USN | | | | | | | | | | **10ES43**

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019

Control Systems

Time: 3 hrs. Max. Marks:100

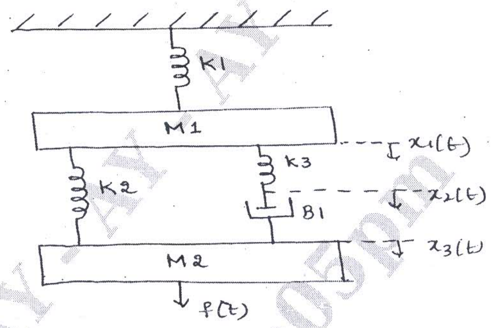
Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART - A

1 a. Define Control System. Give the difference between open loop and closed loop control system, with an example. **(06 Marks)**

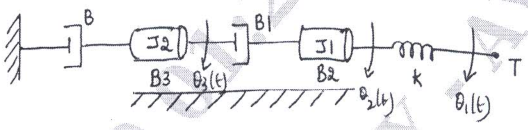
b. For the mechanical system shown in fig.Q1(b),
i) Write the nodal circuit ii) Write the performance equation
iii) Write force voltage and force current analogous circuits. **(09 Marks)**

Fig.Q1(b)



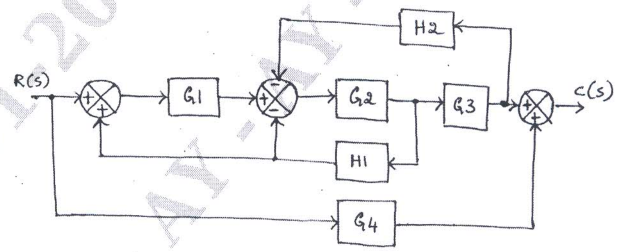
c. For the mechanical system shown in fig.Q1(c),
i) Write the nodal circuit ii) Write the performance equations. **(05 Marks)**

Fig.Q1(c)



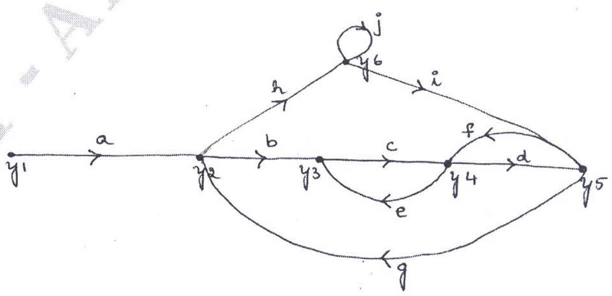
2 a. Find the transfer function C(s)/R(s), using block diagram reduction technique for the figure shown in fig. Q2(a). **(10 Marks)**

Fig.Q2(a)



b. For the signal flow graph, shown in fig.Q2(b), find the transfer function using Mason's gain formula. **(10 Marks)**

Fig.Q2(b)



3 a. For the unity feedback system having open – loop transfer function

$$G(s) = \frac{K(s+2)}{S(s^3+7s^2+12s)}$$, find i) Type of the system ii) Error co-efficient

iii) Steady state error when the input of the system is $\frac{R}{2}t^2$. **(10 Marks)**

b. A feedback control system shown has a damping factor of 0.8. Determine constant K and all the time domain specifications for the system shown in fig.Q3(b). **(10 Marks)**

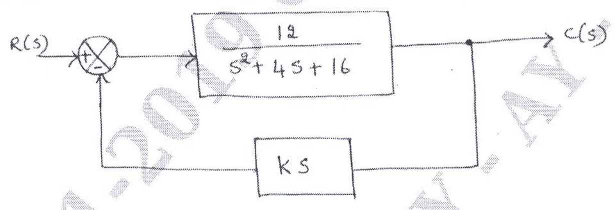


Fig.Q3(b)

4 a. What are the necessary conditions for a system to be stable according to Routh – Hurwitz criteria? **(04 Marks)**

b. The open loop transfer function of a unity feedback control system is given by

$$G(s) = \frac{K}{(s+2)(s+4)(s^2+6s+25)}$$

i) Find the range of K for which the system is stable.

ii) Find K for which system oscillates and what is the corresponding frequency of oscillation. **(10 Marks)**

c. Determine the stability of control system with characteristic equation.

$$s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0.$$ **(06 Marks)**

PART - B

5 a. The open – loop transfer function of a feedback control system is given by **(12 Marks)**

$$G(s)\,H(s) = \frac{K}{S(s+1)(s+2)}$$

Construct the root locus of the control system and find the range of K for which the closed loop system is stable.

b. Sketch the root locus of the control system with open loop transfer function

$$G(s)\,H(s) = \frac{K}{s^2+10s+100}$$. Determine the stability of closed loop system. **(08 Marks)**

6 a. A unity feedback control system has **(10 Marks)**

$$G(s) = \frac{80}{S(s+2)(s+20)}$$. Draw the Bode plot and determine Gain margin, Phase margin, W_{gc} and W_{pc}. Comment on stability.

b. Determine the transfer function from the magnitude plot shown in fig. Q6(b). **(10 Marks)**

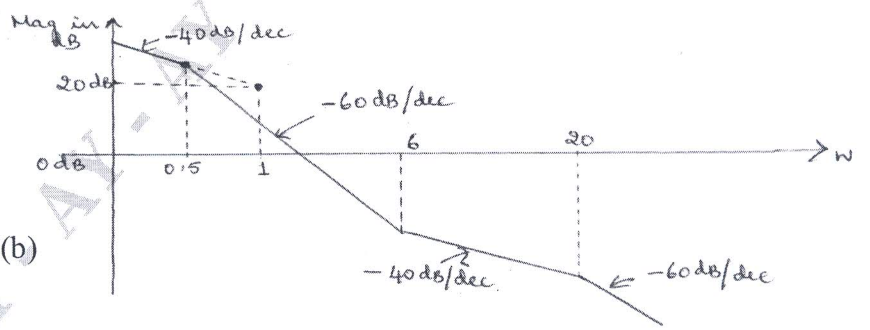


Fig.Q6(b)

7 a. Construct the Nyquist plot for the control system with (14 Marks)

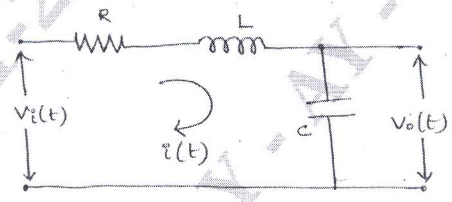
$$G(s)\,H(s) = \frac{K(s+1)}{S(s-1)}$$. From the plot, determine the stability of closed loop system.

b. State Nyquist stability criteria and explain the procedure to find the stability of the system using Nyquist criteria. (06 Marks)

8 a. State the advantages of state space approach. (04 Marks)

b. Obtain the state model of the given electrical network in standard form shown in fig. Q8(b). Given at $t = t_o$, $i(t) = q(t_o)$ and $V_o(t) = V_o(t_o)$. (06 Marks)

Fig.Q8(b)



c. State and prove the properties of state transition matrix. (10 Marks)

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