U.S.N | | | | | | | | | | |

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. In the circuit of Fig. 1(a), K is the gain of an ideal amplifier. Determine the transfer function $\frac{I(s)}{V_i(s)}$ 10

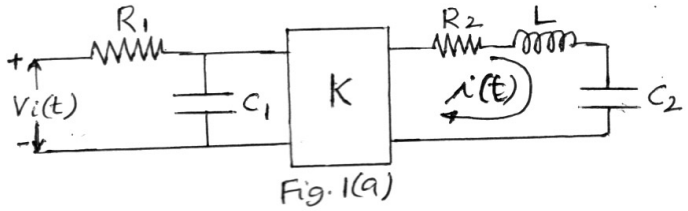

Fig. 1(a)

b. Write the electrical analogous networks based on, i) Torque-Voltage ii) Torque-Current analysis for the mechanical system shown in Fig. 1(b). 10

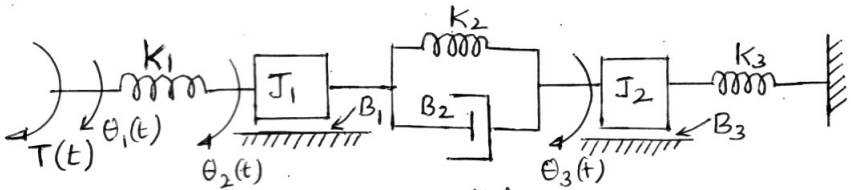

Fig. 1(b)

2 a. Apply block diagram reduction technique to find the transfer function $\frac{C(s)}{R(s)}$ for the system shown in Fig. 2(a). 10

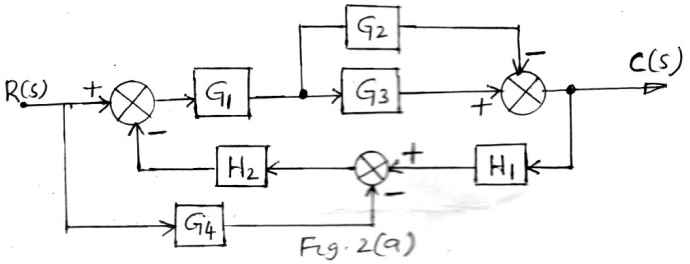

Fig. 2(a)

b. Find the overall $TF = \frac{C(s)}{R(s)}$ for the given signal flow graph shown in Fig. 2(b) using Mason's gain formula. 10

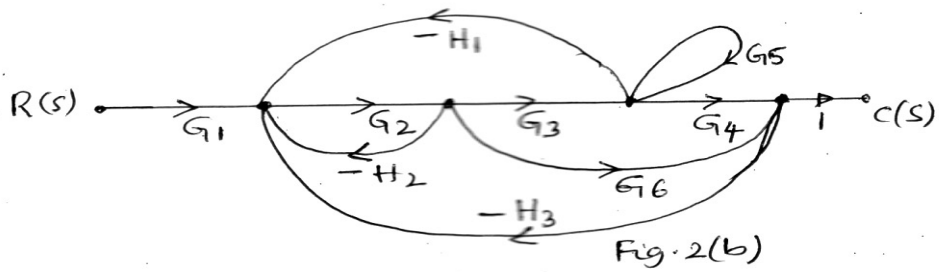

Fig. 2(b)

Contd…2

UNIT - II

3 a. Draw the time domain response *c(t)* of a typical under damped second order system to a step input. Indicate the following time domain specifications of the diagram and also define them; 10

i) Delay time ii) Rise time iii) Peak time iv) Maximum Over shoot v) Settling time

b. The open loop transfer function of a unity negative feedback control system is given by $G(s) = \frac{25}{s(s+5)}$. Determine the following time response specification: 10

i) Delay time (t_d) ii) Rise time (t_r) iii) Peak time (t_p) iv) Maximum Over shoot (M_p).

4 a. Derive the expressions for static error constants. How these coefficients are useful in determining steady state error? State any two limitations of static error coefficient method. 10

b. For unity feedback system having an open loop transfer function, $G(s) = \frac{K(s+2)}{s(s^3+7s^2+12s)}$. 10

Determine; i) Type of system ii) Error constants K_p, K_v, K_a

iii) Steady state error for unit parabolic input

UNIT - III

5 a. A negative feedback control system has $G(s) = \frac{K}{s(s^2+s+1)}$ and $H(s) = \frac{1}{(s+4)}$. Determine the range *K* for absolute stability of the system. Also find the frequency of sustained oscillations for the limiting value of *K*. 10

b. Determine the stability of a system whose characteristic equations are given by, 10

i) $Q(S) = S^5 + S^4 + 2S^3 + 2S^2 + 3S + 15$ *ii)* $Q(S) = S^8 + 5S^6 + 2S^4 + 3S^2 + 1$ Using R-H criterion.

6 a. A unity feedback control system has $G(s) = \frac{K}{s(s+2)(s+5)}$. Sketch the root locus and determine;

i) Breakaway point

ii) Line for $\varepsilon = 0.5$ and the value of *K* for this damping ratio 10

iii) The frequency at which the root-locus crosses the imaginary axis and the corresponding value of *K*

iv) Find the value of *K* at breakaway point

b. A feedback control system has the loop transfer function $G(s)H(s) = \frac{K}{s(s+4)(s^2+4s+20)}$. Plot the root locus as *K* is varied from 0 to ∞. Calculate the value of *K* which causes instability. 10

UNIT - IV

7 a. State any four advantages and two limitations of frequency response analysis. 6

b. What are frequency domains Specifications? Define any four of them. 6

c. A system has $\omega_r = 5$ and $M_r = 3$ in frequency domain. Making suitable assumptions determine t_r, t_s, t_p and damped oscillation frequency. Also find percent over shoot assuming standard second order system. 8

Contd…3

8 a. A unity feedback control system has $G(s)=\frac{80}{s(s+2)(s+20)}$ draw the Bode plot. Determine Gain margin and phase margin. Comment on the stability. 12

b. Determine the transfer function of a system whose magnitude plot is shown in Fig. 8(b) 8

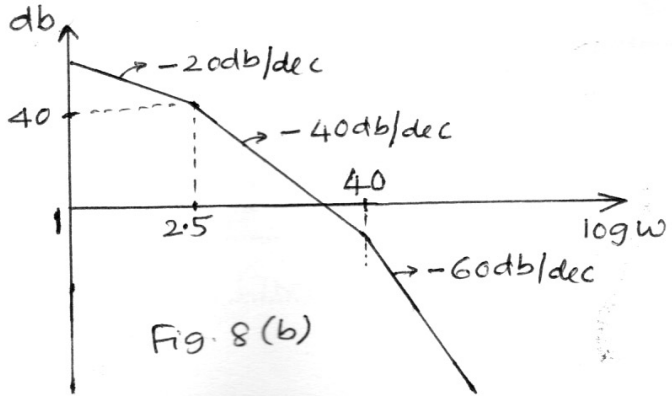

Fig. 8 (b)

UNIT - V

9 a. Sketch the polar plot for the following type 0 sytem $G(s)=\frac{6}{(s+1)(s+2)}$. 10

b. What do you mean by a polar plot? What is the advantage and limitation of polar plots ? Explain the procedure to sketch the polar plot. 10

10 a. Explain Nyquist stability criterion. 6

b. An open loop transfer function of a sytem is given by $G(s)H(s)=\frac{1}{s(1+s)(1+2s)}$. Comment on stability of the system by plotting Nyquist plot. Also find Gain margin and Phase margin. 14

* * *