, RS232, RS422, RS485 standards for data communication, communication protocols (Modbus, Field bus, Profibus, Industrial Ethernet) 4.5 Interfacing SCADA system with PLC: Typical connection diagram 4.6 Object linking and embedding for process control (OPC) - need, architecture 4.7 Developing SCADA screen for simple applications - conveyor system, car washing system, Traffic light system and Hydro-power plant	Lecture Using Chalk-Board Presentations Video Demonstrations Flipped Classroom
5	TLO 5.1 Identify the steps in integrating given HMI panel with given PLC. TLO 5.2 AC drives preferred over DC drives in modern automation systems. Justify. TLO 5.3 Draw wiring diagram of VFD to PLC interfacing. TLO 5.4 Explain the architecture of DCS with the help of sketch. TLO 5.5 List various emerging trends in industrial automation.	**Unit - V Advanced Industrial Automation Systems** 5.1 Human-Machine Interface (HMI): Introduction to HMI, Types of HMIs (Touchscreen, Panel-based, PC-based, Steps for integrating PLC with HMI panel 5.2 AC/DC Drives: Fundamentals of Electrical Drives, Applications of VFDs in Mechatronics Systems 5.3 Distributed Control System (DCS): Architecture and Functioning of DCS, DCS-PLC Comparison and Applications, Role of DCS in Process Automation 5.4 Emerging trends in industrial automation: Introduction to Cloud PLC & SCADA, IIOT, Industry 4.0	Lecture Using Chalk-Board Presentations Case Study Site/Industry Visit

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 various parts of PLC. LLO 1.2 Connect PLC to PC.	1	*Identification of various parts of PLC available in your laboratory	2	CO1
LLO 2.1 Develop ladder diagram to test the functionality of logic gates. LLO 2.2 Simulate the ladder diagram for logic gates.	2	*Development of ladder diagram for testing functionality of logic gates	2	CO2
LLO 3.1 Develop ladder diagram for seal in circuit. LLO 3.2 Simulate the ladder diagram for seal in circuit.	3	*Simulation of simple seal in circuit using PLC simulator	2	CO2

PLC PROGRAMMING AND SCADA **Course Code : 316352**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Develop ladder diagram for mathematical instructions. LLO 4.2 Simulate the ladder diagram for mathematical instructions.	4	*Simulation of mathematical instruction using ladder program	2	CO2
LLO 5.1 Develop ladder diagram to operate siren using timer. LLO 5.2 Execute the ladder program to demonstrate on hardware.	5	* Activation of siren using Timer in PLC	2	CO2
LLO 6.1 Develop ladder diagram for up counter. LLO 6.2 Execute the ladder program to demonstrate on hardware.	6	Simulation of up counter for certain number of counts to turn on lamp	2	CO2
LLO 7.1 Develop ladder diagram for up/down counter. LLO 7.2 Simulate the ladder diagram to make lamp ON/OFF.	7	*Development of ladder program for up/down counter to make lamp ON/OFF	2	CO2
LLO 8.1 Develop ladder diagram for pulse counting using limit switch / proximity sensor LLO 8.2 Simulate the ladder diagram for pulse counting using limit switch / proximity sensor	8	*Development of ladder diagram for pulse counting using limit switch / proximity sensor	2	CO2
LLO 9.1 Develop ladder diagram for latching circuit. LLO 9.2 Simulate ladder diagram for latching circuit.	9	*Simulation of latching circuit using ladder program	2	CO3
LLO 10.1 Develop ladder diagram for motor sequence control. LLO 10.2 Simulate the ladder diagram for motor sequence control.	10	*Simulation of motor sequence control using ladder diagram	2	CO3
LLO 11.1 Develop ladder diagram for traffic light control. LLO 11.2 Simulate the ladder diagram to demonstrate on hardware.	11	*Implementation of traffic light control using ladder diagram	2	CO3
LLO 12.1 Develop ladder diagram for automated elevator control. LLO 12.2 Simulate the ladder diagram for automated elevator control.	12	Implementation of automated elevator control using ladder diagram	2	CO3
LLO 13.1 Develop ladder diagram for tank level control. LLO 13.2 Simulate the ladder diagram to demonstrate on hardware.	13	*Implementation of tank level control using ladder diagram	2	CO3

PLC PROGRAMMING AND SCADA **Course Code : 316352**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 14.1 Develop ladder diagram for conveyor system. LLO 14.2 Simulate the ladder diagram for conveyor system.	14	Implementation of conveyor system using ladder diagram	2	CO3
LLO 15.1 Develop ladder diagram for rotation of stepper motor. LLO 15.2 Simulate the ladder diagram to demonstrate on hardware.	15	*Development of ladder program for rotating stepper motor in forward direction and reverse direction at constant speed	2	CO3
LLO 16.1 Develop ladder diagram for rotation of DC motor. LLO 16.2 Simulate the ladder diagram to demonstrate on hardware.	16	Development of ladder program for ON/OFF control of DC motor in forward and reverse directions	2	CO3
LLO 17.1 Develop ladder diagram for temperature control using any temperature sensor. LLO 17.2 Simulate the ladder diagram to demonstrate on hardware.	17	Development of ladder program for temperature control using any temperature sensor with heater on off	2	CO3
LLO 18.1 Develop ladder diagram for car parking system. LLO 18.2 Simulate the ladder diagram for car parking system.	18	Implementation of car parking system using ladder diagram	2	CO3
LLO 19.1 Develop ladder diagram for bottle filling application. LLO 19.2 Simulate the ladder diagram to demonstrate on hardware.	19	Development of ladder program for bottle filling application	2	CO3
LLO 20.1 Develop ladder diagram for Electro Pneumatic/Hydraulic system. LLO 20.2 Simulate for Electro-Pneumatic/Hydraulic system.	20	Implementation of Electro-Pneumatic/Hydraulic system using ladder diagram	2	CO3
LLO 21.1 Develop ladder diagram for object sorting system. LLO 21.2 Simulate the ladder diagram for object sorting system.	21	Development of ladder program for object sorting (Metallic & Nonmetallic) system	2	CO3
LLO 22.1 Study different SCADA software and system in the market. LLO 22.2 Select the suitable SCADA software for given application.	22	*Selecting the suitable SCADA software for given application	2	CO4
LLO 23.1 Use various functions of SCADA simulation editor. LLO 23.2 Write the steps to develop simple object.	23	*Development of SCADA mimic screen/diagram for START/STOP logic system to turn ON/OFF light after pressing start-stop switch	2	CO4
LLO 24.1 Design alarm annunciation system in SCADA. LLO 24.2 Simulate using SCADA software.	24	Implementation of alarm annunciation using SCADA	2	CO4

PLC PROGRAMMING AND SCADA **Course Code : 316352**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 25.1 Design liquid level controller system in SCADA. LLO 25.2 Simulate using SCADA software.	25	Implementation of liquid level controlling in Tank by using SCADA	2	CO4
LLO 26.1 Develop SCADA mimic screen for temperature control. LLO 26.2 Simulate using SCADA software and observe reporting & trending.	26	Development of SCADA mimic screen for temperature control using any temperature sensor and observe reporting & trending in SCADA System	2	CO4
LLO 27.1 Develop SCADA mimic screen for hydro-power plant. LLO 27.2 Simulate using SCADA software.	27	Development of SCADA mimic screen for hydro-power plant	2	CO4
LLO 28.1 Develop HMI screen with simple objects. LLO 28.2 Simulate using HMI software.	28	*Designing a simple HMI screen with labels, buttons, and indicators	2	CO5
LLO 29.1 Develop multiple HMI screen for different process sections.	29	Designing multiple HMI screens for different process sections	2	CO5
LLO 30.1 Identify various Industry 4.0 technologies such as IoT, AI, robotics, and cloud computing used in automation.	30	*Visit to any industry 4.0 compliant automation industry	2	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)

Micro project

- Automatic mixing system: Implement Automatic product mixing control system using PLC.
- Traffic light control: Prepare PLC based simple traffic light control system.
- Railway gate control using PLC.
- Washing machine control using PLC ladder programming.
- Automatic Street light controller: Prepare a SCADA based system to control the street lights as per the intensity of natural light.
- Home automation: Implement a versatile automation system for home that can automate any three home appliances using SCADA.
- Color sensing and sorting of objects: Develop a HMI screen for sorting of different products based on color.

Student activity

- Prepare a Report on general maintenance and troubleshooting methods of PLC.
- Make a report on market survey of different types of SCADA software.
- Prepare a report on "Industry Website Exploration: Automation Tools".
- Explore any virtual lab on PLC to perform an activity and prepare a report on it.

PLC PROGRAMMING AND SCADA **Course Code : 316352**

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	PLC trainer kit (with analog and digital I/Os) along with IEC 1131-3 compatible programming Software	1,2,3,9,4,5,6,7,10,12,11,13,14,15,16,17,18,19,8,20
2	Tank Water Level Kit	13,25
3	Conveyer belt (24 V DC operated) Kit	14,16,19,20
4	Trainer kit for bottle filling plant	14,19
5	Stepper Motor PLC Interfacing Kit	15
6	IEC Standard compatible latest version of SCADA software from any reputed manufacturer like - Ellipse/ Citect/ wonderware - intouch/Json/Wincc/ Cimplicity etc.	22,23,24,25,26,27
7	Min 7’ inch HMI Panel with standard software	28,29
8	Input and output devices for PLC: Lamps, Siren/Buzzer, DC motors, Proximity sensors, Limit switches, Push buttons, RTD/Thermocouple, solenoid valve, hydraulic & pneumatic actuators	5,6,7,12,17,18,19,8,20,25,26
9	Computer System: OS with windows 10 or higher, minimum of 8 GBRAM	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basics of PLC	CO1	10	4	4	4	12
2	II	PLC Programming	CO2	15	4	8	6	18
3	III	PLC Applications and Troubleshooting	CO3	14	2	4	10	16
4	IV	SCADA Fundamentals	CO4	13	4	6	6	16
5	V	Advanced Industrial Automation Systems	CO5	8	4	2	2	8
Grand Total				**60**	**18**	**24**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

PLC PROGRAMMING AND SCADA **Course Code : 316352**

Formative assessment (Assessment for Learning)

- Two-Class Tests of 30 marks each and average of Two-Class Tests out of 30.
- For laboratory learning, maximum 25 marks and minimum 10 marks.

Summative Assessment (Assessment of Learning)

- End semester assessment is of 70 marks. End semester summative assessment is of 25 marks for laboratory learning.

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	2	-	2	-	-	2			
CO2	3	3	2	3	-	-	2			
CO3	3	2	2	3	2	2	3			
CO4	2	2	3	3	-	-	2			
CO5	2	2	2	2	2	2	3			

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	Petruzella, F.D.	Programmable Logic Controller	Tata-McGraw Hill India, 2010 ISBN: 978-0071067386
2	Bolton, W.	Programmable Logic Controllers	Elsevier Newnes, 2007 ISBN: 978-0750681124
3	John Web, W.; Ronald A. Reis	Programmable Logic Controller	Pearson, 2008 ISBN: 978-0135048818
4	Boyar, S. A.	Supervisory Control and Data Acquisition	ISA Publication, 2009 ISBN: 978-1936007097
5	Manoj, K.S.	Industrial Automation with SCADA Concept, Communication and Security	Notion Press, 2019 ISBN: 978-1684668281

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description

09-12-2025 10:42:11 AM

PLC PROGRAMMING AND SCADA **Course Code : 316352**

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=MS3qJq2jvu0	This NPTEL lecture discuss about basics of program logic controllers. Various programming techniques and terms used in PLC are discussed in detail.
2	https://instrumentationtools.com/free-allen-bradley-plc-ladd er-logic-training-course/	Allen Bradley PLC Ladder Logic Training Course.
3	https://www.youtube.com/watch?v=E2WNPXJf-Kw	PLC Introduction. PLC Basics, Components of PLC, Modular PLC Modules, Input Output.
4	https://www.matrikonopc.com/opc-server/opc-data-access-versi ons.aspx?	OPC Data Access (OPC DA) Versions & Compatibility.
5	https://rapidscada.org/?	An open source SCADA software.
6	https://ial-coep.vlabs.ac.in/	Virtual Laboratory on automation.
7	https://www.youtube.com/watch?v=jXRksET5vNo	A foundational understanding of DCS, explaining its structure and functionality within industrial settings.
8	https://ied-nitk.vlabs.ac.in/List%20of%20experiments.html	Virtual Industrial Electric Drives Lab
9	https://www.youtube.com/watch?v=jNEDOdttBNo	Learn Industrial Automation- Free Tutorial PLC SCADA VFD HMI DCS PAC Industry4.0 M580 TIA Courses

Note :

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

MSBTE Approval Dt. 04/09/2025 **Semester - 6, K Scheme**