PROCESS CONTROL
(AEIE 3101)

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 order to specify a process completely, the number of degrees of freedom of the process should be
(a) Equal to zero (b) Greater than zero
(c) Less than zero (d) Of any arbitrary value.

(ii) Transportation lag of a process is also known as
(a) Response time (b) Dead time
(c) Settling time (d) Both (a) and (b).

(iii) Robotic arm motion control is an example of
(a) Regulatory control (b) Servo control
(c) Feed forward control (d) Adaptive control.

(iv) A PID controller has the transfer function $G_c(s) = \frac{1}{s}\left(0.4 + 2s + s^2\right)$. The proportional band for the controller is
(a) 50% (b) 75% (c) 100% (d) 250%

(v) The Laplace transfer function of a 4 second transportation lag element is
(a) $\frac{1}{s+4}$ (b) e^{4s} (c) e^{-4s} (d) $e^{-\frac{4}{s}}$

(vi) When set point is increased by a step for a proportional controller that controlling a integrating type system, offset error of the system will be
(a) Positive (b) Negative
(c) zero (d) none of the above.

(vii) The operation sequence of PLC is
(a) Output scan, self-check, input scan, logic solve, output scan...
(b) Self-check, input scan, logic solve, output scan, self-check...
(c) Self-check, output scan, input scan, logic solve, self-check...

(d) Input scan, output scan, self-check, logic solve, input scan...

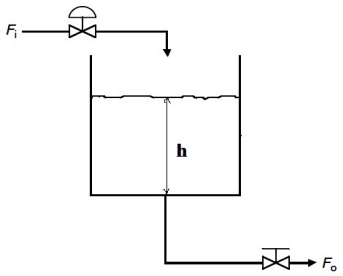
(viii) When a 1st order process is controlled by PI controller, overall dynamics of the close loop process will be of _____ order
(a) Zero (b) 1st (c) 2nd (d) 3rd.

(ix) Override (Selective) Control scheme uses
(a) A single manipulating variable and a single output variable
(b) Several manipulating variables and a single output variable
(c) A single manipulating variable and several output variables
(d) Any of the above.

(x) Flashing occurs in control valve
(a) After cavitations occurs
(b) Before cavitations occurs
(c) When liquid absolute pressure less than its vapour pressure
(d) Both (b) & (c).

Group – B

2. (a) Write down the system equations for a liquid level tank shown in the figure below. Assume the outlet valve is a linear resistance element. Find the transfer function of the system.



(b) Compute the step response of the derived model and draw the response.

(2 + 4) + (4 + 2) = 12

3. (a) Draw the block diagram for a regulatory control loop and discuss the same. Give an example of a servo system.

(b) Draw the PI diagram for a flow control loop according to ISA standards.

(c) The transfer function of a process is given by $\frac{5e^{-3s}}{2+5s+8s^2}$. Find: time constant, damping factor, dead time and static gain.

(4 + 1) + 3 + 4 = 12

Group – C

4. (a) Derive the close loop transfer function of a 1st order process that is controlled by an integral controller assuming final control element and the measuring element both have unity gain.

(b) Explain how did close loop response time changes with respect to process response time?

(c) Draw and discuss the close loop response of the process when reset time is decreased.

(d) Explain derivative kick that may occurred in PD/PID controller.

5 + 2 + 3 + 2 = 12

5. (a) Design an electronic PD controller and write down the transfer function in terms of electrical parameters.

(b) Describe performance evaluation criteria like IAE and ¼ Decay Ratio.

(c) Explain Ziegler-Nichol's continuous oscillation method of controller tuning.

4 + 4 + 4 = 12

Group – D

6. (a) A process need to be controlled in on/off mode. Which type of control valve one should select? Draw the characteristics of the valve selected and explain the same.

(b) Define rangeability and turn down ratio. When does choked flow occur in control valve?

(c) Define control valve flow coefficient (C_v).

(1 + 2 + 3) + (3 + 1) + 2 = 12

7. (a) For a process control system, it is necessary that process fluid flows either through one valve or through the other, but never through both. What type of valve sequencing you should select and describe the same with neat sketch.

(b) Describe the operation of a pneumatic relay with a schematic diagram.

(c) Explain why flashing may occur in control valve?

(1 + 5) + 4 + 2 = 12

Group – E

8. (a) Where did cascade control been used? With suitable block diagram explain the operation of cascade control.

(b) In a combustion process, the combustible fuel needs proportionate air for complete combustion. Suggest and describe the control scheme for effective combustion of the fuel.

(2 + 5) + (1 + 4) = 12

9. (a) Draw and describe the signal conditioning circuit for input module of a PLC for dc field signal.

(b) Draw and explain a PLC ladder diagram to realise the following: A start push-button switch is used to turn on light L1 indicating a conveyor belt is on. When 20 bottles collected in a box, a wrapping machine needs to be on for 5 seconds to wrap the box. The bottles are sensed by a proximity switch. Process will repeat until the stop button is pressed to stop the conveyor belt.

(c) Implement an XOR logic using PLC ladder diagram.

4 + 6 + 2 = 12

Department & Section	Submission link:
AEIE	https://classroom.google.com/c/MTIxODk4ODA4NzU1/a/MjczODMwNzE2NjU1/details