CBCS SCHEME

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21BT62

Sixth Semester B.E. Degree Examination, June/July 2024
Bioprocess 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. By considering one example from each of the following describe the working principle, construction and performance characteristics :
   i) Flow measurement
   ii) Temperatures measurement **(10 Marks)**

b. Briefly explain the principle and instrumentation of flow injection analysis. **(10 Marks)**

OR

2 a. Explain in detail about online and offline biomass estimation. **(10 Marks)**

b. With a neat labelled schematic representation, explain the working of any two level measuring devices. **(10 Marks)**

Module-2

3 a. Solve the equation using Laplace transform

i) $\frac{d^3x}{dt^2} + 4\frac{d^2x}{dt^2} + 5\frac{dx}{dt} + 2x = 2$

ii) Find x(t) by solving $\frac{dx}{dt} + x = 1$. **(10 Marks)**

b. Derive the transfer function of first order system by taking measure in glass thermometer as an example. **(10 Marks)**

OR

4 a. A thermometer is kept inside a constant temperature both at 70°C. This is suddenly transferred into another both kept at 60°C at t = 0. The following are the reading recorded.

Time in (min)	Temperature (°C)
0	70
1	68
2	66
4	64
5	63
8	62
10	61.5
12	61

Find out the time constant for thermometer by two independent methods. **(10 Marks)**

b. Derive the sinusoidal response equation for a first order system with neat graphical representation. **(10 Marks)**

Module-3

5 a. Derive the transfer function equation for two tank interacting system. **(10 Marks)**

b. Two Non-interacting tanks are connected in series the time constant are $\tau_1 = 1$ and $\tau_2 = 2$. Find the response of the tank level 2 if a unit step change is made in the inlet flow rate to tank 1. **(10 Marks)**

OR

6 a. Derive the transfer function of a second order system by considering spring damper as an example. **(10 Marks)**

b. A step change of magnitude 4 is introduced into a system having transfer function :

$\frac{y(s)}{x(s)} = \frac{10}{s^2 + 1.6s + 4}$. Determine

i) % overshoot ii) Rise time iii) Ultimate value of y(t) iv) Max value of y(t)

v) Period of oscillation. **(10 Marks)**

Module-4

7 a. Discuss briefly how actuators and positioners works a final control elements. **(10 Marks)**

b. Briefly explain the principle of PI controller and obtain the transfer function for the same. **(10 Marks)**

OR

8 a. Determine the transfer function y(x)/x(s) for the block diagram show in Fig Q8(a). Express the results interms of G_a, G_b, G_c.

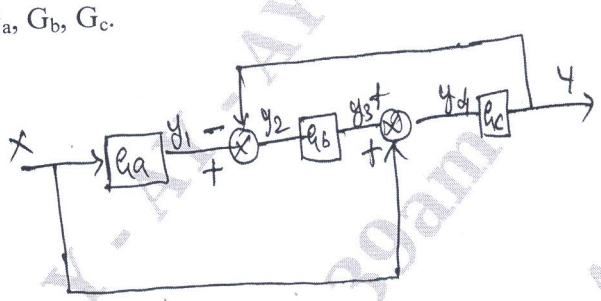

Fig Q8(a) **(10 Marks)**

b. Explain servo and Regulator problem with block diagram and transfer function. **(10 Marks)**

Module-5

9 a. Determine the stability of a control system whose characteristics equation is

i) $s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$

ii) $s^4 + 3s^3 + 5s^2 + 4s + 2 = 0$ **(10 Marks)**

b. Open loop transfer function of a chemical process is given by

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

Find out the range of K for which the system is stable. **(10 Marks)**

OR

10 a. Enumerate the steps involved in the construction of Bode's plot with suitable schematic representation. **(10 Marks)**

b. Constructed of Root locus diagram for the open loop transfer function :

$G(s) \frac{K}{(s+1)(s+2)(s+3)}$. **(10 Marks)**

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