

**Group - E**

8. (a) Feedwater at room temperature need to be heated to a specific temperature by a heat exchanger. Hot steam at constant temperature is to be used as the manipulated variable. Both feed flow rate and feed temperature might get changed at different working conditions. Suggest and describe the best suited control scheme with neat sketch.
- (b) Discuss the use of override control with a process example and necessary P&I diagram.

**(2 + 5) + 5 = 12**

9. (a) Draw and describe the operational block diagram of input module of a PLC.
- (b) Draw a PLC ladder diagram to realise the following: when the garage door is opened, a light is switched on. After the garage door is closed, the light remains on for 60 second. Use a pushbutton switch to open the garage door and a stop switch to close the same.
- (c) Realize 4:1 MUX logic using PLC ladder diagram.

**5 + 5 + 2 = 12****PROCESS CONTROL  
(AEIE 3201)****Time Allotted : 3 hrs****Full Marks : 70*****Figures out of the right margin indicate full marks.******Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.******Candidates are required to give answer in their own words as far as practicable.*****Group – A  
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) In a feedback control loop, manipulated variable is situated in between  
 (a) comparator and controller  
 (b) controller and final control element  
 (c) final control element and process  
 (d) process and comparator.
- (ii) Air-to-Open control valve has  
 (a) reverse acting actuator and direct acting valve body  
 (b) reverse acting actuator and reverse acting valve body  
 (c) direct acting actuator and direct acting valve body  
 (d) all of them.
- (iii) A PID controller has the transfer function as  $2 + \frac{0.4}{s}$ . The proportional band for the controller is  
 (a) 200% (b) 100% (c) 75% (d) 50%.
- (iv) Flashing occurs if the liquid absolute pressure  
 (a) falls below vapour pressure (b) rise above vapour pressure  
 (c) at equal to vapour pressure (d) none of these.
- (v) The proportional gain of a PID controller can be expressed in terms of its proportional band (PB) as  
 (a) PB (b) 100/PB (c) PB×100 (d) PB/100.

- (vi) Transfer function of a controller is  $G_c = \frac{1}{s}(3s^2 + 3s + 2)$ .  $T_I$  and  $T_D$  are respectively:  
 (a) 0.5 min. & 3 min. (b) 3.0 min. & 2.0 min  
 (c) 3.0 min. & 0.5 min. (d) 1.5 min. & 1 min.
- (vii) PLC operation sequence are  
 (a) self check , input scan, logic solve, output scan  
 (b) self check, input scan, output scan, logic solve  
 (c) self check , logic solve, output scan, input scan  
 (d) self check , output scan, input scan, logic solve.
- (viii) The dynamics of a second order system is given by  $9\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 1 = 0$ . The system is  
 (a) under damped (b) overdamped  
 (c) overdamped with ( $\zeta = 1.5$ ) (d) critically damped.
- (ix) In case of a cascade control action, the secondary loop as compared to the primary loop is  
 (a) faster (b) slower (c) stable (d) very slow.
- (x) The transfer function  $[G_c(s) = K_c \left( \frac{1+2s}{s} \right)]$  describe which type of controller?  
 (a) PID (b) PD (c) P (d) PI.

**Group - B**

2. (a) Find the mathematical model of the two tank non-interacting system. State whether the system is overdamped, critically damped or underdamped system and why?  
 (b) What is servo control? Give an example of the same.  
**(8 + 1) + (2 + 1) = 12**
3. (a) What do you mean by regulatory control? Give example of the same.  
 (b) Explain deadtime and time of response. Which one is inherent to process? How controllability is related to deadtime and time of response?

- (c) The transfer function of a process is given by  $\frac{4e^{-1.5s}}{3+7s}$ . Find static gain, time constant and deadtime.  
**(2 + 1) + (2 + 1 + 3) + 3 = 12**

**Group - C**

4. (a) What do you mean by offset error? State the methods to reduce offset error.  
 (b) The transfer function of a process plant is  $\frac{3}{2+3s}$ . It is used in a unity feedback system and is controlled with a proportional controller with 50% proportional band. Find the offset error for a unit step input (increase in Set Point) and also compare the overall time constant with respect to process time constant.  
**(2 + 2) + (6 + 2) = 12**
5. (a) Design an electronic PI controller and find the transfer function for the same.  
 (b) Compute the velocity algorithm for the PID controller. What do you mean by reset windup?  
**5 + (5 + 2) = 12**

**Group - D**

6. (a) Explain flashing and cavitation with neat sketch?  
 (b) The level of a liquid tank needs to be controlled by PI controller. Which type of control valve one should select? Draw the characteristics of the valve selected and explain the same. Define control valve flow coefficient ( $K_v$  ).  
**(3 + 3) + (1 + 2 + 2 + 1) = 12**
7. (a) A pH control process where the incoming liquid always has high pH value, and must be neutralized with acid. What type of valve sequencing you should select and describe the same with neat sketch.  
 (b) Describe the operation of a booster relay with a schematic diagram.  
**(1 + 6) + 5 = 12**