INDUSTRIAL AUTOMATION		
Course Code: 16G5B10		**CIE Marks: 100**
Credits: L:T:P:S:: 4:0:0:0		**SEE Marks: 100**
Hours: 44		**SEE Duration: 3Hrs**

Course Learning Objectives: The students should be able to:	
1	Identify types of actuators, sensors and switching devices for industrial automation
2	Explain operation and controls of Hydraulic and Pneumatic systems
3	Understand fundamentals of CNC, PLC and Industrial robots
4	Define switching elements and sensors which are interfaced in an automation system
5	Describe functions of Industrial switching elements and Inspection technologies for automation
6	Select sensors to automatically detect motion of actuators
7	Develop manual part programs for CNC and Ladder logic for PLC
8	Develop suitable industrial automation systems using all the above concepts

UNIT-I	
Automation in Production Systems: Manufacturing support systems, Automation principles and strategies, Levels of Automation, Production Concepts and Mathematical models, Numericals **Automated Production Lines:** Fundamentals, Applications, Analysis with no storage, Analysis with storage buffer, Numericals	**08 Hrs**
UNIT-II	
Switching theory and Industrial switching elements Binary elements, binary variables, Basic logic gates, Theorems of switching algebra, Algebraic simplification of binary function, Karnough maps, Logic circuit design, problems. Electromechanical relays, Moving part logic elements, Fluidic elements, Timers, Comparisons between switching elements, Numericals **Industrial Detection Sensors and Actuators:** Introduction, Limit switches, Reed switches, Photoelectric sensors- methods of detection, Hall effect sensors, Inductive proximity sensors, Capacitive proximity sensors, Pneumatic back pressure sensors, Absolute encoder, Incremental encoder, Pressure switches and temperature switches; their working principles and applications, Brushless DC motors, Stepper motors and Servo motors	**08 Hrs**
UNIT-III	
Hydraulic Control circuits Components, Symbolic representations, Control of Single and Double Acting Cylinder, Regenerative Circuit application, Pump unloading circuit, Double Pump Hydraulic System, speed control circuits, accumulator circuits **Pneumatic Control circuits** Components, Symbolic representations as per ISO 5599, Indirect control of double acting cylinders, memory control circuit, cascading design, automatic return motion, quick exhaust valve circuit, and cyclic operation of a cylinder, pressure sequence valve and time delay valve circuits.	**10 Hrs**

UNIT-IV	
Introduction to CNC Numerical control, components of CNC, classification, coordinate systems, motion control strategies, interpolation, programming concepts	**08 Hrs**

Industrial Robotics Components of Robots, base types, classification of robots, end of arm tooling, robot precision of movement, programming, justifying the use of a robot, simple numericals	
UNIT-V	
Programmable logic control systems Difference between relay and PLC circuits, PLC construction, principles of operation, latching, ladder diagrams, programming instructions, types of timers, forms of counters, writing simple ladder diagrams from narrative description and Boolean logic. **Programming exercises on PLC with Allen Bradley controller** Programming exercises on motor control in two directions, traffic control, annunciator flasher, cyclic movement of cylinder, can counting, conveyor belt control, alarm system, sequential process, and continuous filling operation on a conveyor.	**10 Hrs**

Course Outcomes: After completing the course, the students will be able to	
1	Illustrate applications of sensors actuators, switching elements and inspection technologies in industrial automation
2	Build circuit diagrams for fluid power automation, Ladder diagrams for PLC and identify its application areas
3	Evaluate CNC programs for 2D complex profiles performed on machining and turning centres interfaced with Robots
4	Develop suitable industrial automated system integrating all of the above advanced automation concepts

Reference Books	
1.	David W. Pessen, 'Industrial automation; Circuit design and components', Wiley India, 1st Edition, 2011, ISBN –13–978–8126529889
2.	Joji P, 'Pneumatic Controls', Wiley India, 1st Edition, ISBN – 978–81–265–1542–4
3.	Anthony Esposito, 'Fluid Power with Applications', 7th Edition, 2013, ISBN – 13; 978–9332518544
4.	Mikell P. Groover 'Automation, Production systems and Computer Integrated Manufacturing, 3rd Edition, 2014, ISBN – 978–81–203–3418–2

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Course with Assignment/ Self-study
Quiz -1	10
Test -1	30
Quiz -2	10
Quiz -3	10
Test -2	30
Assignments	10
Total	**100**
Semester End Evaluation Theory (100)	

Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment/Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**H**				**M**	**L**	**M**	**L**			**L**	**M**
CO2	**L**		**M**	**H**	**M**	**M**	**M**			**M**		
CO3		**L**		**M**	**L**					**M**		
CO4			**H**	**M**	**M**	**L**		**M**	**M**	**H**	**M**	**M**

Low-1 Medium-2 High-3