

Fourth Semester B.E. Degree Examination, June/July 2017
Control System

Time: 3 hrs.

Max. Marks:100

Note: 1. Answer any FIVE full questions, selecting at least TWO questions from each part.
2. Graph and semi log required.

PART - A

- 1 a. Write down the differential equations governing the system below and write the force voltage analogy circuit. (10 Marks)

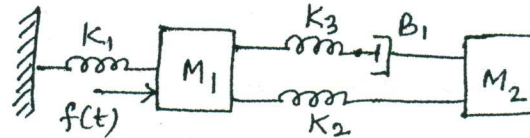


Fig.Q1(a)

- b. For the Fig.Q1(b). Derive the expression for the TF: $\frac{Q_1(s)}{T_1(s)} = \frac{1}{s(s^2 J_{eq} + B_{eq})}$. (10 Marks)

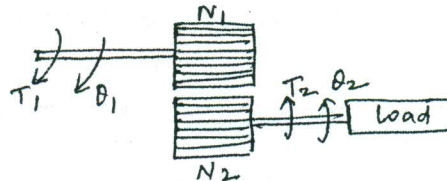


Fig.Q1(b)

- 2 a. Find the TF of the system by using block diagram reduction method. (10 Marks)

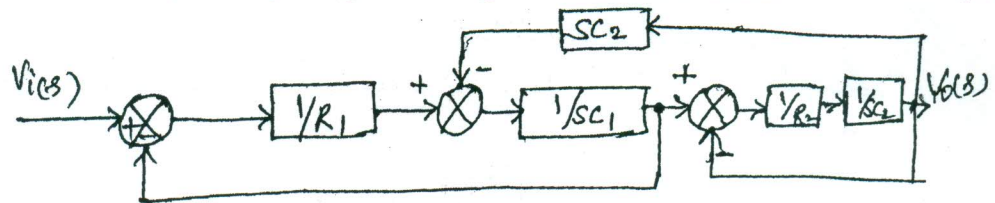


Fig.Q2(a)

- b. Find the C/R for the following system using Mason's gain formula. (10 Marks)

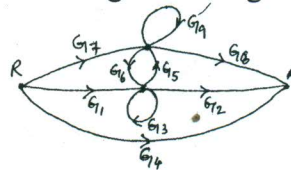


Fig.Q2(b)

- 3 a. Give the definition for the following transient response of a control systems to a unit step input in terms of time domain specifications.

i) Delay time, t_d ii) Rise time, t_r iii) Peak time, t_p iv) Maximum overshoot M_p v) Settling time, t_s with equations. (10 Marks)

- b. A closed loop servo is represented by the differential equation: $\frac{d^2c}{dt^2} + \frac{8dc}{dt} = 64e$ where 'c' is the displacement of the output Shaft 'r' is the displacement of the input shaft and $e = r - c$, determine undamped natural frequency, damping ratio. (10 Marks)

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.

- 4 a. A system with oscillating frequency ω , if it has poles at $s = \pm j\omega$, no poles to the right half of the S plane. Determine the value of 'K' and so that the system is shown below oscillates at a frequency of 2 rad/sec. (10 Marks)

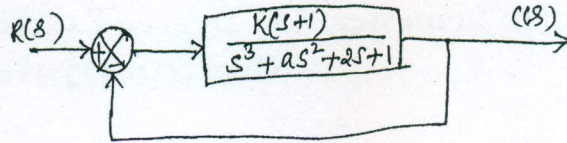


Fig.Q4(a)

- b. The open loop transfer function of servo system with unity feedback is $G(s) = \frac{10}{s(0.1s+1)}$. Evaluate the static error constant of the system. Obtain the steady-state error of the system, when subjected to an input given by the polynomial $r(t) = a_0 + a_1t + \frac{a_2}{2}t^2$. (10 Marks)

PART - B

- 5 For a unity feedback system the open-loop transfer function is given by :

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

- Sketch the root locus for $0 \leq k \leq \infty$
- At what value of K the system becomes unstable?
- At this point of instability, determine the frequency of oscillation of the system. (20 Marks)

- 6 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. (20 Marks)

- 7 The open loop transfer function of unity feedback system is : $G(s) = \frac{K}{s(s+1)(s+10)}$.

Draw the Bode plot and determine :

- Limiting value of K for the system to be stable
- The value of 'K' for gain margin of 7dB
- The value of K for phase margin of 40° $G(s) = \frac{k}{s(s+1)(s+10)}$. (20 Marks)

- 8 a. Write the state equation for the network shown :

(10 Marks)

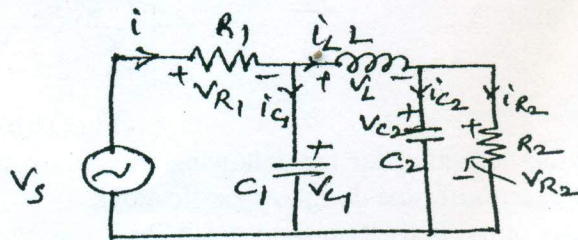


Fig.Q8()

- b. Obtain the characteristic equation of the matrix :

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix}$$

(10 Marks)
