U.S.N.										

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

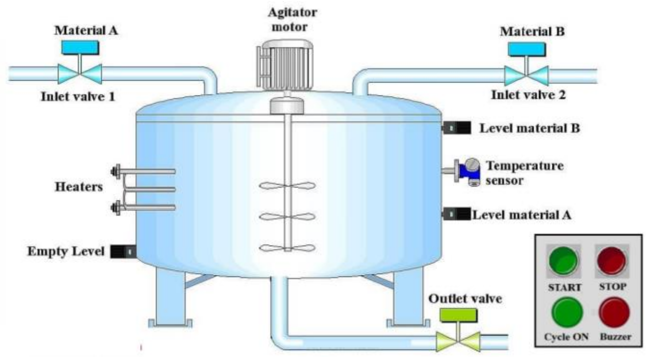
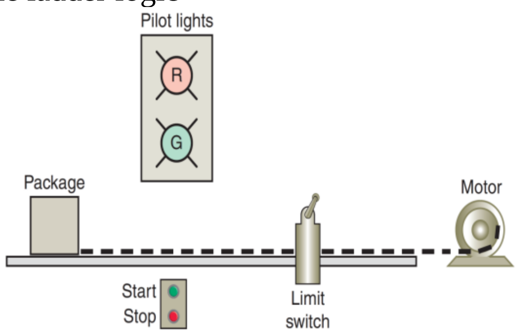
Autonomous Institute Affiliated to VTU

June 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 MODULE.
2. Missing data, if any, may be suitably assumed.
3. Output of the program to be mentioned wherever applicable

		MODULE I	***CO***	***PO***	**Marks**
1	a)	What is automation? Enumerate the key advantages of automation.	*CO1*	*PO1*	**06**
	b)	Suggest and justify a block diagram illustrating the data acquisition process from the physical layer in an automated plant, outlining the key components involved in transmitting this data to the next layer of the automation system.	*CO1*	*PO2*	**08**
	c)	Describe the internal circuitry of a discrete AC output module for a Programmable Logic Controller (PLC).	*CO1*	*PO1*	**06**
		OR			
2	a)	Imagine a ladder program with several rungs, each containing inputs (like switches) and outputs (like lights). Explain the step-by-step program's execution with the help of a diagram.	*CO1*	*PO1*	**08**
	b)	Explain the various programming languages for PLCs as per IEC 61131-3 standards.	*CO1*	*PO2*	**06**
	c)	Propose a suitable ladder logic to implement following equations i) Y=(A+B) CD ii) Y= $A\,\bar{B}\,C + \bar{D} + \bar{E}$	*CO2*	*PO2*	**06**
		MODULE II			
3)	a)	Design a suitable ladder logic program for controlling the process as shown in Fig 3(a), adhering to the IEC 61131.3 standard. Justify the working considering factors such as motor turn-on time and overall process safety.	*CO2*	*PO3*	**09**

		 Fig 3(a)			
	b)	Develop a safe and functional ladder logic program for a conveyor belt system (refer to Fig 3(a)) adhering to IEC 61131-3 standards. The program should ensure proper operation of the conveyor and include necessary safety measures. Summarize the operational sequence as controlled by the ladder logic  Fig 3(b)	*CO2*	*PO3*	**06**
	c)	Explain the various types of timers available in PLCs.	*CO2*	*PO1*	**05**
		OR			
4	a)	Develop a ladder logic program (IEC 61131-3) for a system that requires the sequential shutdown of three motors with a 5-second delay between each. Utilize off-delay timers to achieve this functionality. Summarize the operational sequence of the system.	*CO3*	*PO3*	**07**
	b)	Design an automated grinding process control system(Fig 4(b)) using ladder logic compliant with IEC 61131-3. The system should incorporate a mechanism to account for the turn-on time of the grinding motors. Describe the explanation of the system's operation.	*CO3*	*PO3*	**09**

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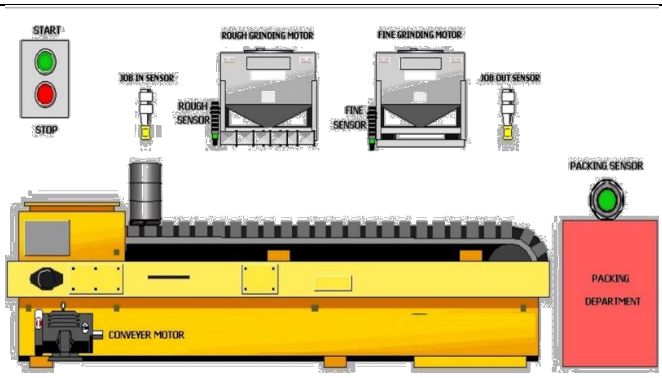
<tr><td></td><td></td><td>

Fig 4(b)</td><td></td><td></td><td></td></tr>
<tr><td></td><td>c)</td><td>Explain the operation of various types of counters.</td><td>CO3</td><td>PO1</td><td>04</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>Explain the functionality of the Sequencer Compare (SQC) instruction within a PLC program. How does it contribute to sequence control.</td><td>CO3</td><td>PO1</td><td>06</td></tr>
<tr><td></td><td>b)</td><td>Develop a PLC program to regulate an oven's temperature. The program must ensure the oven operates within a +/- 1% tolerance around a setpoint of 600°F. Describe the working of the ladder logic.</td><td>CO3</td><td>PO3</td><td>07</td></tr>
<tr><td></td><td>c)</td><td>Suggest appropriate method how BCD input interface module can be connected to a thumbwheel switch.</td><td>CO3</td><td>PO1</td><td>07</td></tr>
<tr><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>a)</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>
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Fig 6(a)
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 Fig 5 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.</td><td>CO3</td><td>PO3</td><td>07</td></tr>
<tr><td></td><td>b)</td><td>An industrial process requires temperature monitoring in Fahrenheit. Design a PLC ladder logic program to interface with a thumbwheel switch for Celsius input and provide the converted Fahrenheit temperature to the control system.</td><td>CO3</td><td>PO3</td><td>07</td></tr>
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	c)	Explain the various data manipulation commands performed by PLC.			**06**
		MODULE IV			
7	a)	Explain the important parameters to be considered while designing a DCS network	*CO4*	*PO1*	**06**
	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.	*CO4*	*PO2*	**09**
	c)	Enumerate the advantages of DCS.	*CO4*	*PO1*	**05**
		OR			
8	a)	Suggest the key functional components of a Distributed Control System (DCS) work together to achieve process control and automation in industrial settings?	*CO4*	*PO2*	**08**
	b)	Guiness Brewery located at Ireland is one of the most successful beer brands worldwide. It is a large-scale manufacturing/process plant comprising of control loops that needs to be monitored and controlled. Suggest a suitable DCS architecture and justify the same.	*CO4*	*PO2*	**10**
	c)	Define Distributed Control Systems.	*CO4*	*PO1*	**02**
		MODULE V			
9	a)	Enumerate the various types of SCADA. Describe the essential components of a SCADA system and explain how they interact to achieve effective monitoring and control of a process.	*CO3*	*PO2*	**07**
	b)	Distribution Monitoring and Control pose unique challenges for SCADA systems due to their critical need for reliability, diverse functionalities, and seamless compatibility across a vast network. Considering these challenges, analyze the specific requirements and suggest a suitable SCADA system and justify the same.	*CO3*	*PO2*	**08**
	c)	What are the benefits of using a SCADA system.	*CO1*	*PO1*	**05**
		OR			
10	a)	Design a mimic-based operator panel for a water-heating process control system. Justify mimic-based interface for this specific application with a neat diagram of the panel.	*CO4*	*PO2*	**08**
	b)	Summarize the essential principles that contribute to a high-quality Human-Machine Interface (HMI).	*CO4*	*PO1*	**06**
	c)	Analyse the similarities and differences between Programmable Logic Controllers (PLCs) and Operator Interfaces (Desktop-Based).	*CO4*	*PO1*	**06**

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