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10AE71

Seventh Semester B.E. Degree Examination, Dec.2019/Jan.2020
Control Engineering

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

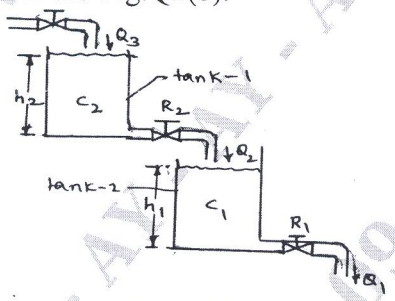
1 a. Explain the terms:
(i) Control system (ii) Disturbance (iii) Open loop control system
(iv) Closed loop system **(04 Marks)**

b. What is Feedback? Explain the effects of feedback. **(06 Marks)**

c. Explain the following control action:
(i) Proportional plus integral (ii) Proportional plus derivative. **(10 Marks)**

2 a. Derive the transfer function of an armature controlled D.C. motor where output parameter is the angle turned by the motor shaft and the input is the applied voltage to the armature circuit. **(10 Marks)**

b. A process plant consists of two tank of capacitance C_1 and C_2. If the flow rate into the top tank is Q_3, find the transfer function relating this flow to the level in the bottom tank. Each tank has a resistance R in its outlet pipe. Consider the tank to be a non-interacting. The plant is shown in the Fig.Q2(b). **(10 Marks)**



h = head
Q = flow rate
C = hydraulic capacitance
R = hydraulic resistance
$\frac{H_1(s)}{Q_3(s)} = ?$

Fig.Q2(b)

3 a. Reduce the block diagram shown in Fig.Q3(a) and find the overall transfer function.

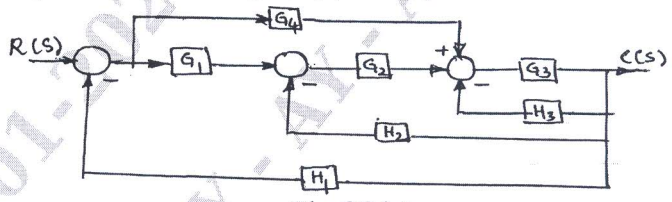


Fig.Q3(a) **(10 Marks)**

b. For the signal flow graph shown in Fig.Q3(b), find $\frac{C(s)}{R(s)}$ using Mason's gain formula.

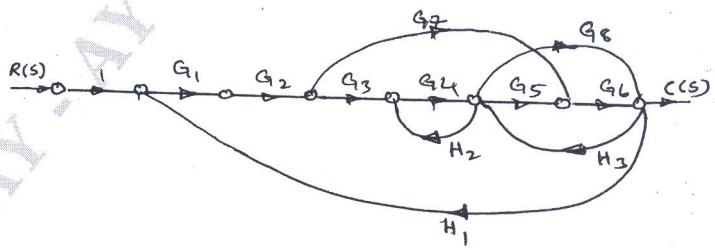


Fig.Q3(b) **(10 Marks)**

4 a. Obtain the expression for time response of the First order system subjected to unit step input. **(06 Marks)**

b. The overall loop transfer function of a unity negative feedback system is $G(s) = \frac{144}{s(s+2)}$ obtain (i) Peak time (ii) Rise time (iii) Settling time (iv) Maximum overshoot. **(08 Marks)**

c. The characteristic equation of a system is given by
$s^4 + 5s^3 + 5s^2 + 4s + k = 0$
Determine the range of k for stability using R-H criterion. **(06 Marks)**

PART – B

5 a. Define the following terms and show on the Nyquist plot:
(i) Gain margin (ii) Phase margin (iii) gain cross over frequency
(iv) Phase cross over frequency **(08 Marks)**

b. Comment on the stability of the system using Nyquist plot whose open loop transfer function is given by

$$G(s)H(s) = \frac{12}{s(s+1)(s+2)}$$ **(12 Marks)**

6 Construct the Bode diagram on a semi-log paper for a unity feed system whose open loop transfer function is given by

$$G(s)H(s) = \frac{0.75(1+0.2s)}{s(1+0.5s)(1+0.1s)}$$

Is the system stable? **(20 Marks)**

7 Sketch the root locus plot for a negative feedback system whose open loop transfer function is given by

$$G(s)H(s) = \frac{k}{s(s+4)(s^2+s+1)}$$ **(20 Marks)**

8 a. What is the necessity of system compensation? Draw the block diagram for series and parallel compensation and explain. **(12 Marks)**

b. Using Kalman test show that the following system is completely observable.

$$\dot{x} = \begin{bmatrix} -3 & 1 & 1 \\ -1 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix} x + \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 2 & 1 \end{bmatrix} u$$

$$\dot{y} = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} x$$ **(08 Marks)**

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