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) A process is fully described by 4 equations and total number of variables involved in the process is 6. The degrees of freedom of the system is
(a) 2 (b) 4 (c) 6 (d) 10.

(ii) Two non-interacting level tanks when connected in series, the overall system response become a _____ system
(a) Zero order (b) 1st order
(c) 2nd order (d) Integral system

(iii) Washing machine is an example of
(a) Close loop control (b) Open loop control
(c) Servo control (d) Regulatory 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) 100% (b) 50%
(c) 40% (d) 25%

(v) The dynamics of a second order system is given by $8\frac{d^2y}{dt^2}+3\frac{dy}{dt}+2y=3x$. The time constant for the system is
(a) 8/3 Sec (b) 3/8 Sec
(c) 4 Sec (d) 2 Sec

(vi) Which of the following is the reference input given to the controller?
(a) Manipulated variable (b) Measured variable
(c) Set point variable (d) Controlled variable

(vii) The transfer function of a 4 second transportation lag element is

(a) $1/(s+4)$ (b) e^{4s}

(c) e^{-4s} (d) $e^{-s/4}$

(viii) 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

(ix) In cascade control, as a rule of thumb, the dominant time constant in the slave loop is _____ of the dominant time constant in the master loop.

(a) Less than one third (b) Greater than one third

(c) Same as (d) Independent

(x) PLC operation sequence are

(a) Self check, Input scan, output scan, logic solve

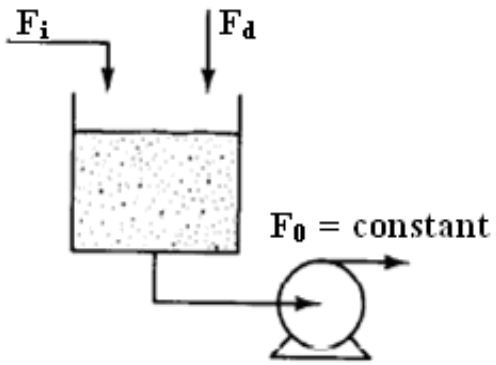
(b) Self check, logic solve, output scan, Input scan

(c) Self check, output scan, Input scan, logic solve

(d) Self check, Input scan, logic solve, output scan.

Group – B

2. (a) Derive the transfer function for a liquid level tank system as shown in the figure. F_i and F_d are the input flows and F_0 is output flow.



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

(c) Define distance velocity lag.

4 + (4 + 2) + 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 $\frac{4e^{-3s}}{3+5s+18s^2}$. 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) 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 PI controller and find the transfer function for the same.

   (b) Describe performance evaluation criteria, ISE and ITAE of any processes.

   (c) Explain Cohen Coon method of controller tuning.

4 + 4 + 4 = 12

Group – D

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

   (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.

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

(2 + 2 + 1) + (1 + 2 + 2) + 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) + 5 = 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 a motor M1. After 10 second motor M2 starts. Stop switch stops M1 and M2.

   (c) Describe the operation of up-counter use in PLC.

4 + 5 + 3 = 12

Department & Section	Submission Link
AEIE	https://classroom.google.com/c/MzY0NTQxNDc0MjMx/a/MzY0NTQxNDc0MjQy/details