GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3162421
Semester VI
Subject Name: INDUSTRIAL AUTOMATION

Type of course: Professional Elective Course

Prerequisite: Industrial Communication Systems, Digital Electronics, Industrial Instrumentation, Control System,

Rationale: Students of Power Electronics engineering should have basic skill of controlling any system. Semi automatic, fully automatic systems in various industries now a day's controlled by PLC, SCADA, DCS. Careful learning of the subject will build up skill, competency to understand, control various industrial process, systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Contents:

Sr. No	Topics content	Teaching Hours	Module Weightage
1	INTRODUCTION Physical Process, Types of Industrial Processes, Process Automation System, Needs Met by automation, Advantages of Automation, Steps of Automation, Main Components of Industrial Automation. Localized Process, Distributed Process, Supervisory Control and Data Acquisition.	3	8%
2	PLC Basics Introduction, definition & history of the PLC, PLC advantage & disadvantage, overall PLC system, CPU & programmer/monitors, PLC input& output modules, the PLC as a computer, the central processing unit, the processor, I/O modules, power supplies, programming equipment, programming formats, , process scanning consideration, input ON/OFF switching device, input analog device, output ON/OFF device, output analog device.	6	15%
3	Basics PLC Programming PLC input instruction, output: coils, inductors & others, operational procedures, contact & coil input/output programming examples, a look at fail-safe circuit, industrial process examples. Relation of Digital Gate Logic to Contact/Coil Logic - Digital logic gates, Boolean algebra PLC programming, conversion examples. Creating Ladder Diagrams from Process Control Descriptions - Ladder diagram & sequence listing, large process ladder diagram construction, flow charting as programming method.	3	7%
4	PLC Basic and Intermediate Functions Register - general characteristics of registers, module addressing, holding	6	15%

	registers, input registers: single & group, output registers: single & group. PLC Timer Functions - PLC timer functions, examples of timer function industrial application, industrial process timing application. PLC Counter Functions - Introduction, PLC counters examples of counter function industrial application. PLC Arithmetic Functions - PLC addition & subtraction, PLC multiplication, division & square-root: PLC trigonometric & log function. PLC Number Comparison Functions - Introduction, PLC basic comparison function, PLC basic comparison function application, PLC advanced comparison function.		
5	Data Handling Functions and PLC Functions Working with Bits The PLC SKIP and MASTER CONTROL RELAY Functions - the SKIP function & application, the MASTER CNTROL RELAY function & application. Jump Functions - jump with non-return, jump with return. PLC Data Move Systems - PLC MOVE function & application, moving large blocks of PLC data, PLC table & registers moves, other PLC MOVE functions. PLC Digital Bit Functions and Applications - Introduction, bit pattern in a register, changing a register bit status, shift register function, shift register application. PLC Sequencer Functions - electromechanical sequencing, the basic PLC sequencer function, a basic PLC sequencer application with timing, other PLC sequencer function, cascading sequencer.	6	15%
6	SCADA SYSTEMS HARDWARE and SOFTWARE Introduction, History of SCADA, Fundamental Principles of Modern SCADA Systems, SCADA Hardware and Software, Comparison of the terms SCADA, DCS, PLC and smart instrument, Considerations and benefits of SCADA system, Remote Terminal unit(RTU), Application Programs, PLCs used as RTUs, The Master Station, Master Terminal unit (MTU),System Reliability and Availability, Communication Architecture, Configuration of MTU. The components of a SCADA system, SCADA software package, Specialized SCADA Protocols, Error Detection, Distributed Network Protocols, New technologies in SCADA systems.	9	20%
7	SYSTEM AVAILABILITY, COMMON CONFIGURATIONS and APPLICATIONS of DCS System Availability: Introduction of System availability, Standby Schemes, Distributed Control System, Network Control System, I/O Redundancy. Common Configurations of DCS: Introduction, Common configurations, Distributed Control System, Network Control System, An engineering station, System/project tree structure DCS system database, Configuration of control functions, Configuration of operator/monitoring functions, Configuration of system hardware structure, Configuration of system software, Documentation, Commissioning Applications: Use of DCS in pulp, paper environment, Use of DCS in petroleum-refining environment, Use of DCS in oil and gas processing environment, DCS Applications in power plants, Iron plant, steel plant,	9	20%

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Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40	**35**	**15**	**05**	**05**	**---**

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:

1 Programmable Logic Controllers: Principles and Applications, John W. Webband Ronald A. Reis, Prentice– Hall India publication

2 Overview of Industrial Process Automation, KLS Sharma, Elsevier Publication

3 Practical SCADA for Industry, David Bailey, Elsevier Publication

4 Practical Distributed Control Systems (DCS) for Engineers and Technicians, IDC Technologies

5 Programmable logic controller, Frank D. Petruzella, Tata McGraw-Hill publication

6 Programmable Logic Controllers, W. Bolton, Elsevier Newnes publication

7 Instrument Engineers 'Handbook, B. G. Liptak

Course Outcome:

Sr. No.	CO statement At the end of this course, students will demonstrate the ability to	Marks % weightage	Topics Mapped
CO1	Outline industrial automation system.	8	1
CO2	Interpret the Programmable Logic Controller (PLC) and its functions.	45	2,3,4,5
CO3	Develop PLC programs for different industrial applications.	7	3,4,5
CO4	Explain basic SCADA System Hardware, Software and Protocols	20	6
CO5	Explain the architecture and local control unit of Distributed Control System (DCS) and various industrial applications.	20	7

The following are suggested list of experiments based on theme:

1. To study block diagram of Programmable Logic Controller.
2. To study I/O modules of PLC.
3. Introduction to Ladder Programming and to implement basic Logic Gates.
4. To study different Registers of PLC.
5. To study different Timers and Counters of PLC.

6. To perform basic PLC programs using Timer.
7. To perform basic PLC programs using Counter.
8. To study Data Handling functions of PLC.
9. To study Distributed Control System Configuration.
10. To study application of Distributed Control System.
11. To study Remote Terminal Unit and Master Terminal Unit.
12. To study SCADA system protocols.

Major Equipment:
Personal Computer/Laptop, Simulation software, PLCs, Input/ Output devices.

List of Open Source Software/learning website:

1. - https://nptel.ac.in
2. - http://nptel.iitm.ac.in/courses.php
3. - http://coep.vlab.co.in/?sub=33&brch=97
4. - http://www.plcdev.com/book/export/html/9
5. - http://www.plcmanual.com/
6. - http://literature.rockwellautomation.com/
7. - http://www.automation.siemens.com/
8. - http://www.abb.com
9. - http://www.schneider-electric.co.in
10. - http://www.ge.com