UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
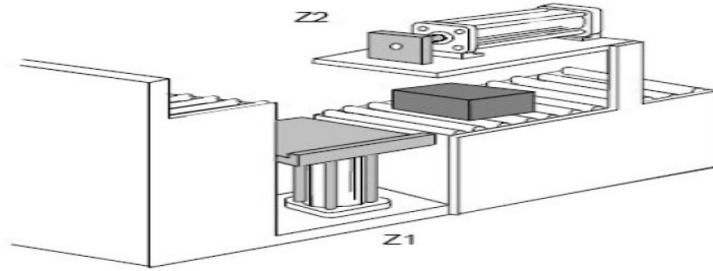### End Semester Examination, May 2022

Course: Program Logic Controller & HMI **Semester:** VI
Program: B. Tech (Mechatronics Enginnering) **Time:** 03 hrs.
Course Code: MECH 3006 **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 ? Explain its funactlity.	4	CO1
Q 2	With technical details like Data Rate, Frame format and error handling method, explain PROFIBUS communication protocol.	4	CO2
Q 3	With neat diagram describe control word register format for analog input module (R-IB IL AI 2/SF-230-PAC).	4	CO3
Q 4	Construct a PLC ladder diagram and realize the given expression $Y = A + \bar{B} + C$.	4	CO3
Q 5	Define SCADA system.	4	CO 1

SECTION B
(4Qx10M= 40 Marks)

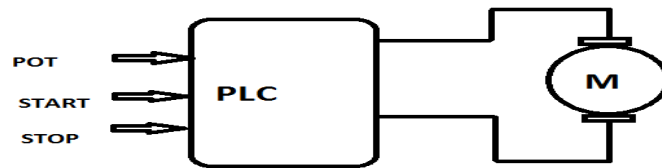| Q 6	In order to avoid high starting currents, three-phase asynchronous motors are firstly switched in a star connection and then, after a time delay, switched over into a delta connection. By activating the S1 pushbutton "Start", the star contactor K2 and the main contactor K1 are activated. The star contactor K2 is deactivated after a time delay of 5 s and simultaneously, the delta contactor K3 is activated. By activating the S2 pushbutton "Stop" or the motor protection switch F2, the control is immediately set into the idle state. You have to note in the program preparation that the main contactor K1 may only be activated if contactor K2 has been activated. It must moreover be ensured that the star contactor K2 and the delta contactor K3 are never activated simultaneously. The respective switching states of the contactors are to be queried via S4 and S5. 1. Determine the type of the signal encoders and receivers and prepare an assignment list. 2. Prepare a variable decleration table. 3. Design a ladder diagram for process.	10	CO3

Q 7	Assume three conveyors feed a main conveyor. Each conveyor has a proximity sensor which count from each feeder conveyor and fed into main conveyor. Construct a PLC ladder logic program to obtain the total count of parts on the main conveyor. Use a time to update the total every 10 seconds. If total count after 10 second on 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 in below figure. After actuating start button switch sequence will execute. Assume 2nd cylinder Z2 require 2 minute to do stamping work. Also assume all cylinder default position is home position. Consider impulse directional control valve. **(Sequence is A + B + B - A -)** Example: Stamping Device	10	CO 4
Q 9	Write a PLC program for an indicating light is to go ON when a count reaches 3.The light is then go off when a count of 5 is reached. Design, construct, and test PLC circuits for this process.	10	CO 4
SECTION-C **(2Qx20M=40 Marks)**		
Q 10	Design a PLC ladder diagram and hardware configuration for the Work pieces coming in on the right roller conveyor should be elevated and sent in a new direction. After actuating the start button, the piston of cylinder raises	20	CO5

	the work pieces to the height of the second roller conveyor with its elevating platform. Cylinder 1 remains in this position until cylinder 2 has pushed the work pieces from the elevating platform onto upper roller conveyor. When cylinder 2 has securely pushed all the work pieces onto the upper Roller conveyor, cylinder 1 moves down again only when cylinder has retracted into its lower end position does cylinder 2 also retract. Additionally a new start is only possible when cylinder is actually in its back end position. 		
Q 11	Design a PLC ladder diagram and hardware configuration for the DC motor control using PWM method. With potentiometer vary the duty cycle and accordingly speed of the motor should change. Shown in below figure, use appropriate relay to match the current rating. OR For the stepper motor, consider minimum step angle is $1°$ and pulse train to run the motor is generated by the PLC. a) How many pulses are required to rotate the motor through five complete revolutions? b) If it is desired to rotate the motor at a speed of 25 rev/min, what pulse rate must be generated by the robot controller? Write ladder logic program to rotate the stepper motor 5 times in clockwise and 5 times in counter clockwise direction.	20	CO5