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06ME71

Seventh Semester B.E. Degree Examination, December 2011

Control Engineering

Time: 3 hrs. Max. Marks:100

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

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.

PART – A

1 a. Define control system. Compare open loop and closed loop control systems with two examples for each type. **(06 Marks)**

b. Name the basic controllers and their good and undesirable characteristics. **(06 Marks)**

c. With a block diagram, explain proportional, integral differential controller. **(08 Marks)**

2 a. Obtain the transfer function of the mechanical system shown in Fig.Q2(a), writing the physical system equations. **(08 Marks)**

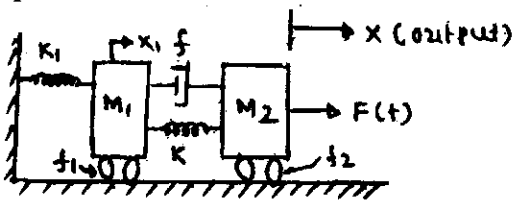

Fig.Q2(a)

b. Write the differential equations governing the behaviour of the mechanical system shown in Fig.Q2(b). Also obtain the analogous electrical circuit based on force voltage analogy and loop equations. **(12 Marks)**

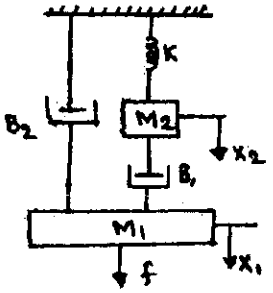

Fig.Q2(b)

3 a. Determine the overall transfer function of the block diagram shown in Fig.Q3(a). **(10 Marks)**

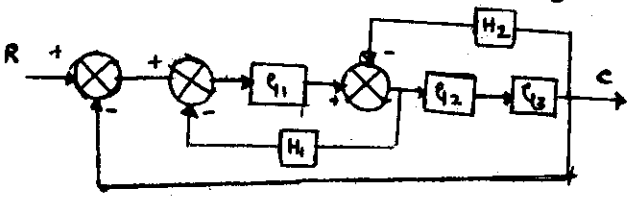

Fig.Q3(a)

b. Use Mason's gain formula for determining the overall transfer function of the system shown in Fig.Q3(b). **(10 Marks)**

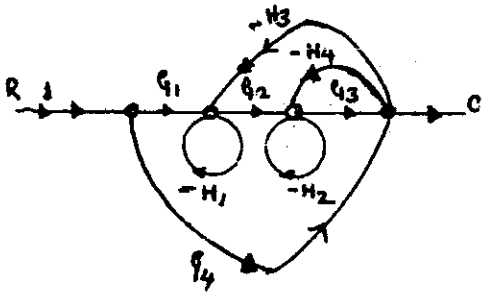

Fig.Q3(b)

4 a. Derive an expression for the unit step response of first order systems and steady state error. **(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 the settling time, peak overshot and time to peak overshot for a unit step input. **(08 Marks)**

c. Determine the stability of the system whose characteristic equation is given by $S^4 + 6S^3 + 23S^2 + 40S + 50 = 0$ **(04 Marks)**

PART – B

5 a. State and explain the Nyquist stability criterion. **(06 Marks)**

b. Draw the Nyquist plot for a given open loop transfer function $GH(S) = \frac{K}{S(1+S)(1+2S)(1+3S)}$. Determine the range of K for which the system is stable. **(14 Marks)**

6 a. Define the terms gain margin and phase margin. Explain how these can be determined from Bode plots. **(06 Marks)**

b. Sketch the Bode plot for the transfer function $G(S) = \frac{Ke^{-0.1S}}{S(1+S)(1+0.1S)}$. Find the value of K for the crossover frequency = 5 rad/sec. **(14 Marks)**

7 An aeroplane with an autopilot in the longitudinal mode has a simplified openloop transfer function $G(S)H(S) = \frac{K(S+1)}{S(S-1)(S^2+4S+16)}$. Sketch the root-locus plot and determine the range of K for stability. **(20 Marks)**

8 a. Discuss various methods of compensation in feedback control systems. **(10 Marks)**

b. Explain with a block diagram the lag lead compensator. **(10 Marks)**

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