Q. Code:816098

Reg. No. | | | | | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Seventh Semester

ME18703 – MECHATRONICS

(Mechanical Engineering)

(Regulation 2018 / 2018 A)

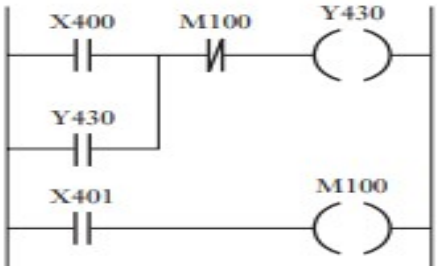
TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	The students will illustrate and understand the basic concepts of Mechatronics system and its constituent systems such as measurement system, control systems and various sensors and transducers involved in mechatronics system design.	**2**
CO 2	The students will be able to develop the programming for microprocessor and microcontroller which they can be implemented in mechatronic system design.	**3**
CO 3	The students will be able to interface the various modules involved in mechatronics system design.	**3**
CO 4	The students will be able to write the programs to automate any manufacturing process using PLC	**3**
CO 5	The students will be able to design a mechatronics system for a given application using a mechatronics approach.	**3**

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Indicate True or False or the correct answer. a. Condition monitoring means monitoring the condition of a machine when it is not running. b. Eddy-current type of transducer produces an output proportional to velocity.	**1**	**3**
2.	Understand the purpose of the following mechatronic system and recommend appropriate sensors and actuators to carry out the specified task. a. Temperature Control System Purpose: To maintain the temperature of a confined space at the specified temperature. b. Anti-Lock Braking System Purpose: To prevent wheels from locking up by automatically modulating the brake pressure during an emergency stop.	**1**	**3**
3.	Define opcode and operand, and specify the opcode and operand in the instructions MOV H, L.	**2**	**2**
4.	Write a line of assembler program for (a) load the accumulator with 20 (hex), (b) decrement the accumulator A, (c) clear the address H0020, (d) ADD to accumulator A the number at address H0020.	**2**	**3**
5.	Devise a timing circuit that will switch on an output for 1 s then off for 20 s, then on for 1 s, then off for 20 s, and so on.	**3**	**3**
6.	Write the program instructions corresponding to the program in Figure and state the results of inputs to the PLC.	**3**	**3**



7.	What is Mechatronics? How is it different from the traditional approach to designing? State the advantage of using the mechatronics design methodology.	**4**	**3**
8.	Design a system involving a PLC for placing on a conveyor belt of boxes in batches of four.	**4**	**3**
9.	List four sensors used in the Electronic Engine management system and their functions.	**5**	**2**
10.	Name any four applications of microsensors in a mechatronics system.	**5**	**2**

PART- B (5 x 14 = 70 Marks)

			Marks	CO	RBT LEVEL
11. (a)		Discuss the principles of operation and the various types of stepper motors used in industrial applications. Provide examples of industrial scenarios where each type of stepper motor would be most suitable and justify your choices.	**(14)**	**1**	**3**
		(OR)			
(b)	**(i)**	Outline the method used to actuate inductive and capacitive proximity sensors.	**(7)**	**1**	**2**
	(ii)	Compare the operation of the reflective-type and through-beam photoelectric sensors.	**(7)**	**1**	**2**
12. (a)	**(i)**	With a neat sketch, explain the architecture of 8255 PPI.	**(10)**	**2**	**2**
	(ii)	Match the following.	**(4)**	**2**	**2**

i) Direct addressing mode	MVI A, 20H
ii) Indirect addressing mode	MOV A, B
iii) Register addressing mode	LDC C200H
iv) Immediate addressing mode	MOV A, M

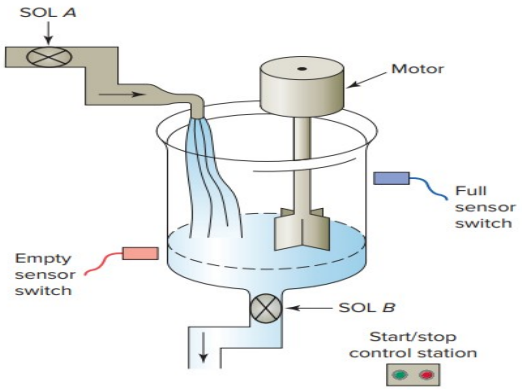
(OR)

(b)	**(i)**	Write programs in assembly language to subtract a hexadecimal number in memory address 0050 from a hex decimal number in memory location 0060 and store the result in location 0070.	**(9)**	**2**	**3**
	(ii)		**(5)**	**2**	**3**

Data transfer instructions	JNC
Arithmetic instructions	HLT
Branching instructions	MOV B, C
Logical Instructions	ADD B
Control Instructions	ORI

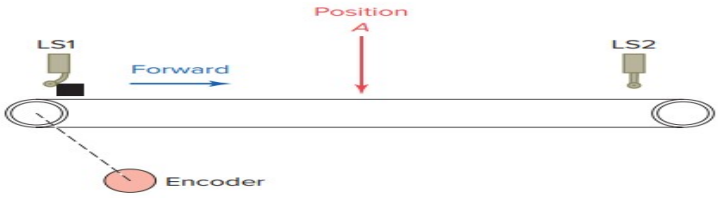
13. (a)		Write a program to implement the process illustrated in Figure. The sequence of operation is to be as follows: • Normally open start and normally closed stop pushbuttons are used to start and stop the process. • When the start button is pressed, solenoid A energizes to start filling the	**(14)**	**3**	**3**

tank.
• As the tank fills, the empty level sensor switches close.
• When the tank is full, the full-level sensor switches close
• Solenoid A is de-energized.
• The agitate motor starts automatically and runs for 3 min to mix the liquid.
• When the agitate motor stops, solenoid B is energized to empty the tank.
• When the tank is empty, the empty sensor switch opens to de-energize solenoid B.
• The start button is pressed to repeat the sequence.



(OR)

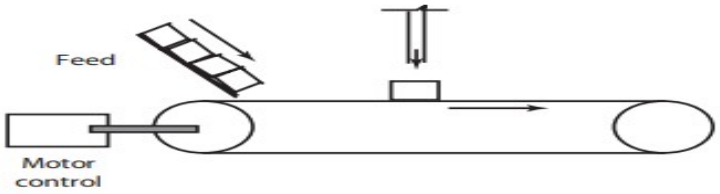
(b) Design a PLC program and prepare a typical I/O connection diagram and ladder logic program that will correctly execute the industrial control process in Figure. The sequence of operation is as follows: **(14) 3 3**
• Product in position (limit switch LS1 contacts close).
• The start button is pressed, and the conveyor motor starts to move the product forward toward position A (limit switch LS1 contacts open when the actuating arm returns to its normal position).
• The conveyor moves the product forward to position A and stops (position detected by 8 off-to-on output pulses from the encoder, which are counted by an up-counter).
• A time delay of 10 s occurs, after which the conveyor starts to move the product to limit switch LS2 and stops (LS2 contacts close when the actuating arm is hit by the product).
• An emergency stop button is used to stop the process at any time.
• If the sequence is interrupted by an emergency stop, the counter and timer are reset automatically.



14. (a) Present outline solutions of possible designs for the following: **(14) 4 3**
(a) a temperature controller for an oven.
(b) a mechanism for sorting small-, medium- and large-size objects moving along a conveyor belt so that they each are diverted down different chutes for packaging.
(c) an x–y plotter (such a machine plots graphs showing how an input to x varies as the input to y changes)

(OR)

(b)	A bottling plant uses an automated mechanism for filling the container and transporting them from one point to another as shown in Figure. The sensors monitor the amount of solid or liquid filled. A conveyor mechanism transports the containers. Design a mechatronic system for the case described. Identify the types of sensors you used, describe how they work, and explain how you are going to interface and control them. Make suitable sketches if needed.	**(14)**	**4**	**3**



15. (a)	Explain the role of mechatronic control systems in automated manufacturing processes, Evaluate the challenges faced in deploying such systems in real-world manufacturing environments and propose innovative solutions to address them.	**(14)**	**5**	**3**

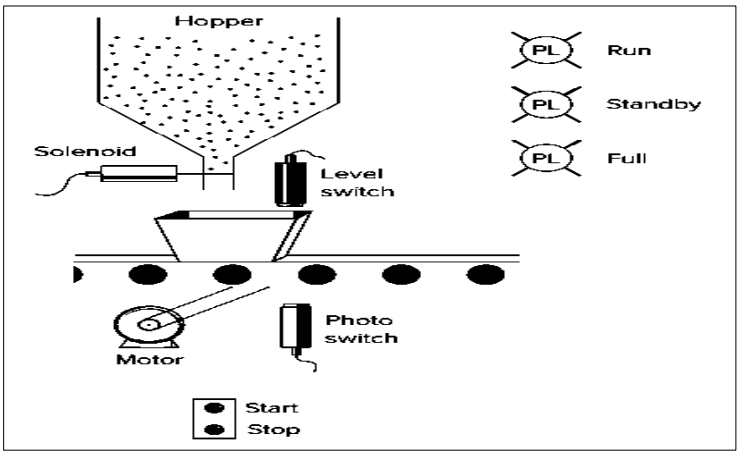
(OR)

(b)	Explore the application of artificial intelligence (AI) techniques in mechatronics, focusing on their role in enhancing the adaptability, autonomy, and intelligence of robotic systems.	**(14)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	Draw the PLC ladder program for the sketch of a continuous filling operation. This process requires that boxes moving on a conveyor be automatically positioned and filled. The sequence of operation for the continuous filling operation is as follows: • Start the conveyor when the start button is momentarily pressed. • Stop the conveyor when the stop button is momentarily pressed. • Energize the run status light when the process is operating. • Energize the standby status light when the process is stopped. • Stop the conveyor when the right edge of the box is first sensed by the photosensor. • With the box in position and the conveyor stopped, open the solenoid valve, and allow the box to fill. Filling should stop when the level sensor goes true. • Energize the full light when the box is full. The full light should remain energized until the box is moved clear of the photosensor.	**(10)**	**3**	**3**


Hopper
Solenoid
Level switch
PL
Run
PL
Standby
PL
Full
Photo switch
Motor
Start
Stop

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