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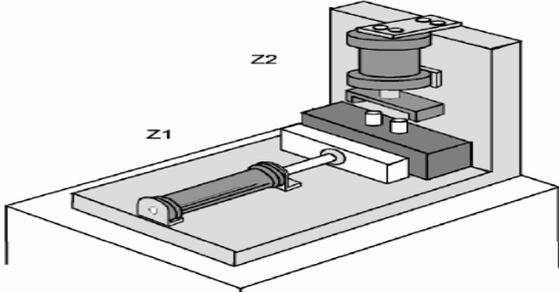
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2021

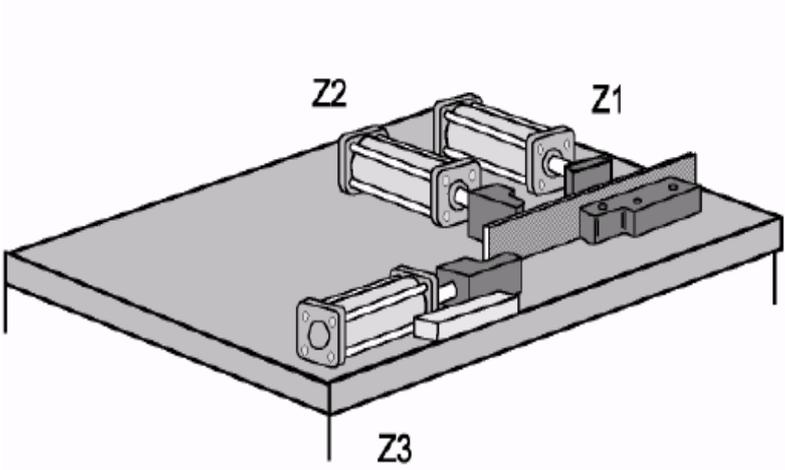
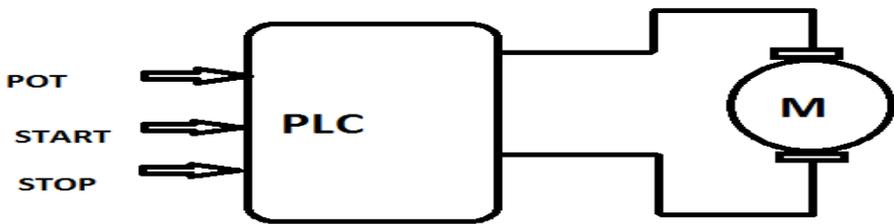
Programme Name:	B. Tech (Mechatronics Engineering)	Semester :	VI
Course Name :	Program Logic Controller & HMI	Time :	03 hrs.
Course Code :	MECH 3006	Max. Marks :	100
Nos. of page(s) :	04		
Instructions:	All questions are compulsory.		

SECTION A
All questions are compulsory and carry equal marks.

S. No.		Marks	CO
Q 1	Explain data manipulation instructions and pulse instruction with example.	5	CO1
Q 2	Explain why networks are important in manufacturing controls. Explain general features of PROFIBUS communication protocol.	5	CO3
Q 3	Briefly list and describe the different methods for addressing values (e.g., word, bit, literal, etc.)	5	CO1
Q 4	What is the difference between HMI and SCADA?	5	CO5
Q 5	Explain the differences between stepper motors, variable frequency induction motors and DC motors using tables.	5	CO2
Q6	Define OSI/ISO Model. Any communication protocol uses which layer and why?	5	CO4

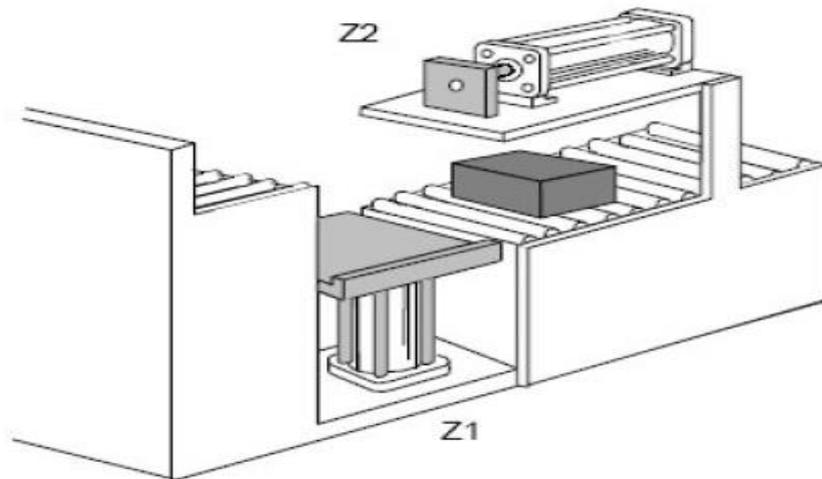
SECTION B
Answer all the questions.

Q 1	<p>Pressing in device</p> <p>Design a PLC ladder diagram and hardware configuration using relay circuit (if required) for the pressing in device shown in below figure. After actuating start button switch sequence will execute. Assume 2nd cylinder Z2 require 1.5 minute to do stamping work. Also assume all cylinder default position is home position. Consider 5/2 spring return directional control valve.</p>  <p align="center">Example of application: "Pressing-in device"</p> <p>(Assume sequence is A + B + B - A -)</p>	10	CO3
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<p>Q 2</p>	<p>Write a PLC program to implement the bending device for sheet metal parts is to be performed on a work piece. The sequence of motion of cylinders is:</p> <ol style="list-style-type: none"> Cylinder 1 clamp the work piece Cylinder 2 performs bending operation on a work piece Cylinder 2 return backs Cylinder 3 performs bending operation on a work piece Cylinder 3 return backs Cylinder 1 unclamps the work piece. (Consider 5/2 impulse directional control valve)  <p>Example of application: "Bending aluminum into hooks"</p>	<p>10</p>	<p>CO4</p>
<p>Q 3</p>	<p>Design a PLC ladder diagram and draw 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. (Motor Rating 24V/ 2.2 A)</p>  <p>OR</p> <p>For the stepper motor, consider minimum step angle is 0.6 ° and pulse train to run the motor is generated by the PLC.</p>	<p>10</p>	<p>CO5</p>

	<p>a) How many pulses are required to rotate the motor through five complete revolutions?</p> <p>b) If it is desired to rotate the motor at a speed of 15 rev/min, what pulse rate must be generated by the robot controller?</p> <p>Write ladder logic program to rotate the stepper motor 3 times in clockwise and 3 times in counter clockwise direction.</p>		
<p>Q 4</p>	<p>“Separating workpieces”</p> <p>Design a PLC ladder diagram and hardware configuration to construct a separating work piece system which operates as follows</p> <div data-bbox="188 734 608 1050" style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>Case 1: manual Operation</p> <p>Case 2: Manual operation with automatic retraction</p> <p>Case 3: Fully automatic operation.</p> </div> <div data-bbox="683 792 1241 1037" style="text-align: center;"> </div>	<p>10</p>	<p>CO4</p>
<p>Q 5</p>	<p>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 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</p>	<p>10</p>	<p>CO3</p>

start is only possible when cylinder is actually in its back end position.



SECTION-C
Answer all the questions.

Q 1 4 tanks that can be manually emptied are filled from one joint storage tank using 4 pumps. For the "Max" (full) notification and the "Min" (empty) notification, each tank has a signal encoder. The pumps have different connected loads.

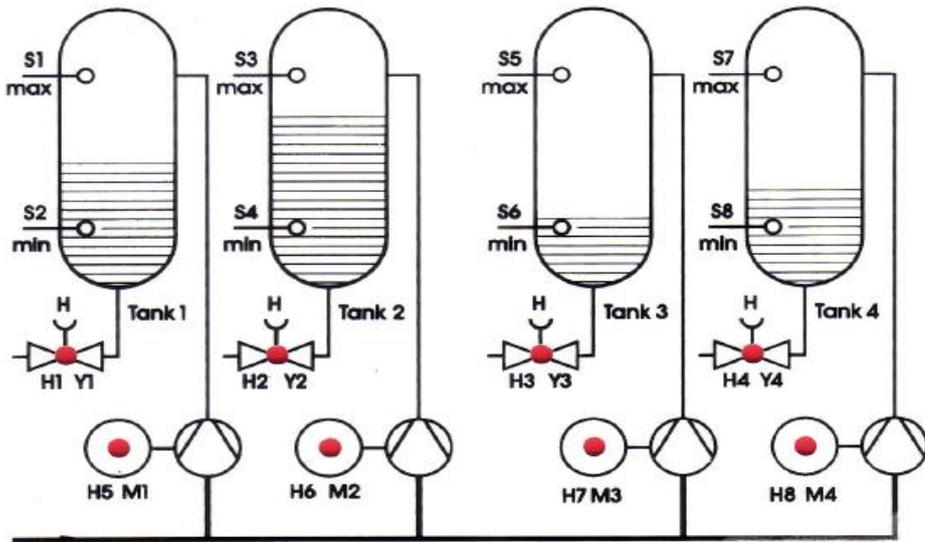
- Pump 1: 3 kW
- Pump 2: 2 kW
- Pump 3: 7 kW
- Pump 4: 5 kW

A control is to secure that in the "Max" (full) notification regarding one tank, the latter is automatically refilled. In doing so, the connected load of 10 kW must not be exceeded.

1. Determine the type of the signal encoders and receivers and prepare an assignment list.
2. Prepare a variable declaration chart
3. Prepare the PLC program.

(20)

CO5



OR

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 1V. A mass of 500Kg results in a 6V output. Write a program that will measure the mass when an input sensor (M) becomes true. If the mass is between 300Kg to 400Kg and alarm output (A) will be turned ON. If 400 Kg to 500 Kg then alarm output, (B) will be turned ON. Write ladder logic and indicate the general settings for the analog IO.