Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, May 2025

Course: Programmable Logic Controller & HMI **Semester:** VI

Program: B. Tech (Mechatronics Engineering) **Time:** 03 hrs.

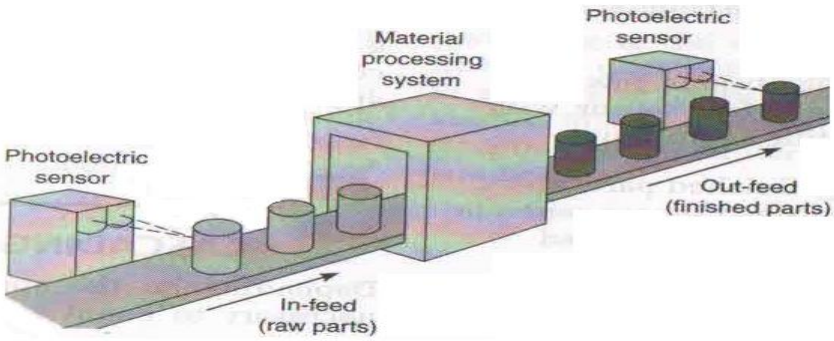
Course Code: ECEG3045 **Max. Marks: 100**

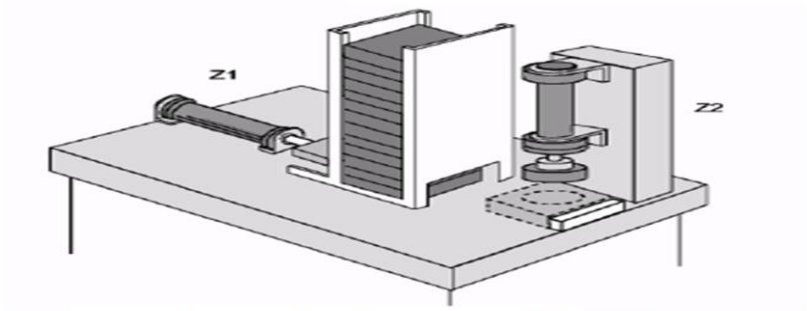
Instructions: This question paper has three sections, Section A, Section B, and Section C.

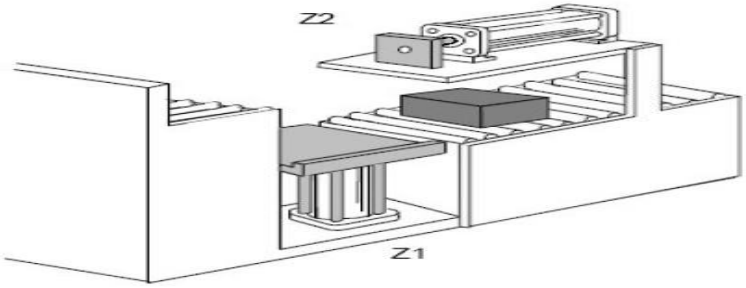
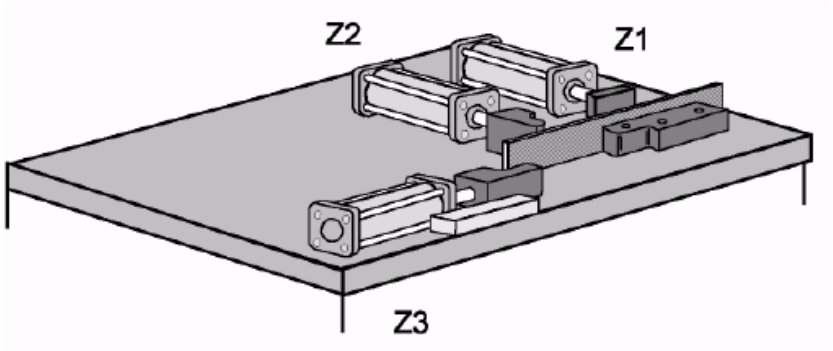
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Define HMI and SCADA and explain its functionality.	**4**	**CO1**
Q 2	With technical details like Data Rate, Frame format, and error handling method, explain the PROFIBUS communication protocol.	**4**	**CO2**
Q 3	With a neat diagram describe the control word register format for the analog input module (R-IB IL AI 2/SF-230-PAC).	**4**	**CO3**
Q 4	Construct a PLC ladder diagram and realize the expression $Y = A + \overline{B} + C$.	**4**	**CO2**
Q 5	Explain why a stop button must be normally closed and a start button must be normally open.	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

Q 6	A process is supposed to have exactly 15 parts in it. You have three indicating lights to indicate the conveyor count status: less than 15, yellow: exactly 15, green: and more than 15, red. The count of parts on the conveyor is set at 15 each morning by an actual count of parts. There are two sensors on the conveyor, one is actuated by parts entering the conveyor, and the other is actuated by parts leaving. Design a PLC program to carry out this process, the system should also include a start and stop button.  	**10**	**CO4**

Q 7	Assume three conveyors feed a main conveyor. Each conveyor has a proximity sensor that counts from each feeder conveyor and feeds into the main conveyor. Construct a PLC ladder logic program to obtain the total count of parts on the main conveyor. Use the time to update the total every 10 seconds. If the total count after 10 seconds on the main conveyor reaches 120 then stop all feeder conveyors.	**10**	**CO4**
Q 8	Design a PLC ladder diagram and hardware configuration for the stamping device shown below figure. After actuating the start button switch sequence will execute. Assume 2nd cylinder Z2 requires 2 minutes to do stamping work. Also, assume all cylinder's default position is the home position. Consider an impulse directional control valve. **(Sequence is A+ B + A -B -)**  Example: Stamping Device	**10**	**CO4**
Q 9	Write a PLC program for an indicating light to go ON when a count reaches 3. The light then goes off when a count of 5 is reached. Design, construct, and test PLC circuits for this process. **OR** In a car parking station, a maximum of 10 cars can be parked. Two photoelectric sensors are placed in the station Entry and OUT gate to sense the entering and leaving cars. Based on the no. of cars parked in the station three different color lamps were switched ON 1. When zero car in the parking station then the green lamp ON 2. If no. of cars from 1 to 9 yellow lamp is switched ON 3. If no. of cars in the station is equal to 10 red lamps are switched ON	**10**	**CO3**
SECTION-C (2Qx20M=40 Marks)			
Q 10	Design a PLC ladder diagram and hardware configuration for the workpieces coming in on the right roller conveyor should be elevated and sent in a new direction. After actuating the start button, the piston of the cylinder raises the workpieces to the height of the second roller conveyor with its elevating platform. Cylinder 1 remains in this position until cylinder 2 has pushed the workpieces from the elevating platform onto the upper roller conveyor. When cylinder 2 has securely pushed all the workpieces onto the upper Roller	**20**	**CO4**

	conveyor, cylinder 1 moves down again only when the cylinder has retracted into its lower-end position does cylinder 2 also retract. Additionally, a new start is only possible when the cylinder is in its back-end position.  		
Q 11	A machine is connected to a load cell that outputs a voltage proportional to the mass on a platform. When unloaded the cell outputs a voltage of 0V. A mass of 1000 Kg results in a 10V output. Write a program that will measure the mass when an input sensor (M) becomes true. If the mass is between 500Kg to 600 Kg and alarm output (A) will be turned ON. If 800 Kg to 900 Kg then alarm output, (B) will be turned ON. Write ladder logic and indicate the general settings for the analog IO. **OR** Design a displacement-dependent sequential control system using three double-acting cylinders and impulse-operated 5/2 directional control valves. The system should incorporate signal overlapping and follow a step-by-step sequence. The proposed system objective is to demonstrate how the sequence is controlled using proximity (magnetic) sensors mounted on the cylinders. Use electrically controlled impulse valves to actuate the cylinders based on sensor feedback. **(Sequence is A+ B + C + C - A - B -)** • Illustrate the complete control circuit diagram. • Define the step sequence for the operation of all three cylinders. • Explain the role of signal overlapping in maintaining proper control.  	**20**	**CO5**