

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: INDUSTRIAL AUTOMATION
(Code: 3361107)**

Diploma Programme in which this course is offered	Semester in which offered
Electronics and Communication Engineering	Sixth

1. RATIONALE

The aim of this course is to introduce students with present Industrial Automation scenario in India. The broad knowledge of essential component of present industrial Automation Industry such as Programmable Logic Controller (PLC), Distributed Control System (DCS), Supervisory Control and Data Acquisition (SCADA), industrial drives, human machine interface will enable the students to maintain the above automation controls systems used in the present industry. Thus this course is very important for students who want to use their knowledge of electronic engineering for working in industrial automation sector.

2. COMPETENCY

The course content should be taught and with the aim to develop required skills in the students so that they are able to acquire following competency :

- **Maintain electronic circuitry of different types of industrial automation systems**

3. COURSE OUTCOMES

The theory should be taught and practical should be undertaken in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domains to demonstrate the following course outcomes:

- Describe working of various blocks of basic industrial automation system
- Connect the peripherals with the PLC
- Use various PLC functions and develop small PLC programs
- Summarize Distributed control system and SCADA system
- Use various industrial motor drives for the Industrial Automation

4. TEACHING AND EXAMINATION SCHEME

SCHEME Teaching Scheme (In Hours)				Total Credits (L+T+P)	Examination Scheme				Total Marks
					Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150	
04	00	02	06	70	30	20	30		

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** - Practical; **C** - Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit-I PLC Basics	1a. Explain block diagram for PLC based automation system with sketch. 1b. Draw block diagram of various PLC modules and explain them in brief. 1c. Interface the input analog and digital devices to PLC 1d. Interface the output analog and digital devices to PLC	1.1 Need and benefit of automation 1.2 PLC system: applications of PLC, PLC modules, I/O module, Communication module, PID module 1.3 Input analog and digital devices 1.4 Output analog and digital devices
Unit-II PLC Functions	2a. Describe the function of five common types of registers used in PLC and describe its applications. 2b. Develop ladder logic for flip flops (R-S, ONE SHOT, D, T, and J-K) in PLC. 2c. Describe PLC delay timer and counter functions 2d. Describe how different simple arithmetic operations can be performed by PLC. 2e. Describe how logical operations can be performed by PLC 2f. Formulate the applications of advanced PLC functions 2g. Describe PLC sequencer functions.	2.1 PLC registers 2.2 PLC timer function 2.3 PLC counter function 2.4 PLC simple arithmetic and logical functions 2.5 PLC ladder logic diagram 2.6 Advanced PLC functions like SKIP, MASTER CONTROL RELAY, JUMP with non return, jump with return 2.7 Sequencer function
Unit-III PLC Programm ing and Applicatio ns	3a. Draw neat sketches of PLC process applications. 3b. Identify Input and Output devices for the given application 3c. Develop simple ladder Logic diagram for PLC process 3d. State the trouble shooting steps for any PLC system	3.1 PLC application: Bottling filling plant, Material handling elevator, 2-axis robot with sequencer control, Level control 3.2 Troubleshooting
Unit-IV DCS and SCADA	4a. Explain concept of DCS. 4b. Draw and describe hierarchy of DCS. 4c. List and describe functions of each level of DCS. 4d. Summarize functions each component of SCADA system. 4e. Explain architecture of SCADA system.	4.1 Introduction to DCS, concept of DCS, hierarchy of DCS, function of each level of DCS. 4.2 Introduction to supervisory Control and Data Acquisition system (SCADA), SCADA Architecture, Interfacing SCADA with PLC

	4f. Describe how PLC can interfacing with SCADA	
Unit-V Industrial Drives	5a. Explain working of V/F speed control of induction motor. 5b. Describe speed control of stepper motor 5c. Describe construction, characteristics, working and application of SERVO motor 5d. Describe construction, characteristics, working and application of DC motor	5.1 Induction motor drive: V/F Control, Direct torque control 5.2 Stepper motor drives 5.3 AC and DC Servo motor drives 5.4 DC motor drives

6. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (Theory)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	PLC Basics	08	7	3	0	10
II	PLC Functions	12	7	7	0	14
III	PLC Programming and Application	12	3	3	10	16
IV	DCS and SCADA	12	4	8	4	16
V	INDUSTRIAL DRIVES	12	3	8	3	14
Total		56	24	29	17	70

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised 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.

7. SUGGESTED EXERCISES/PRACTICALS

The practical should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

Note: Here only outcomes in psychomotor domain are listed as practical. However, if these practical are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical/Exercise (Outcomes in Psychomotor Domain)	Approx. Hours Required
1	I	Install hardware and software components of Given PLC system. Check it's working by running a sample program	2

S. No.	Unit No.	Practical/Exercise (Outcomes in Psychomotor Domain)	Approx. Hours Required
2	I	Identify intelligent, PID , Input , Output , Communication module	2
3	I	Wire Inputs , Outputs via PLC input output modules	2
4	I	Wire intelligent, PID , Communication module with PLC	2
5	II	Develop ladder logic to realize D flipflop	2
6	II	Develop ladder logic to realize RS flipflop	2
7	II	Develop ladder logic to realize JK flipflop	2
8	II	Develop ladder logic to realize T flipflop	2
9	II	Simulate Industrial application of PLC On Delay Timer.	2
10	II	Check the delay timer operation using actual PLC	2
11	II	Check the UP/DOWN COUNTER operation using actual PLC	2
12	III	Check the SUBTRACTION Function using actual PLC	2
13	III	Simulate Bottle filling process on PLC simulator. Verify operation of the same process using actual PLC. Draw connection details for the same process	2
14	III	Simulate material handling elevator operation on PLC simulator. Verify operation of the same process operation using actual PLC. Draw connection details for the same process.	2
15	IV	Testt the DCS	2
16	IV	Test the SCADA.	2
17	IV	Set up a SCADA configuration	2
18	V	Test the induction motor drive.	2
19	V	Test the Vector control modes of operation of AC drive.	2
20	V	Test the AC drive	2
21	V	Interfacing AC drive with PLC	2
22	V	Test the stepper motor drive	2
23	V	Test the servo drive and position control	2
Total Hours			46
Note: Perform any of the practical exercises from above list for a minimum of 28 hours depending upon the availability of resources so that skills matching with the most of the outcomes of every unit are included.			

8. SUGGESTED STUDENT ACTIVITIES

- i. Test different types of transducers using simulation software like pro-sim, simulink, lab volt etc.
- ii. Present seminar on any one topic related to the subject
- iii. Develop a small project using LAB VIEW software

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i. Arrange visits to nearby Industries where automation is employed considerably.
- ii. Give Internet based assignments on different aspects of industrial automation to groups of students and ask them to submit report and present in class.
- iii. Organise expert lecture by engineers who are installing/commissioning/maintaining industrial automation systems.
- iv. Display of video/animation films explaining working of different automation components and systems.

10. SUGGESTED LEARNING RESOURCES

A) Books

S.No.	Title of Books	Author	Publication
1.	Programmable Logic Controllers Principles and applications	Webb John W. and Reis A. Ronald	PHI ,New Delhi, Latest edition
2.	Programmable Logic Controllers	Bolton W .	Elsevier India Pvt. Ltd. New Delhi
3.	Programmable Logic Controllers	John R Hackworth	Pearson education New Delhi, Latest edition
4.	Process Control Instrumentation	C. D. JOHNSON	John Wiley and Sons
5.	PLCs & SCADA: Theory and Practice	Rajesh Mehra and Vikrant Vij	Laxmi Publications, New Delhi, Latest edition
6.	Instrumentation Engineering Handbook	LIPTAK	Chilton Book Company , Latest edition
7.	Distributed Computer Control for Industrial Automation	POPOVIC & BHATKAR	CRC Press, New Delhi, Latest edition
8.	Computer Based Industrial Control	KRISHNA KANT	PHI, New Delhi, Latest edition
9.	Power Electronics – Circuits, Devices and Applications	RASHID M. H	PHI / Pearson Education

B) Major Equipment/Materials with Broad Specifications

- i. PLC trainer
- ii. AC drive trainer
- iii. DC drive trainer
- iv. DCS Trainer

C) Software/Learning Websites

- (1) PLC simulator (freeware)
- (2) DCS simulator
- (3) Learning Websites
 - i. www.control.com
 - ii. www.plcs.net
 - iii. www.pacontrol.com
 - iv. En.wikipedia.org
 - v. www.seimens.com
 - vi. www.ab.rockwellautomation.com › Allen-Bradley
 - vii. www.abb.co.in
 - viii. www.triplc.com
 - ix. <http://plc-training-rslogix-simulator.soft32.com/free-download/>
 - x. www.youtube.com
 - xi. www.ourinstrumentationgroup.com
 - xii. www.plcsimulator.net/
 - xiii. <http://scada.winsite.com>

xiv. <http://sourceforge.net/projects/scadabr/files/latest/download?source=directory>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. B. P. Raval**, Lecturer, Electronics and Comm. Engineering, G.P. Rajkot
- **Prof. K.R. Vadalia** Lecturer, Electronics and Comm. Engineering, G.P. Rajkot
- **Prof. T. R. Parmar**, Lecturer, Electronics and Comm. Engineering, G.P. Palanpur
- **Prof. B.B. Renuka**, Lecturer, Electronics and Comm. Engineering, AVPTI, RAJKOT
- **Prof. A.R. Chandegara**, Lecturer, Electronics and Comm. Engineering, G.P. Palanpur

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. Anjali Potnis**, Assistant Professor, Department of Electrical and Electronics Engineering
- **Prof. Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering