Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2018

Course: MEEL 324 / PLC and HMI **Semester: VI**
Program: B.Tech Mechatronics Engineering
Time: 03 hrs. **Max. Marks: 100**

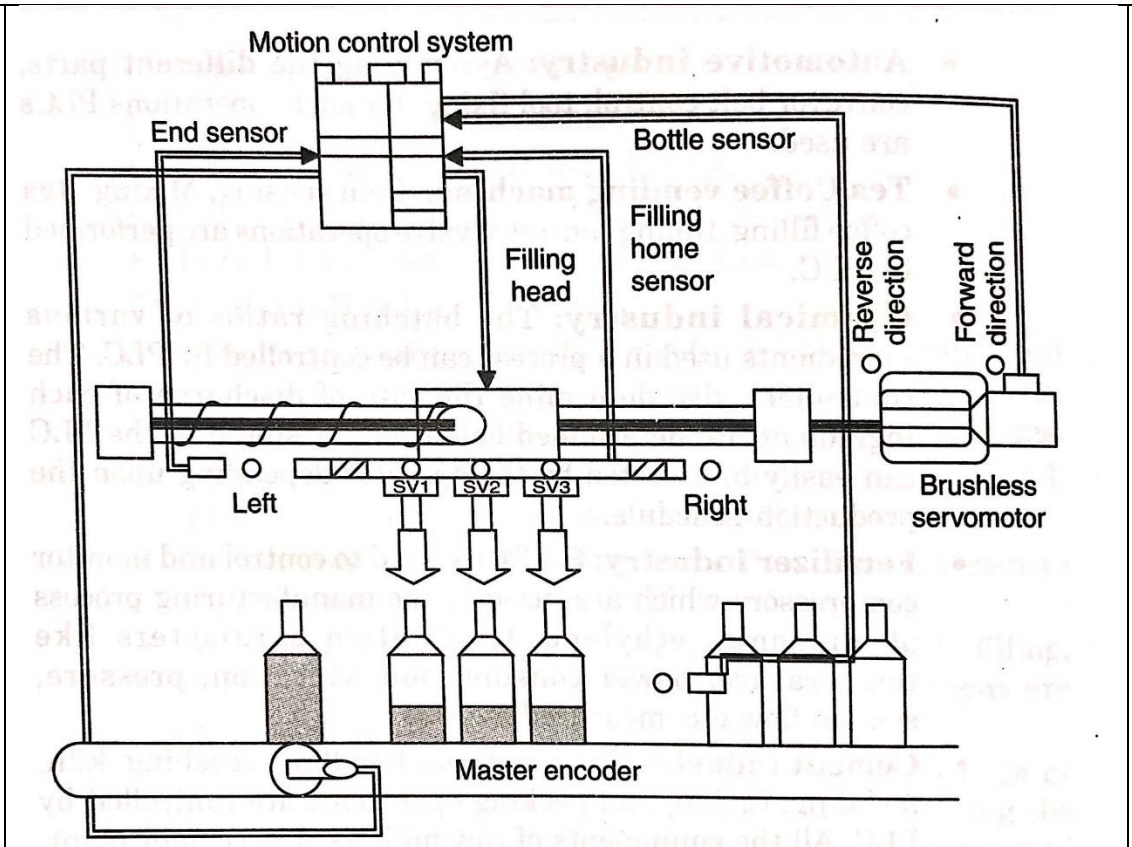
Instructions:
Mention the PLC make and model used for programming.
Take assumption as per your convenience, also mention it.
Internal choice is provided for Question No. 8 or 9

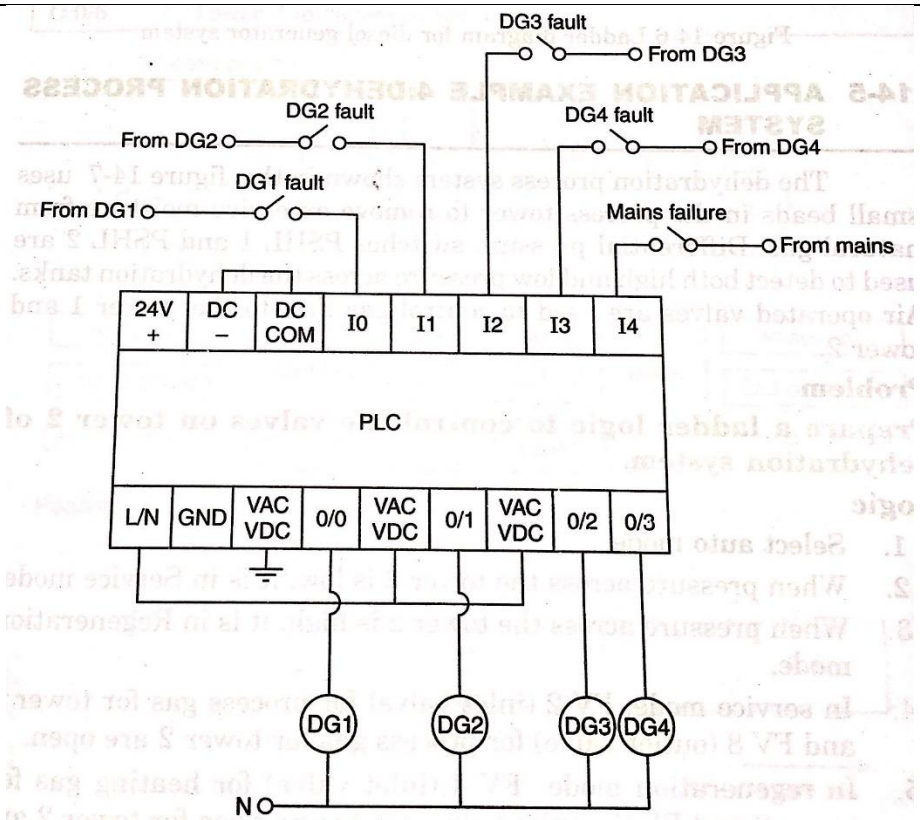
Marks Distribution:
Section A: 20 Marks
Section B: 40 Marks
Section C: 40 Marks

SECTION A

S. No.		Marks	CO
Q 1	Fill in the blanks: a. The ….. instruction is an input instruction used to test when two values are equal. b. When executing the equal instruction, when source A and source B are equal, the instruction is ……; otherwise, the instruction is false. c. When programming the equal instruction, if you use a constant as source B, the constant will be tested for equality with the data residing in the address specified in source…… d. The equal instruction is an …….. instruction e. The …….. instruction is used to test two values for inequality.	**5**	**CO1**
Q2	Differentiate between real time and historical trends.	**5**	**CO3**
Q3	Can we provide help about specific alarms that the operators can access easily?	**5**	**CO3**
Q4	Answer the following with justification: a. Can automation systems, like a DCS, communicate using industry standard Communication drivers like Modbus? **True/ False** b. Can the SCADA system do multiple applications and use the same Historian? **True/ False** c. SCADA stands for _____. d. Electronic buses are used for _____ with field devices. e. PLC stands for_____.	**5**	**CO2**

SECTION B			
Q 5	Do the calculation below with ladder logic. **n_2 = -(10 + (n_0) X (n_1))** where n_0, n_1, n_2 are different addresses.	**10**	**CO4**
Q6	The bottling line system shown below employs a conveyor that will transfer the filled bottles to the destination. The system has two left and right sensors for the bottle filling. The bottles will be filled sequentially. The bottle is filled when, it is empty and at proper position. Draw the ladder logic to implement the following control function for the bottling line system. i. It is assumed that initially the filling head is midway between the two end sensors. ii. When start push button is pressed the motor starts moving in the reverse direction, moving the filling head in the right direction. iii. Once the filling head reaches to the end sensor on right hand side, the motor stops. iv. After this the system waits for bottle to come. v. Once the bottle sensor senses that the bottle is present, the motor starts moving in the forward direction moving the filling head in the left direction. vi. At the same time the filling solenoids are energized allowing liquid to be filled in the bottles. vii. Once the filling head reaches the end sensor on the left hand side the filling solenoids are de-energized and the motor starts moving in the reverse direction. viii. The cycle continues till stop button is pressed.	**10**	**CO4**

			
Q7	The diesel generator set systems wiring diagram is shown below. It employs four DG's. The global objective is that when there is a mains failure out of four DG's on two DG's. Develop a PLC program to implement the following control function: a. The system keeps monitoring the mains failure input b. When mains fail the DG1 and DG3 starts automatically c. In case there is a fault in DG1 then DG2 starts automatically d. Similarly in case there is fault in DG3 then DG4 starts automatically e. In case there is fault in DG3 or DG4 the respective DG stops f. In case DG2 is running and the fault in DG1 is cleared, then DG2 shall stop and DG1 shall start automatically. g. Similarly in case DG4 is running and the fault in DG3 is cleared, then DG4 shall stop and DG3 shall start automatically.	**10**	**CO5**

			
Q8	Consider a community gas distribution system having following configuration: a. Storage and distribution facility at community gate (centralized storage facility) where HMI master unit will also be located. b. 12 individual household units. c. 6 commercial units. d. Master nodes for each 4 household units and 2 commercial units respectively. Design a HMI system along with the detailed architecture of the system so as to highlight the functioning of each and every component. i. Suggest how the system can be made more redundant, safe etc. ii. Explain various communication modes and medium with various remote units.	**10**	**CO4**
	OR		
Q9	Design the PCD and CCD to control the forward and reverse motion of a 3-phase induction motor, considering switching of reverse operation after 5 sec of forward switching. Also, develop the ladder logic of the same.	**10**	**CO5**
SECTION-C			

Q 10	This morning you received a call from Mr. Ian M. Daasprate at the Old Fashioned Widget Company. In the past when they built a new machine they would used punched paper cards for control, but their supplier of punched paper readers went out of business in 1972 and they have decided to try using PLCs this time. He explains that the machine will dip wooden parts in varnish for 2 seconds, and then apply heat for 5 minutes to dry the coat, after this they are manually removed from the machine, and a new part is put in. They are also considering a premium line of parts that would call for a dip time of 30 seconds, and a drying time of 10 minutes. He then refers you to the project manager, Ann Nooyed. You call Ann and she explains how the machine should operate. There should be start and stop buttons. The start button will be pressed when the new part has been loaded, and is ready to be coated. A light should be mounted to indicate when the machine is in operation. The part is mounted on a wheel that is rotated by a motor. To dip the part, the motor is turned on until a switch is closed. To remove the part from the dipping bath the motor is turned on until a second switch is closed. If the motor to rotate the wheel is on for more that 10 seconds before hitting a switch, the machine should be turned off, and a fault light turned on. The fault condition will be cleared by manually setting the machine back to its initial state, and hitting the start button twice. If the part has been dipped and dried properly, then a done light should be lit. To select a premium product you will use an input switch that needs to be pushed before the start button is pushed. She closes by saying she will be going on vacation and you need to have it done before she returns: a) List the variables needed to indicate when each state is on, and list any timers and counters used. b) Write the ladder logic to achieve so.	**20**	**CO5**
Q11	The system shown below employs washing a car in a washing chamber. It includes- a) Detecting a car in a washing chamber. b) Washing a car by spraying chemical and water. c) Brushing (only upper and right side of car) d) Drying a car using hot air. e) START push button is used to start the process. STOP is used to stop the process. LS limit switch is used to detect a car in washing chamber. M_CONVEYOR is used to drive the conveyor until the car is in a position, as indicated by car present switch LS. V1 valve is used to sprinkle water + chemical on a car. V2 valve is used to sprinkle water on a car. V3 valve is used to spray hotr air on a car. M_UPPER motor s used to move the brush on the upper side of a car. M_RIGHT motor is used to move the brush on the right side of a car. Prepare a ladder logic to implement the following control function for car washing system. i. When START push button is pushed, the function starts.	**20**	**CO4**

	ii. On M_CONVEYOR motor, when LS (limit switch) is off. iii. Off M_CONVEYOR motor, when LS is on. iv. On V1 valve, on M_UPPER, on M_SIDE for 100 seconds when LS is on. v. Off V1, after 100 seconds. vi. On V2, when V1 is off. vii. Off V2, after 50 seconds. viii. On V3, when V2 is off. ix. Off V3, after 50 seconds. x. On M_CONVEYOR motor again and repeat the cycle from step ii to ix.