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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)

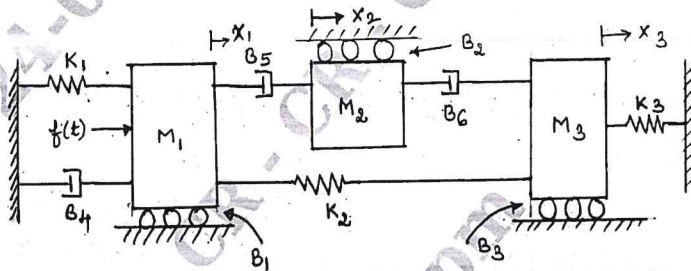


Fig.1(b)

- 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)

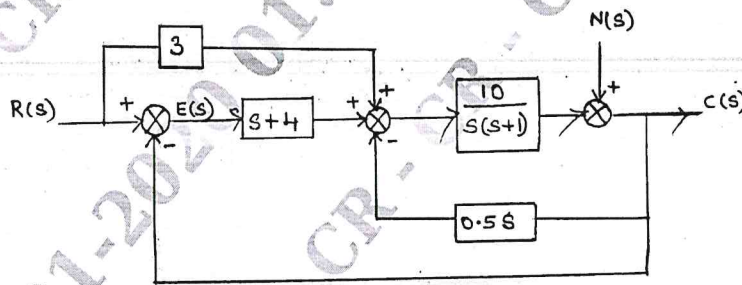


Fig.Q2(a)

- 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)

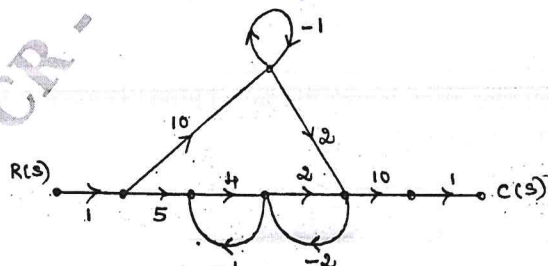


Fig.Q2(b)

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Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
 2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

- 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)

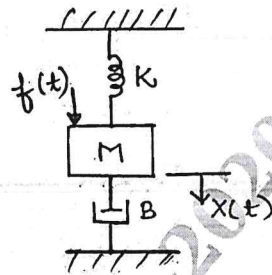


Fig.Q3(b)(i)

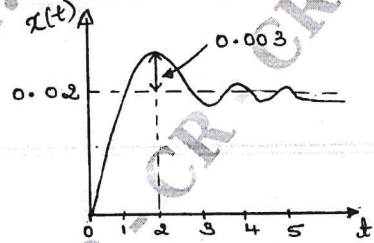


Fig.Q3(b)(ii)

- c. The open loop 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)

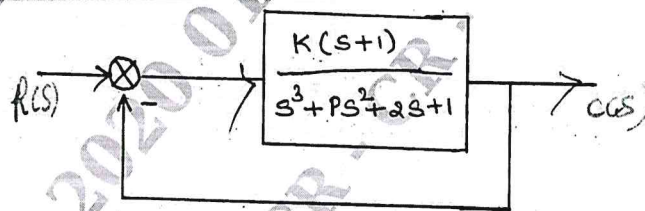


Fig.Q4(c)

**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 given 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 :

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

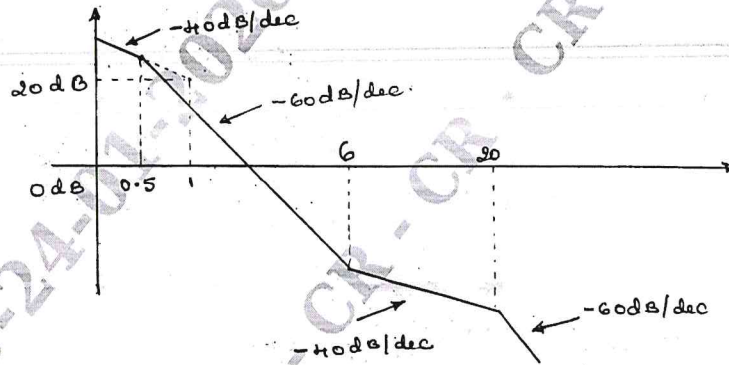


Fig. Q6(b)

- 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 :

- State (04 Marks)
  - 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)

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