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.

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10ME/PM82

Eighth Semester B.E. Degree Examination, June/July 2015
Control Engineering

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART - A

1 a. Distinguish between open loop and closed loop control systems, with suitable examples. **(04 Marks)**

b. What are the ideal requirements of control system? **(06 Marks)**

c. What is Control Action? Briefly explain proportional, proportional plus derivative and proportional plus derivative plus integral controllers, with the help of block diagrams. **(10 Marks)**

2 a. Obtain the differential equation for the mechanical system shown in fig. Q2(a) and draw the equivalent mechanical system, also draw the analogous electrical network based on i) Force – voltage analogy ii) Force – current analogy. **(10 Marks)**

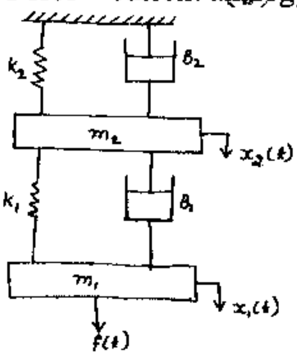

Fig.Q2(a)

b. Derive the transfer function of an armature controlled DC motor. The field current is maintained constant during operation. Assume that the armature coil has back emf $e_b = k_b \frac{d\theta}{dt}$ and the coil current produces a torque $T = K_m I$ on the rotor, K_b and K_m are the back emf constant and motor torque constant respectively. **(10 Marks)**

3 a. Reduce the block diagram shown in fig. Q3(a) to its simplest possible form and find its closed loop transfer function. **(10 Marks)**

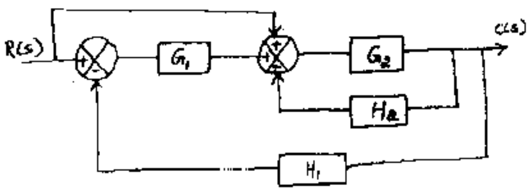

Fig.Q3(a)

b. Using Mason's gain formula, find the gain of the following system shown in fig. Q3(b). **(10 Marks)**

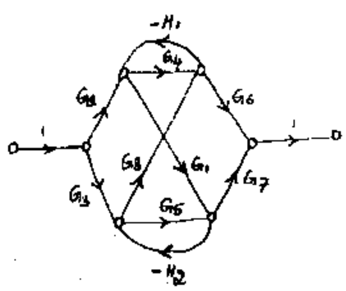

Fig.Q3(b)

4 a. Derive an expression for the unit step response of first order system. (08 Marks)

b. A unity feedback system is characterized by an open loop transfer function

$G(s) = \dfrac{K}{s(s+10)}$. Determine the gain K, so that the system will have a damping ratio of 0.5.

For this value of k determine peak time, setting time and peak overshoot for a unit step input. (08 Marks)

c. Ascertain the stability of the system given by the characteristic equation

$S^5 + 4S^4 + 12S^3 + 20S^2 + 30S + 100 = 0$, using R – H criteria . (04 Marks)

PART - B

5 a. Sketch the polar plot for the transfer function

$G(s) = \dfrac{10}{s(s+1)(s+2)}$. (10 Marks)

b. Apply Nyquist stability criterion to the system with transfer function.

$G(s)\ H(s) = \dfrac{4s+1}{s^2(1+s)(1+2s)}$ and ascertain its stability. (10 Marks)

6 Sketch the Bode plot for

$G(s)H(s) = \dfrac{2}{s(s+1)(1+0.2s)}$. Also obtain gain margin and phase margin and crossover frequencies. (20 Marks)

7 Sketch the root locus plot for

$G(s)H(s) = \dfrac{K}{s(s+2)(s+4)(s+6)}$. For what values of K the system becomes unstable? (20 Marks)

8 a. Explain the following : i) Lead compensator ii) Lag compensator. (12 Marks)

b. Determine the state controllability and observability of the system described by

$$\dot{x} = \begin{bmatrix} -3 & 1 & 1 \\ -1 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix} x + \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 2 & 1 \end{bmatrix} u$$

$$Y = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} x .$$ (08 Marks)

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