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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. - Electrical and Electronics Engineering

Semester End Examination; Dec. - 2019

Linear Control Systems

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Differentiate between open loop and closed loop control system. 6

b. Give the classification of control systems. 8

c. Determine the transfer function $Y_2(s) / F(s)$ of the system shown in Fig. 1(c). 6

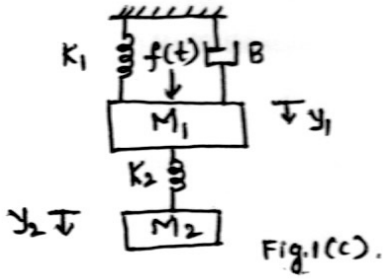

Fig. 1(c).

2 a. Obtain the transfer function model of AC servo motor. 6

b. Determine the overall transfer function C(s) / R(s) for the system shown in Fig. 2(b). 8

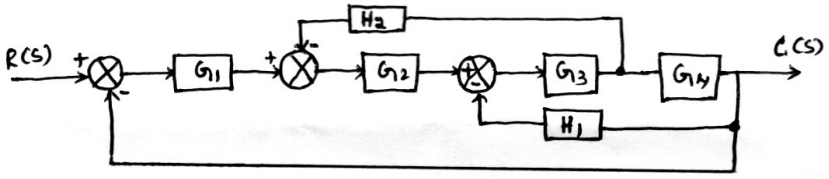

Fig. 2(b)

c. For the signal flow graph shown in Fig. 2 (c), obtain closed loop transfer function using Mason's gain formula. 6

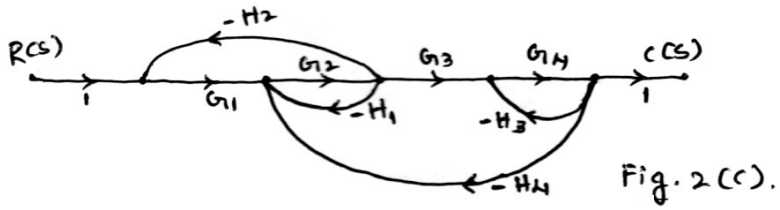

Fig. 2(c).

UNIT - II

3 a. Define transient response specifications in time domain. 10

b. Derive the expression for the peak overshoot. 4

c. For a unity feedback system $G(s) = \frac{s(s+1)}{s^2(s+3)(s+10)}$. Determine the type of the system, error coefficient and steady state error for input $r(t) = 1 + 3t + \frac{t^2}{2}$ 6

Contd…2

4 a. Explain the effects of adding poles and zeros to open loop and closed loop transfer function. 6

b. Derive the expression for unit step response of second order system when damping ratio is less than unity. 8

c. The response of a servomechanism is, $c(t) = 1 + 0.2\ e^{-60t} - 1.2\ e^{-10t}$ when subject to a unity step input. Obtain an expression for closed loop transfer function. Determine the undamped natural frequency and Damping ratio. 6

UNIT - III

5 a. Define Routh's stability criterion and explain the necessary conditions for stability. 8

b. Using RH criterion determine the stability of the system having the characteristic equation, $s^6 + 2s^5 + 8s^3 + 8s^2 + 8s + 4 = 0$. 6

c. The open loop transfer function of a unity feedback system is G (s) = $\frac{K(s+2)}{s(s+3)(s^2+5s+10)}$

(i) Find the value of K so that the steady state error for the input $r(t) = t\ u(t)$ is less than or equal to 0.01 6

(ii) For the value of K found in part (i) Verify the stability of closed loop system. Use R-H criterion.

6 a. Explain the procedure to sketch Root locus. 12

b. Sketch the root locus for the unity feedback system whose open loop transfer function is, G (s) = $\frac{K(s^2+6s+25)}{s(s+3)(s+2)}$. 8

UNIT - IV

7 a. Define frequency domain specifications with respect to frequency response analysis. 7

b. List the advantages and limitations of frequency response analysis. 8

c. Transient response of a second order under damped system subjected to unit step input is having 16.2% at time $\pi / 5\sqrt{3}$. If the system is subjected to sinusoidal input. Find;

(i) The frequency of the input at which amplitude of steady state response will have maximum value 5

(ii) Maximum value of steady state output

8 a. Find the T.F. of the system whose Bode diagram is shown in Fig. 8 (a). 8

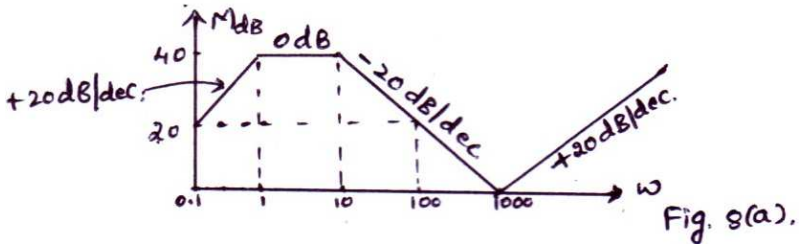

Fig. 8(a).

b. Sketch the bode plot for the system, G (s) = $\frac{75(1+0.2s)}{s(s^2+16s+100)}$. Determine G.M. and P.M. 12

Contd...3

UNIT - V

9 a. Explain how to determine G.M. and P.M. from polar plots? 6

b. Draw typical sketches of polar plot for the followings : 6

(i) Type 2, Order 4

(ii) Type 1, Order 3

(iii) Type 0, order 3

c. Sketch polar plot for the system, G (s) = $\frac{1}{s^2(1+s)(1+2s)}$. Determine gain margin and phase margin. 8

10 a. Explain the concept of Mapping theorem. 12

b. Sketch the Nyquist plot of a UFBCS having the OLTF G(s) = $\frac{5}{s(1-s)}$. Determine the stability of the system using Nyquist stability criterion. 8

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