USN 1 A Y 1 4 E E 0 8 6

10ES43

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Control System

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Write the difference between open loop and closed loop control system. **(06 Marks)**

b. For the mechanical system shown in Fig.Q1(b), obtain the force-voltage and force-current analogous network. **(14 Marks)**

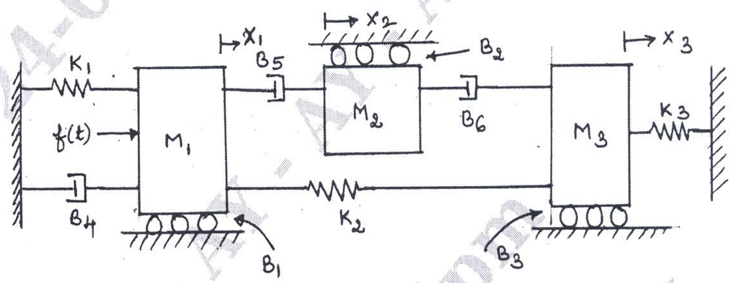

Fig.1(b)

2 a. The block diagram of a feedback control system is shown in Fig.Q2(a). Find :
i) The transfer function C(S)/E(S) if N(S) = 0
ii) The transfer function C(S)/R(S) if N(S) = 0. **(12 Marks)**

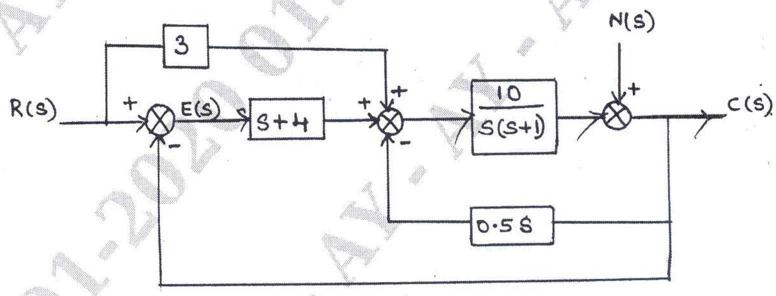

Fig.Q2(a)

b. Find the transfer function C(S)/R(S) using Masons gain formula for the signal flow graph shown in Fig.Q2(b). **(08 Marks)**

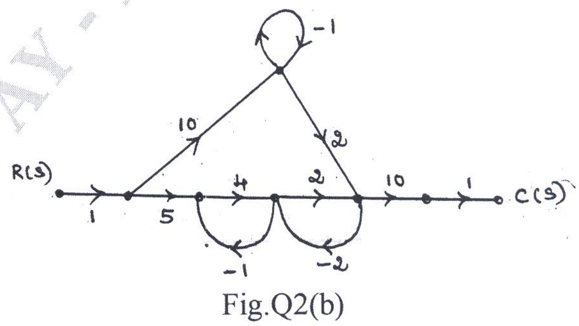

Fig.Q2(b)

3 a. Derive the expression for maximum overshoot. **(06 Marks)**

b. Fig.Q3(b)(i) shows a mechanical vibratory system, when a force of 9.8N is applied to the system the mass oscillates as shown in Fig.Q3(b)(ii). Find the values of M, B and K. **(10 Marks)**

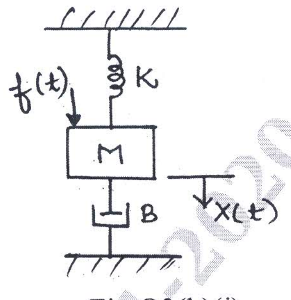

Fig.Q3(b)(i)

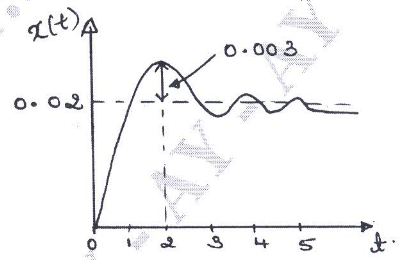

Fig.Q3(b)(ii)

c. The open lop transfer function is given by :

$$G(s) = \frac{10(s+2)}{s(s+3)(s+4)}$$

Find the error constants (K_p, K_V and K_a). Also find the steady state errors. **(04 Marks)**

4 a. Explain Routh's criterion for determining the stability of a system and mention its limitations. **(06 Marks)**

b. Examine the stability by Routh's criterion for the characteristics equation :

$s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$. **(06 Marks)**

c. Find the values of K and P so that the system shown in Fig.Q4(c) oscillates with a frequency of 2 rad/sec. **(08 Marks)**

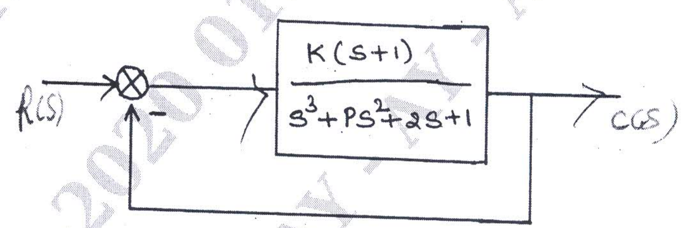

Fig.Q4(c)

PART – B

5 a. State the different rules for the construction of root locus. **(08 Marks)**

b. Sketch the root locus for a negative feedback control system whose open loop transfer function is give by

$$G(S)H(S) = \frac{K(s+4)}{S(s^2+2s+2)}$$

Comment on its stability. **(12 Marks)**

6 a. A unity feedback control system is characterized by an open loop transfer function :

$$G(s)H(s) = \frac{K}{s(1+s)(1+0.1s)(1+0.01s)}$$

Using bode plots, find :

i) The value of K to give a gain margin of 10 dB

ii) Value of K to give a phase margin of 25°. **(12 Marks)**

b. Determine the transfer function of a system whose magnitude plot is shown in Fig.Q6(b). **(08 Marks)**

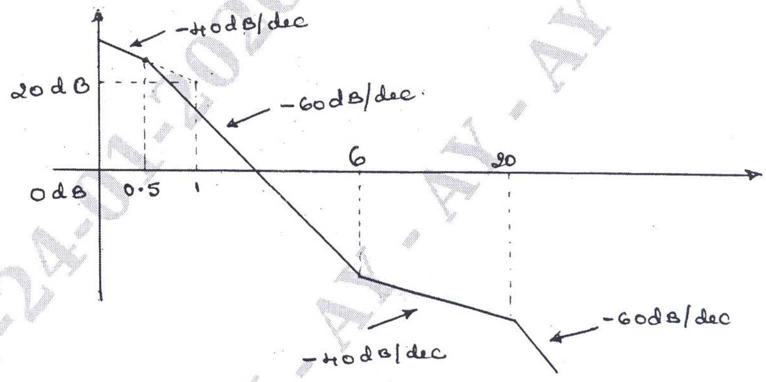

Fig.Q6(b)

7 a. Explain Nyquist stability criterion. **(06 Marks)**

b. Sketch the Nyquist plot for the open loop transfer function :

$$G(s)H(s) = \frac{10}{(s+2)(s+4)}$$

Determine the stability of the closed loop system by Nyquist criterion. **(10 Marks)**

c. Sketch the polar plot for the transfer function :

$$G(s) = \frac{S}{1+ST}.$$ **(04 Marks)**

8 a. Define the following terms :

i) State

ii) State variables. **(04 Marks)**

b. List the properties of state transition matrix. **(04 Marks)**

c. Obtain the state transition matrix, for the state model whose matrix A is give by :

$$A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}.$$ **(12 Marks)**

* * * * *