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10ES43

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 atleast 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)**

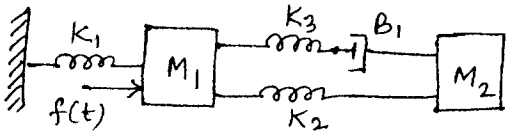

Fig.Q1(a)

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)**

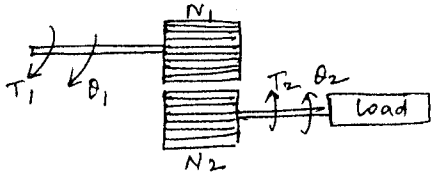

Fig.Q1(b)

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

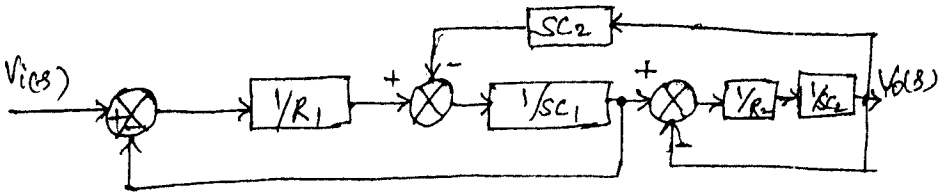

Fig.Q2(a)

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

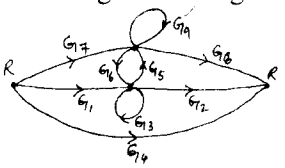

Fig.Q2(b)

3 a. Give the definition for the following transient response of a control systems to a unit step input interms of time domino specifications.
i) Delay time, t_d ii) Rise time, t_r iii) Peak time, t_p iv) Maximum overshoot Mp 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)**

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4 a. A system with oscillating frequency w, if it has poles at s = ±jw, 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)**

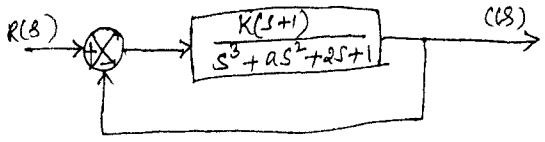

Fig.Q4(a)

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 $r(t) = a_0 + a_1 t + \frac{a_2}{2} t^2$. **(10 Marks)**

PART – B

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

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

i) Sketch the root locus for $0 \le k \le \infty$
ii) At what value of K the system becomes unstable?
iii) 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 :
i) Limiting value of K for the system to be stable
ii) The value of 'K' for gain margin of 7dB
iii) 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)**

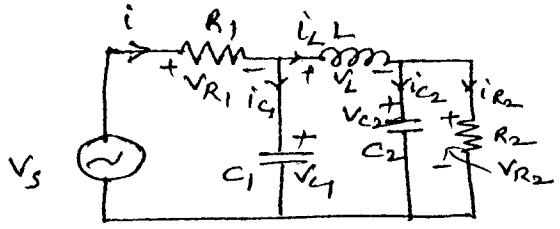

Fig.Q8()

b. Obtain the characteristic equation of the matrix :

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix}.$$ **(10 Marks)**

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