

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: POWER ELECTRONICS (24)

SUBJECT NAME: Industrial Automation

Subject Code: 2172411

BE SEMESTER VII

Type of course: Engineering Science (Instrumentation & Control Engineering)

Prerequisite: 1) 2142406 - Digital Electronics and its Applications
 2) 2152408 - Industrial Instrumentation
 3) 2152409 - Microcontroller for Power Electronics
 4) 2162410 - Industrial Communication Systems

Rationale: Students of Power Electronics engineering should have basic skill of controlling any system. Semi automatic and fully automatic systems in various industries now a days controlled by PLC, SCADA and DCS. Thorough study of the subject will develop skill and competency to control various process and systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
			PA		ALA	ESE	OEP			
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Topic	Teaching Hrs/ week	Module Weightage%
1	INTRODUCTION Physical Process, Types of Industrial Processes, Industry Classification, Process Automation System, Needs Met by automation, Advantages of Automation, Steps of Automation, Process Signals, Main Components of Industrial Automation.	02	05-10
2	PROGRAMMABLE LOGIC CONTROLLER BASICS AND PLC PROGRAMMING Overview of PLC systems, parts of PLC, Input/Output modules, power supplies and isolators, Fundamental PLC wiring diagram, relays, switches, transducers, sensors, seal-in circuits. Fundamentals of logic, Program scan, Relay logic, PLC programming languages, Digital logic gates, Boolean algebra PLC programming.	08	15-20
3	TYPES OF AUTOMATION SYSTEMS Localized Process, Distributed Process, Supervisory Control and Data Acquisition.	04	10-15

Sr. No.	Topic	Teaching Hrs/ week	Module Weightage%
4	<p>SYSTEM AVAILABILITY, COMMON CONFIGURATIONS OF DCS</p> <p>System Availability: Introduction of System availability, Standby Schemes, Distributed Control System, Network Control System, I/O Redundancy.</p> <p>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</p>	08	15-25
5	<p>DCS APPLICATIONS, IMPLEMENTATION, AND FUTURE TRENDS</p> <p>Applications: Use of DCS in pulp and 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, Cement plant.</p> <p>Implementation: System strategy, Automation plan, Project implementation, Installation and commissioning, Change management</p> <p>Future Trends: Introduction, Creation of E-commerce solution</p>	08	15-25
6	<p>SCADA SYSTEMS HARDWARE & FIRMWARE</p> <p>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.</p>	08	15-25
7	<p>SCADA SYSTEMS SOFTWARE AND PROTOCOLS</p> <p>The components of a SCADA system, SCADA software package, Specialized SCADA Protocols, Error Detection, Distributed Network Protocols, New technologies in SCADA systems.</p>	04	10-15
8	<p>AUTOMATION SYSTEM FUNCTIONALITIES AND APPLICATION AREAS</p> <p>Major Functionalities like Data Acquisition, Data Supervision or Monitoring, Process Survey, Process Control, Process Studies, Human Interaction, Data Logging and History Generation, Data Exchange, Data Availability, Current Trends in Automation Systems, Modern Control Center, Application Areas of Automation System.</p>	06	15-20

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks

Remembrance R Level	Understanding U Level	Application A Level	Analyze N Level	Evaluate E Level
30%	25%	25%	10%	10%

Legends: R : Remembrance ; U = Understanding; A = Application 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. Webb and 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 Instrument Engineers' Handbook, B. G. Liptak
- 5 Practical Distributed Control Systems (DCS) for Engineers and Technicians, IDC Technologies
- 6 Programmable logic controller, Frank D. Petruzella, Tata McGraw-Hill publication
- 7 Distributed Computer Control for Industrial Automation, Vijay P. Bhatkar
- 8 Programmable Logic Controllers, W. Bolton, Elsevier Newnes publication
- 9 Computer Based Industrial Control, Krishna Kant, PHI
- 10 Computer Aided Process Control, S.K.Singh, PHI

Course Outcome:

After learning the course the students should be able to:

1. Describe the Programmable Logic Controller (PLC) and their programming languages.
2. Explain the architecture and local control unit of Distributed Control System (DCS) and various industrial applications.
3. Explain basic SCADA System Hardware, Software and Protocols.

List of Experiments:

Directions for Laboratory work:

- The list of experiments is given as a sample.

- Minimum 10 experiments should be carried out.

1. To study the block diagram of Programmable Logic Controller.
2. To study Input and Output modules interface of PLC.
3. Introduction to ladder programming and to implement basic logic gates.
4. To study the basic of automation, structures of instrumentation system and safety consideration.
5. To study basic DCS configurations
6. To study programming of DCS system

7. To study the Distributed control system configuration
8. Application of Distributed Control System
9. To study remote terminal unit and master terminal unit.
10. To study SCADA System Protocols.
11. To study functionality of automation system.

Design based Problems (DP)/Open Ended Problem:

Major Equipment:

Computers, simulation software, PLCs, Input/ Output devices. SCADA software.

List of Open Source Software / learning website:

Learning website:

- <http://nptel.iitm.ac.in/courses.php>
- <http://coep.vlab.co.in/?sub=33&brch=97>
- <http://www.plcdev.com/book/export/html/9>
- <http://www.plcmanual.com/>
- <http://literature.rockwellautomation.com/>
- <http://www.automation.siemens.com/>
- <http://www.abb.com>
- <http://www.schneider-electric.co.in>
- <http://www.ge.com>
- <http://www.honeywell.com>
- <http://www.yokogawa.com>

ACTIVE LEARNING ASSIGNMENTS: Preparation of presentation which include slides, videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The presentation should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.