GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL & ELECTRONICS ENGINEERING
INDUSTRIAL AUTOMATION
SUBJECT CODE: 2180807
B.E. 8thSEMESTER

Type of course: A study of the applications of Industrial Automation Systems

Prerequisite: Control System Engineering and Digital Control System

Rationale: The course provides the student with basic knowledge of the industrial automation systems design, installation, modification, maintenance, and repair. Automation is the aura of any industry. It has found its place and importance in Industries to handle any sophisticated process to increase the productivity. In consequence, automation experts play a quintessential role in Industries which systematize the Plant operations. It explores to the technology of Industrial Automation and Control as widely seen in factories of all types both for discrete and continuous manufacturing. The course discusses a wide range of related topics from the advantage and architecture of automation systems, measurement systems including sensors and signal conditioning, discrete and continuous variable control systems, hydraulic, pneumatic and electric actuators, industrial communication and embedded computing and CNC Machines.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Total Hrs.	% Wtg.
1.	**General Concepts:** General concepts of the industrial production. Concepts of production systems and production processes. Automation production systems and their classification. Architecture of Industrial Automation Systems.	**4**	**10-15%**
2.	**Control Technologies in Automation:** Industrial Control Systems, Process Industries Versus Discrete-Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms. Controlled variable, controlling parameters, process equation load, transient, process, lag, self-regulation, control lag, variable range, dead time, cycling.	**8**	**20-25%**

3.	**Introduction to Automatic Control:** Characteristic of different discrete controller mode, two position mode, multi position mode, floating control mode, introduction of different continuous controller mode. Proportional, integral, derivative, PI, PID Control, PID Control Tuning, Feed forward Control Ratio Control, Time Delay Systems and Inverse Response Systems, Special Control Structures, Introduction to Sequence Control, PLC, RLL, Sequence Control. Scan Cycle, Simple RLL Programs, Sequence Control. More RLL Elements, RLL Syntax, A Structured Design Approach to Sequence Control, PLC Hardware Environment	**14**	**30-40%**
4.	**Control System Components:** Flow Control Valves, Hydraulic Control Systems – I, Hydraulic Control Systems – II, Industrial Hydraulic Circuit, Pneumatic Control Systems – I, Pneumatic Systems – II, Energy Savings with Variable Speed Drives, Introduction to CNC Machines	**8**	**20-25%**
5.	**Distributed Control System:** Evaluation of DCS, system architecture-hierarchical of DCS at function levels, Database organization, system implementation concepts, System elements-fields, station, intermediate station, central computer system, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADA. Higher Level Automation Systems	**12**	**25-30%**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	28	21	7	7	-

Reference Books:

1. Johnson, C.D., "Process Control Instrumentation Technology", Prentice Hall.
2. Liptak, B.G., "Instrument Engineers – Handbook", (Vol. – II), CRC Press.
3. Groover, M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, 5th Ed, 2009.
4. Krishna Kant, "Computer Based Industrial Control", EEE-PHI, 2nd Ed, 2010.
5. Viswanandham, "Performance Modeling of Automated Manufacturing Systems", PHI, 1st Ed, 2009.
6. Morriss, S.B., "Programmable Logic Controllers", Prentice hall.
7. Webb, J.W., and Reis, R.A., "Programmable Logic Controllers: Principles & Applications", Prentice Hall, 2002.
8. Shinskey, F.G., "Process Control Systems: Application, Design and Tuning", McGraw-Hill Professional, 1996.
9. Thomas E. Marlin, "Process Control: Designing Processes and Control for Dynamic Performance", McGraw – Hill, International Edition
10. Dale E. Seborg, Thomas F. Edger, Duncan A. Mellichamp, "Process Dynamics and Control", Wiley India.

Course Outcome: After the successful completion of this course, the student will be able:

1. To identify potential areas for automation and justify need for automation
2. To select suitable major control components required to automate a process or an activity

3. To translate and simulate a real-time activity using modern tools and discuss the benefits of automation.
4. To identify suitable automation hardware for the given application.
5. To recommend appropriate modeling and simulation tool for the given manufacturing application.

Suggested list of experiments:

1. Introduction of PLC and PLC trainer system kit
2. Introduction to PLC Programming
3. Input/ Output specifications, wiring & configuration of PLC
4. To develop a ladder diagram for a stepper motor based pick & place jig
5. To develop a ladder diagram for an L.V.D.T. and lead screw type arrangement jig
6. To develop a ladder diagram for a Bottle filling and Conveyor belt jig
7. To develop a ladder diagram for temperature measurement and control jig
8. To develop a ladder diagram for sequential lamp On/Off jig
9. Interfacing of PLC to the PC and Real-time programming
10. To Study of SCADA based industrial automation

SUGGESTED LIST OF STUDENT ACTIVITIES:

Industrial Control Applications: Cases Studies minimum one for Cement, Thermal, Water Treatment & Steel Plants applications

Major Equipments:

Programmable Logic Controllers PLC Training Kit Hardware, Software & USB Interface

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include 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 power-point slides 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.