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06ES/EC/TE/EE/ML/BM43

Fourth Semester B.E. Degree Examination, June/July 2013
Control System

Time: 3 hrs. Max. Marks:100

Note: *1. Answer FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Define control system. Explain the differences between open loop control system and closed loop control system, with examples. **(10 Marks)**

b. Draw the signal flow graph and obtain the closed loop transfer function of a system whose block diagram is given Fig. Q1(b). **(10 Marks)**

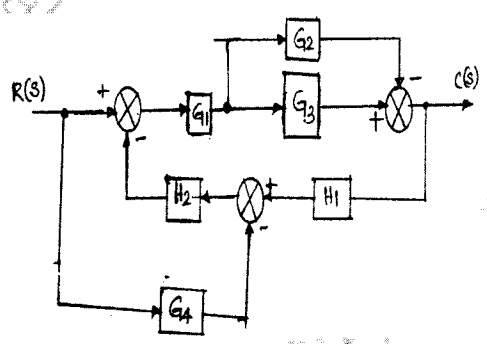

Fig. Q1(b)

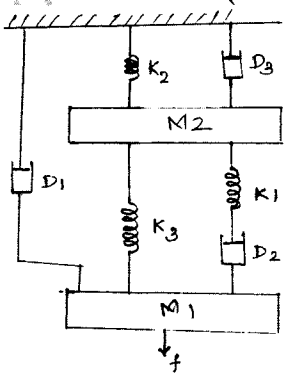

Fig Q2(a)

2 a. For the mechanical system shown in Fig. Q2(a), obtain the F – V analogous electrical network. **(12 Marks)**

b. Obtain the transfer function of field controlled servo motors. **(08 Marks)**

3 a. Starting from fundamentals derive an expression for the step response of typical under damped second order closed loop control system. Show the typical variation of the response and mark the settling time on 5% tolerance basis. **(14 Marks)**

b. Explain the following time domain specifications of a second order system
i) Delay time ii) Rise time iii) Settling time iv) Peak time. **(06 Marks)**

4 a. For the system with characteristic equation $s^4 + ks^3 + s^2 + s + 1 = 0$, determine the range of k for stability. **(10 Marks)**

b. The open loop transfer function of a UFB control system is given by

$$G(s) = \frac{50}{s(1+0.05s)(1+0.2s)}$$

Apply R – H criteria. Show that the system is unstable confirm that the introduction of the two terminal pair network connected in cascade with G(s) makes the system stable.
$C_1 = 0.5\mu F$; $C_2 = 10\ \mu F$; $R_1 = 1\ M\Omega$ **(10 Marks)**

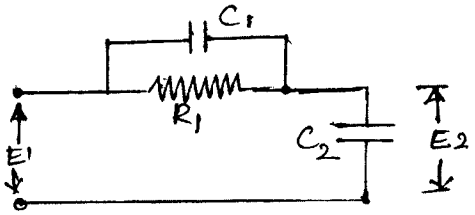

Fig. Q4(b)

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 – B

5 a. As applied to root locus, explain how to
   i) Determine angle of departure or arrival from a complex pole or zero
   ii) Determine the break away or beak in points if they are present
   iii) Calculate k on a given point on the root locus **(08 Marks)**

   b. The characteristic equation of a single loop unity feedback control system is given by $F(S) = s^3 + 8s^2 + 20s + k = 0$. Sketch the complete root locus diagram and from that find :
   i) Two values of k that make the system critically damped
   ii) Tow values of k for which the damping ratio is 0.95
   iii) Write closed loop transfer functions for the values of k found in part(ii). **(12 Marks)**

6 a. State and explain Nyquist stability criterion. **(08 Marks)**

   b. The open loop transfer function of unity feedback system is given by

$$G(s) = \frac{k}{s(s+1)(s+2)}$$

   Sketch NYquist plot and find the range of k. **(12 Marks)**

7 a. Define the following as applied to bode plots
   i) Gain margin
   ii) Phase margin
   iii) Gain cross over frequency
   iv) Phase crossover frequency
   v) Corner frequency. **(06 Marks)**

   b. The open loop transfer function of a unity feedback control system in given by

$$G(s) = \frac{k(s+1)}{s(s+0.1s)^2(1+0.02s)}$$

   i) Draw the bode plot and hence find phase margin and gain margin for k = 1
   ii) Determine the value of k for a gain margin of 20 dB and the value of k for a phase margin of 30°. **(14 Marks)**

8 a. Write short notes on :
   i) State transition matrix
   ii) State space analysis. **(06 Marks)**

   b. Obtain the state model of the electric network shown in Fig. Q8(b) by choosing minimal number of state variables. **(08 Marks)**

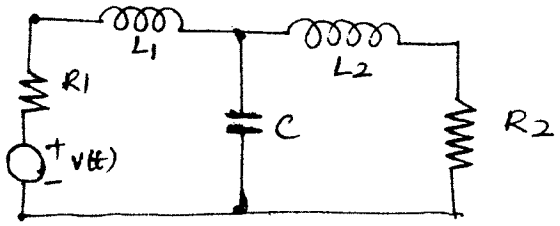

Fig. Q8(b)

   c. Construct a state model for a given system characterized by the differential equation :

$$\frac{d^3y}{dt^3} + \frac{6d^2y}{dt^2} + \frac{11dy}{dt} + 6y + u = 0$$

   Draw the state diagram. **(06 Marks)**

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