CBCS SCHEME

USN [| | | | | | | | |]

18BT61

Sixth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Process Control and Automation

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Why any bioreactor requires instrumentations? What are the factors that need to be maintained in a reactor? **(10 Marks)**

b. With a neat sketch, explain flow injection analysis. **(10 Marks)**

OR

2 a. Explain briefly the ON-LINE measurement of the estimation of the biomass. **(10 Marks)**

b. With a neat sketch, explain any one pressure measuring device. **(10 Marks)**

Module-2

3 a. Derive the transfer function $\frac{H(s)}{Q(s)}$ for the liquid level system shown in the Fig.Q3(a).

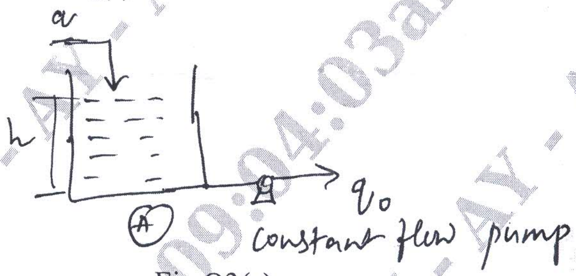

Fig.Q3(a) **(10 Marks)**

b. Two non interacting tanks are connected in series where the time constants are $\tau_1 = 1$, $\tau_2 = 0.5$ and $R_2 = 1$. Sketch the response of the level in tank 2, if a unit step change magnitude is made in the input flow rate to tank 1. **(10 Marks)**

OR

4 a. Derive the transfer function 2 tank interacting system. **(10 Marks)**

b. Find the transfer function $\frac{H_3(s)}{Q(s)}$ for the following system shown in Fig.Q4(b).

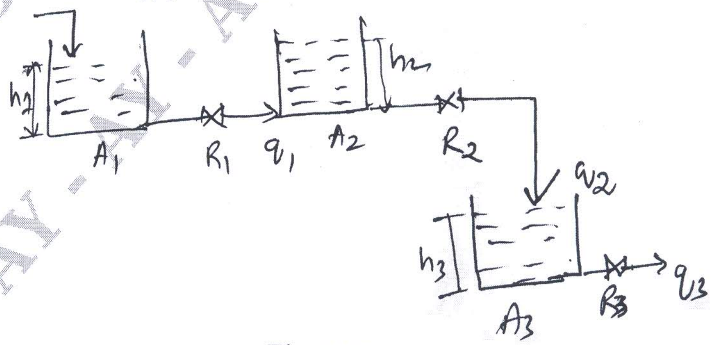

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Derive the transfer function for 2nd order system taking a suitable example. **(10 Marks)**

b. For a 2nd order system subjected to a step change of magnitude 4. Determine:
(i) Overshoot (ii) Cyclic frequency (iii) Response time (iv) Rise time
(v) Decay ratio (vi) Ultimate response if damping coefficient is 0.6 and w_n is 5 rad/s. **(10 Marks)**

OR

6 a. Derive step response for 2nd order system. **(10 Marks)**

b. What do you mean by transportation lag? Derive the transfer function for transportation lag. **(10 Marks)**

Module-4

7 a. With a neat sketch explain pneumatic control valve. **(10 Marks)**

b. A step change of magnitude 4 is introduced into a PI controller. The value of gain is 6 and the reset rate is 0.5. Plot the response of the PI controller. **(10 Marks)**

OR

8 a. Determine the offset for proportional controller towards a step change in load variable (regulatory mechanism). **(10 Marks)**

b. Determine the transfer function $\frac{C(s)}{R(s)}$ for the block diagram shown in Fig.Q8(b).

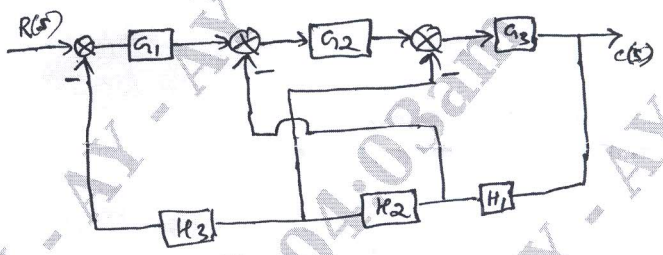

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. Draw the Bode diagram for the first order system. **(10 Marks)**

b.

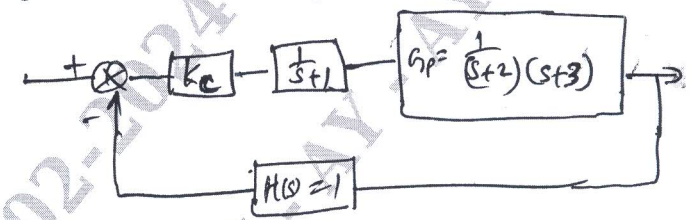

Fig.Q9(b)

Find:
(i) Characteristic equation
(ii) Determine the value of K_e for which control system is stable.
(iii) For which value of K_e the control system is on the threshold of stability. **(10 Marks)**

OR

10 a. Explain the root locus method to check the stability of the control system. **(10 Marks)**

b. For the given open loop transfer functions find out the range of K for which the system stable. What will be the frequency of sustained oscillation:

$$G(s) = \frac{K}{(s+1)(50s^2+12s+0.5)}$$ **(10 Marks)**

* * * * *