U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

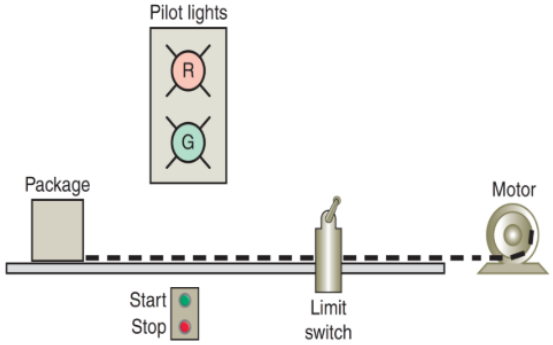
Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: VI**
Branch: Electronics and Instrumentation Engineering **Duration: 3 hrs.**
Course Code: 22EI6PCPSA **Max Marks: 100**
Course: Process Automation

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Output of the program to be mentioned wherever applicable

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		MODULE - I	CO	PO	Marks
1	a)	Compare the various types of automation system.	CO1	PO1	**08**
	b)	Enumerate the advantages and disadvantages of DDC.	CO1	PO1	**06**
	c)	Explain the architecture of a PLC with suitable diagram.	CO1	PO1	**06**
		OR			
2	a)	Define Automation. Explain the key characteristics that differentiate between various automation technologies.	CO1	PO2	**08**
	b)	Propose a schematic for the internal circuitry of a discrete AC input module for a PLC. Provide reasoning behind your component selection and how the circuit achieves its function	CO1	PO2	**06**
	c)	Describe the essential components of a Direct Digital Control (DDC) system used in building automation and list the advantages.	CO1	PO2	**06**
		MODULE - II			
3	a)	With the help of ladder diagram explain the importance of Latching relay	CO2	PO2 PO3	**05**
	b)	Design a ladder program for a sequential process control as shown in Fig 2b according to IEC 61131.3 standards and summarize the operation  Fig 2 b	CO2	PO2 PO3	**06**

<table>
<tr><td></td><td></td><td>c)</td><td>The PLC controlled grinding system uses a conveyor belt to feed objects through rough and fine grinding stages based on sensor detection. Pressing a start button initiates the process, grinding each object for set times and activating a packing light upon completion. Safety features like emergency stops and sensor-based interlocks can be added for robustness. Develop a suitable ladder program as per IEC 61131-3 standards to simulate Automatic Grinding Process and justify the operation.</td><td>CO2</td><td>PO2
PO3</td><td>09</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>a)</td><td>In a ladder diagram, how does a retentive timer differ from a regular timer? Explain the benefits of using a retentive timer with suitable diagram</td><td>CO2</td><td>PO2
PO3</td><td>06</td></tr>
<tr><td></td><td>b)</td><td>Iguatemi Shopping Mall, located in Fortaleza, is the second largest mall in the Brazilian region of Ceará. Every day an average of 50.000 customers visit the stores, restaurants, cinemas and premises of Iguatemi Fortaleza mall, fully embracing its extensive leisure offer.
This amount of traffic requires an advanced parking facility, able to manage the continuous flow of customers without downtime and complications. Suggest a suitable PLC logic to automate parking system</td><td>CO2</td><td>PO2
PO3</td><td>07</td></tr>
<tr><td></td><td>c)</td><td>Gravelly Hill Interchange is junction 56 of the M6 motorway and is more commonly known as the spaghetti junction. Since the junction is witnessing heavy vehicular movements from North to South and East to West direction. It is suggested to automate the traffic signal using PLC for vehicles moving in both directions. Design a suitable ladder program to so as to suit all critical situations as per standards.</td><td>CO2</td><td>PO2
PO3</td><td>07</td></tr>
<tr><td></td><td></td><td>MODULE - III</td><td></td><td></td><td></td></tr>
<tr><td>5</td><td>a)</td><td>Consider a situation wherein a PLC accepts the temperature in Celsius from the thumbwheel switch and displays in Fahrenheit. Design a suitable ladder logic to implement the same.</td><td>CO2</td><td>PO2
PO3</td><td>05</td></tr>
<tr><td></td><td>b)</td><td>
<table>
<tr><td>N/S</td><td colspan="3">Red</td><td>Green</td><td>Yellow</td></tr>
<tr><td>E/W</td><td>Green</td><td>Yellow</td><td>Red</td><td colspan="2">Red</td></tr>
<tr><td>Time in Sec</td><td>20 Sec</td><td>5 Sec</td><td>5 Sec</td><td>10 Sec</td><td>5 Sec</td></tr>
</table>
Fig 4 b
Shibuya Crossing, Tokyo, Japan is highly-trafficked intersection and is famous for its massive pedestrian scramble crossings. When the pedestrian light turns green, pedestrians flood the intersection in all directions, creating a visually striking scene. A traffic signal with the timing chart as shown in</td><td>CO2</td><td>PO2
PO3</td><td>08</td></tr>
</table>

			Fig 4 b is suggested by an expert committee. Analyze the requirement and develop a ladder logic, integer table to execute a series of actions based on a predefined timing sequence using SQO instruction as per IEC standards. Summarize the execution of the ladder logic being proposed.			
		c)	How can the SQI instruction be used in PLC programming to monitor machine operating conditions? Provide a specific example to illustrate its practical application.	*CO2*	*PO2* *PO3*	**07**
			OR			
	6	a)	Enumerate the various Data Manipulation and Data Compare instructions available in PLC.	*CO1*	*PO1*	**06**
		b)	Design a ladder diagram for Vessel Overfill alarm using appropriate logic as per IEC 61131.3 standards and summarize the sequence of operation	*CO2*	*PO2* *PO3*	**07**
		c)	Explain the event driven sequencer instruction with appropriate PLC instructions.	*CO2*	*PO2* *PO3*	**07**
			MODULE - IV			
	7	a)	Describe how a DCS utilizes its key functional components to achieve industrial process automation.	*CO3*	*PO4* *PO6*	**08**
		b)	Considering a typical industrial process with several interconnected control loops (e.g., temperature control, pressure regulation), propose a suitable Distributed Control System (DCS) architecture. Justify your choices for each level (field level, control level, operator interface) based on the process requirements and desired functionalities.	*CO3*	*PO4* *PO6*	**08**
		c)	Enumerate the advantages of DCS	*CO1*	*PO2*	**04**
			OR			
	8	a)	Define DCS. Explain the key features of DCS	*CO1*	*PO1*	**06**
		b)	Design and illustrate a suitable DCS architecture for a typical industrial process. Justify your design choices considering factors like scalability, reliability, safety, and maintainability.	*CO3*	*PO4* *PO6*	**08**
		c)	Explain the role of controllers in a DCS	*CO1*	*PO1*	**06**
			MODULE - V			
	9	a)	Consider a scenario where a SCADA system is used to monitor and control an industrial process. Explain how the different components would work together to achieve effective monitoring and control of a process	*CO3*	*PO4* *PO6*	**06**
		b)	What are the benefits of using a SCADA system	*CO1*	*PO2*	**05**
		c)	How do Networked SCADA Systems and IoT SCADA Systems differ in their architectures and functionalities, particularly in the context of data acquisition, control capabilities, and security considerations?	*CO3*	*PO4* *PO6*	**09**

			OR			
	10	a)	Summarize the essential principles that contribute to a high-quality Human-Machine Interface (HMI)	*CO3*	*PO4* *PO6*	**08**
		b)	What are the key differences and functionalities between Operator/Mimic panels and Operator Stations	*CO3*	*PO4* *PO6*	**06**
		c)	Explain the general data structure of HMI with suitable diagram	*CO3*	*PO4* *PO6*	**06**

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