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06ME71

Seventh Semester B.E. Degree Examination, December 2010
Control Engineering

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain the concepts of open loop and closed loop systems, with examples and block diagrams. **(08 Marks)**

b. Derive the transfer function for an armature controlled D.C. motor, which relates output angular displacement (θ) with input voltage (e). **(12 Marks)**

2 a. What is control action? **(02 Marks)**

b. Draw the block diagram with brief explanation of an industrial automatic controller with measuring element. **(06 Marks)**

c. Briefly explain proportional and integral control action, with necessary block diagrams and mathematical expressions. **(12 Marks)**

3 a. A dynamic vibration absorber is shown in Fig.Q3(a). Obtain the differential equations describing the behaviour of the system. Draw also the analogous electrical circuit, based on the force-voltage analogy. List all the analogous elements. **(10 Marks)**

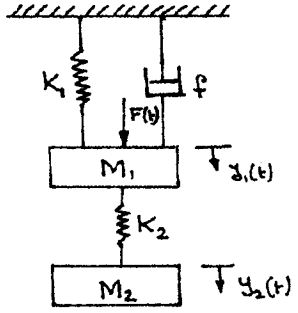

Fig.Q3(a)

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

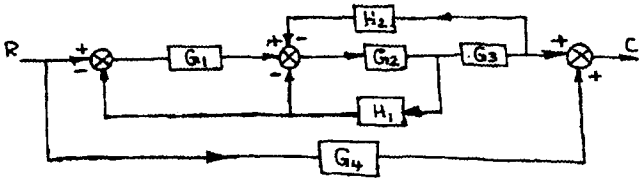

Fig.Q3(b)

4 a. Derive expressions for the responses of a first order system, subjected to :
i) Step input ii) Ramp input **(08 Marks)**

b. A system oscillates with a frequency ω, has poles at S = ± JW and no poles in the right half of S-plane. Determine the values of constants K and a, so that the system shown in Fig.Q4(b) oscillates at a frequency of 2 rad/sec. **(12 Marks)**

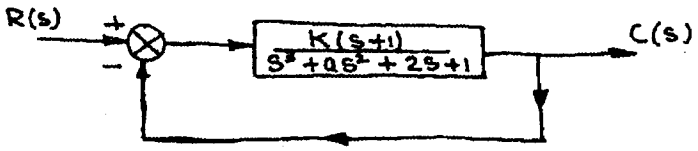

Fig.Q4(b)

PART – B

5 a. Briefly explain the concept of gain margin and phase margin by drawing neat polar plots, for both stable and unstable systems. **(06 Marks)**

b. Sketch the complete Nyquist plot for $G(S)H(S) = \frac{K(4S+1)}{S^2(1+S)(1+2S)}$. Also determine the range values of K for stability, using the Nyquist stability criterion. **(14 Marks)**

6 Draw Bode magnitude and phase angle plots for the transfer function given as :

$$G(S)H(S) = \frac{4(1+0.5S)}{S^2(1+2S)(1+0.5S+0.125^2S^2)}.$$

Use asymptotic straight line approximation method. Also determine the gain margin and the phase margin from the plot. Hence comment on the system stability. **(20 Marks)**

7 a. Define root locus. **(03 Marks)**

b. The closed loop transfer function of a unity feedback system is given by :

$$\frac{C(S)}{R(S)} = \frac{K(S+4)(S+6)}{S(S+2)+K(S+4)(S+6)}.$$

Sketch the root locus diagram of the system. Show all relevant details on the plot. **(17 Marks)**

8 a. Explain the need for system compensation. **(06 Marks)**

b. Write a note on:

i) Lead compensator

ii) Lag compensator. **(14 Marks)**

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