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

Time: 3 hrs.

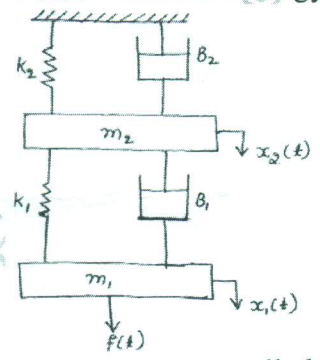
Max. Marks:100

**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)

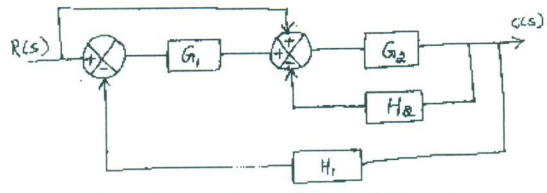
Fig.Q2(a)



- 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)

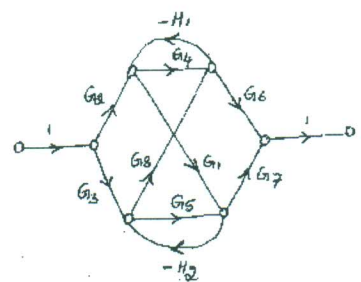
- 3 a. Reduce the block diagram shown in fig. Q3(a) to its simplest possible form and find its closed loop transfer function. (10 Marks)

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)



Important Note : 1. On completing answers, compulsorily draw diagonal cross lines on the remaining blank pages. 2. Any revealing of identification, appeal to evaluator and/or equations written on the remaining blank pages. 8 = 50, will be treated as malpractice.



- 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  $G(s) = \frac{K}{s(s+10)}$ . 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  $G(s) = \frac{10}{s(s+1)(s+2)}$ . (10 Marks)  
b. Apply Nyquist stability criterion to the system with transfer function.  $G(s) H(s) = \frac{4s+1}{s^2(1+s)(1+2s)}$  and ascertain its stability. (10 Marks)

- 6 Sketch the Bode plot for  $G(s) H(s) = \frac{2}{s(s+1)(1+0.2s)}$ . Also obtain gain margin and phase margin and crossover frequencies. (20 Marks)

- 7 Sketch the root locus plot for  $G(s) H(s) = \frac{K}{s(s+2)(s+4)(s+6)}$ . 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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