SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology
Instrumentation and Control

B. Tech. III Semester –VI

Subject Name: PLC and SCADA **Subject Code: BTIC13601**

Type of course: PCC

Prerequisite (if any): Digital Electronics, Industrial Measurement, Process Control

List of Courses where this course will be prerequisite: Distributed Control System

Rationale:
This course will provide the students platform for learning Programmable Logic Controller (PLC) Programming. PLC is a very important device to control any system and is widely used in industries now a day. This course gives a detailed knowledge and practice of PLC programming with Graphics development in SCADA software for visualization of control.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	2	4	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

BSC: basic science course /ESC: Engineering Science Course /HSM: Humanities and management /PCC: Professional Core course /PEC: professional Elective course /OEC: Open Elective course/ MD: mandatory noncredit course

Sr. No.	Content	Total Hrs	Module Weightage
1	**PLC Basics** Introduction, history of the PLC, Principles of Operation, Various Parts of a PLC, memory, the processor, I/O modules; power supplies. PLC advantage & disadvantage, PLC versus Computers, PLC Application. Programming equipment.The I/O section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O specifications, The CPU, Memory design, Memory Types, Programming Devices, Various Brands of PLCs	5	10%
2	**Basics of PLC Programming** Processor Memory Organization, Program Scan, PLC Programming languages, Relay type instructions, Instruction addressing, Branch Instructions, Internal Relay Instructions, Input -Output Image table, Latch-Unlatch instructions, Ladder Programming for Boolean equations, ladder logic program from a narrative description.	3	7%
3	**Various I/O Devices interfacing with PLC.** Different types of Input devices, Switches: Push-button Switches, Toggle Switches, Proximity switches, Temperature Switch, Pressure Switch, and Level Switch,Flow Switches, manually operated switches,Motor starters, Transducers and sensors, Transmitters etc. Their working, specification and interfacing with PLC. Different types of Output devices : Electromagnetic Control Relays, Latching relays, Contactors, Motors, Pumps, Solenoid Valves etc. Their working, specification and interfacing with PLC.	5	11%
4	**Logical, Arithmetic and Data handling Instructions:** Different Logical operation Instructions, Different Integer Math Instructions: Addition, Subtraction, Multiplication, Division, Increment, Decrement- Integer, Byte, Double Word. Different Floating-Point Math Instructions: Addition, Subtraction, Multiplication, Division, Square Root, Sin, Cosine, Exponential, PID. Advanced Instructions: Different Comparison, Data handling instructions,Program Control Instructions, Conversion Instructions	8	18%

	Different Interrupt Instructions		
5	**Programming Timers and counters** Timer instructions, ON delay timer instruction, Off-Delay timer instruction, Retentive Timer, Cascading Timers, examples of timer function industrial application; industrial process timing application.Counter Instructions, Up-counter, down counter, UpDown counter, Cascading counters, Incremental encoder counter applications, Combining counter and timer functions, High Speed counter instruction, examples of counter function industrial application	**7**	**16%**
6	Sequencer and shift register instructions PLC Sequencer Functions. Introduction; electromechanical sequencing; the basic PLC sequencer function; a basic PLC sequencer application with timing; other PLC sequencer function; cascading sequencer. Controlling a Robot with a PLC. Introduction; basic two axis ROBOT with PLC sequencer control; industrial three axis ROBOT with PLC control	**5**	**11%**
7	**Analog PLC Operation** Introduction, Types of PLC Analog Modules and Systems, PLC Analog Signal Processing, PLC Analog Application Examples, PID Modules, PID Tuning, Typical PID Functions.	**3**	**7%**
8	**Basics of SCADA** SCADA key features, remote Terminal Units (RTU), PLC used as RTU, DCS versus SCADA terminology, SCADA software packages, Connecting PC with PLC. Application area for SCADA.	**3**	**7%**
9	**SCADA Graphics Design** Sample Process Design, Tag Creation, Interlinking Tag with PLC programming, Communication link between PLC-SCADA. Linking Analog as well Discrete input-Output and controlling through SCADA, Basic Animation etc.	**6**	**13%**

Suggested Specification table with Marks (Theory): (For B Tech only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	**10%**	**15%**	**10%**	**10%**	**45%**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

Sr no	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Programmable logic controller	Frank D. Petruzella	Mc Graw Hill, ISBN13: 9781264163342	2023	6th Edition
2	Programmable Logic Controllers: Principles and Applications	John W. Webb and Ronald A. Reis	Prentice Hall Education, ISBN-13-978-8120323087	2002	5th Edition
3	Introduction to programmable logic controller	Gary dunning	Thomson Press (India) Ltd ISBN:9788131503027	1998	3rd Edition
4	Programmable Logic Controllers	W. Bolton	Elsevier Newnes publication ISBN- **978-0128029299**	2015	6th edition
5	Programmable Controllers	Thomas A Hughes	**ISA**	2004	4th Edition
6	Overview of Industrial	K.L.S.	Elsevier pub.	2016	2nd ed.

	Process Automation	Sharma	ISBN-9780128053546		

Course Outcomes:

After studying the subject, Students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Describe the hardware structure of PLC and interfacing of input-output modules, power supply and computer with PLC.	10%
CO-2	Interface different on-off switches, push buttons, keypad, analog sensors etc. with input modules and relay, solenoid valve, LED, servo valve, solid state devices etc. to output modules of PLC.	20%
CO-3	Apply knowledge of digital logic and microcontroller concepts for understanding and use of functional blocks in ladder programming, process scanning and status table updation.	10%
CO-4	Write, simulate, debug and analyze the ladder programs using basic as well advanced instructions and SCADA tagging to develop program related discrete and analog control loops.	50%
CO-5	Develop an industrial automation application using PLC-SCADA in a team .	10%

How strongly POs are addressed by each CO of a subject is indicated by level 1: Slight (Low)2: Moderate (Medium)3: Substantial (High)

Mapping CO-POs:

	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**														
CO2			**3**		**3**								**3**		

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CO3					**3**								**3**		
CO4		**2**			**3**								**3**	**3**	**3**
CO5									**3**			**3**	**3**	**3**	**3**

List of Open learning website:

https://plc-coep.vlabs.ac.in/
http://www.plcdev.com/book/export/html/9
https://cache.industry.siemens.com/dl/files/582/1109582/att_22063/v1/s7200_system_manual_en-US.pdf :S7-200 Programmable Controller System Manual
https://instrumentationtools.com/learn-programmable-logic-controller plc/
https://instrumentationtools.com/open-source-plc-and-scada-software/
InTouch SCADA Course Videos
https://www.youtube.com/watch?v=T5ZVu2cjSpw

List of Open Source Software:

https://plc-coep.vlabs.ac.in/

FOR LAB SESSIONS:

List of Experiments:

1. Introduction to ladder programming& to implement basic logic gates and boolean equations.
2. Develop, Simulate and Test Ladder diagram for a. A Door Bell Operation. b.Security Lock.
3. Develop, Simulate and Test Ladder diagram for Bottle Filling system
4. Develop, Simulate and Test Ladder diagram for Traffic Light Control System
5. Develop Simulate and Test Ladder diagram for an alarm annunciator system.
6. Develop Simulate and Test Ladder diagram for Batch Mixer system.
7. Design ladder diagram for level control system.
8. Develop and test PLC program for ON-OFF and PID Controller for Temperature control Application.
9. Design ladder for three sequential motor control system.

10.Design ladder programming using timer and counter and higher arithmetic and sequencer instructions.

Major Equipment Needed: Computers, SCADA software, PLCs, Input/ Output devices.