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10AE71

Seventh Semester B.E. Degree Examination, Jan./Feb. 2021
Control Engineering

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What are the requirements of an ideal control system? **(06 Marks)**

b. With a sketch, explain the working of an automatic tank – level control system. **(06 Marks)**

c. Explain the characteristics of following controllers
(i) Proportional plus integral (ii) Proportional plus derivative. **(08 Marks)**

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

b. Obtain the transfer function for the mechanical system shown in the Fig Q2(b). Where F(t) is the input and x_2 be the output also obtain force – voltage electrical analogous circuit.

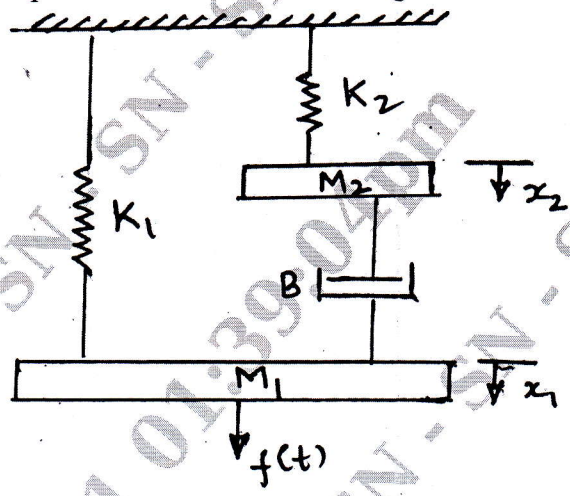

Fig Q2(b) **(10 Marks)**

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

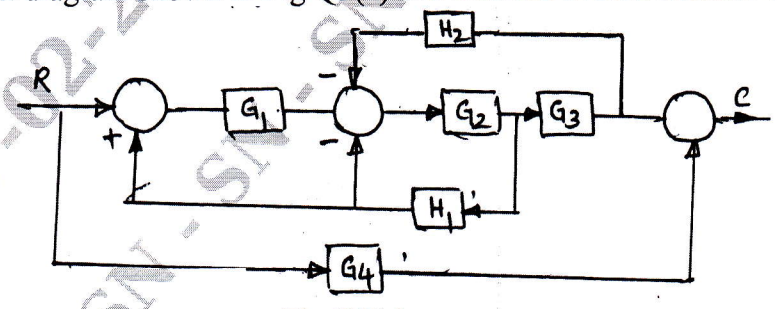

Fig Q3(a) **(10 Marks)**

b. Obtain the closed loop transfer function $\frac{Y(s)}{R(s)}$ for the signal flow graph of a system shown in Fig Q3(b) by use of Mason's gain formula.

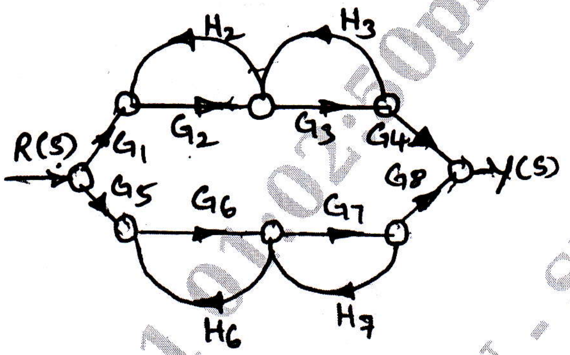

Fig Q3(b) **(10 Marks)**

4 a. Explain standard test signals. **(06 Marks)**

b. For first order system subjected to unit ramp input show that the steady state error is equal to time constant. **(08 Marks)**

c. Investigate the stability of a closed loop system using Routh Herwitz criterion whose characteristic equation in $s^5 + 3s^4 + 7s^3 + 20s^2 + 6s + 15 = 0$. **(06 Marks)**

PART – B

5 a. Sketch the polar plot for the system $G(s)\ H(s) = \dfrac{1}{(1+sT_1)(1+sT_2)}$. Find the values of magnitude and frequency where the plot intersect imaginary axis. **(10 Marks)**

b. Draw the Nyquist plot for the open loop transfer function $G(s)H(s) = \dfrac{1}{s(1+s)(1+0.25s)}$. Ascertain the nature of stability. **(10 Marks)**

6 a. Write the advantages of Bode plot. **(04 Marks)**

b. Draw the Bode plot for the Open loop transfer function $G(s)H(s) = \dfrac{10}{s(1+s)(1+0.02s)}$. Determine the following :

i) Gain margine and phase margin

ii) Gain cross over frequency and phase cross over frequency

iii) Stability of the closed loop system. **(16 Marks)**

7 a. Write the steps for construction of root locus. **(08 Marks)**

b. Sketch the root locus plot for an unity feedback control system having Open loop transfer function. $G(s)H(s) = \dfrac{K}{s(s+3)(s^2+3s+4.5)}$. **(12 Marks)**

8 a. Explain the following terms :

i) Controllability ii) Observability. **(10 Marks)**

b. Give suitable state variable representation for the system described by

$$\frac{d^3y}{dt^3} + 3\frac{d^2y}{dt^2} + 6\frac{dy}{dt} + 7y(t) = 2u(t)$$ **(10 Marks)**

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