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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Fifth Semester, B.E. - Electrical and Electronics Engineering

Semester End Examination, Dec. - 2014

Linear Control Systems

Time: 3 hrs *Max. Marks: 100*

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

PART - A

1.a. Define the following terms:

i) System

ii) control system

iii) Servomechanism. 5

iv) Open-loop system

v) Closed loop system.

b. Find the transfer function of second order RLC system. 5

c. For the mechanical system shown in Fig. 1(b)

i) Draw mechanical network

ii) Write differential equations

iii) Draw Force-voltage analogous electrical network. 10

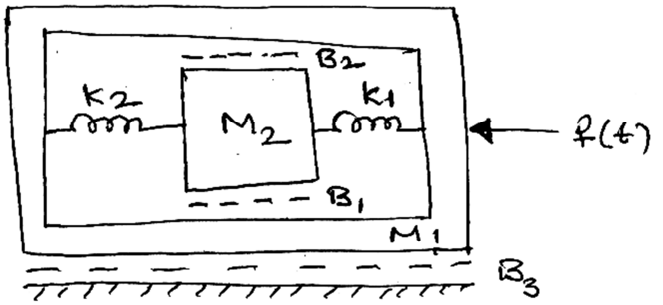

Fig. 1(b)

2 a. Obtain the transfer function $\frac{\theta(S)}{E_a(S)}$ for the armature controlled DC motor and draw the block diagram. 12

b. Obtain $\frac{C(S)}{R(S)}$ for the block diagram shown in the Fig. 2(b) using block diagram reduction technique. 8

Contd…2

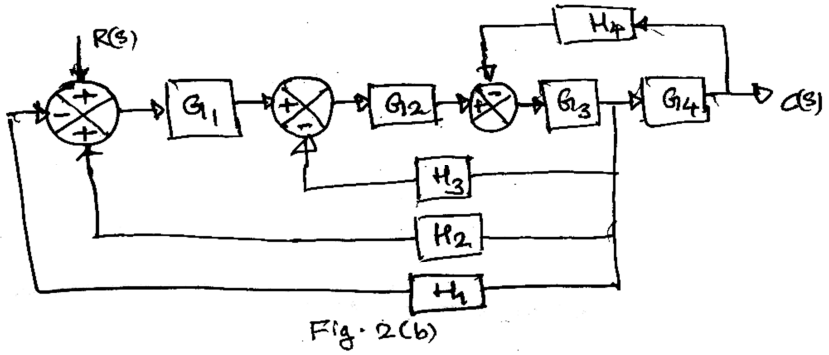

Fig. 2(b)

3 a. Obtain the transfer function $\frac{C(S)}{R(S)}$ for the signal flow graph shown in Fig. 3(a) 10

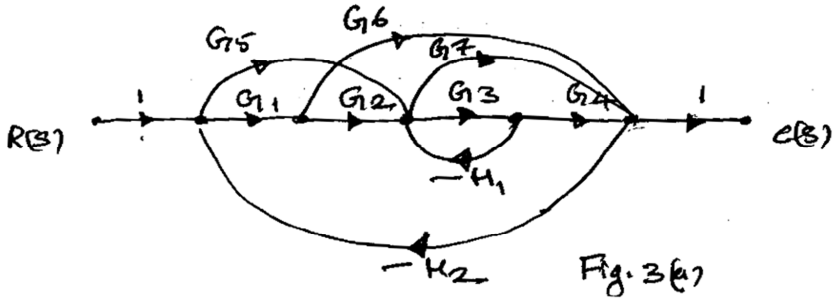

Fig. 3(a)

b. Define standard test signals those are used in time domain analysis and give their Laplace transforms. 6

c. Obtain the expression for unit step response of a first order system with unity feedback. 4

4 a What is the significance of time domain specifications? Derive the expression for rise time and peak time in case of second order system. 7

b. Explain the effects of PI controller for 2nd order system performance. 6

c. Determine the step, ramp and parabolic error coefficients for a unity feedback system whose open loop transfer function is $G(S)=\frac{K}{S(S+5)(S+2)}$ Find steady state error for ramp input. 7

PART - B

5 a. Define the terms: 6

i) Absolute stability ii) Conditional stability iii) Marginal stability

b. Discuss the special case of Routh thurwitz criterion when all the elements in any one row of the array are zero. 4

c. The open loop transfer function of a unity feedback control system is given by 10

$$G(S)=\frac{K}{(S+2)(S+4)(S^2+6S+25)}$$

Determine the range of K using RH criterion for absolute stability. Also estimate the value of K which will cause sustained oscillations and frequency of oscillations at this value of K.

6 a. Discuss the steps involved to plot Root locus from the open loop transfer function. 10

b. Sketch the root locus for the open loop transfer function $G(S)H(S)=\frac{K(S+2)}{(S^2+2S+2)}$ 10

7 a. Define gain margin and phase margin. Explain how to find the stability of the closed loop system from Bode plot using suitable illustration. 10

b. Sketch the Bode plot for the open loop transfer function

$G(S)H(S)=\frac{10}{S(S+0.1S)(1+S)}$ 10

Also find GM and PM.

8 a. Explain the Nyquist – Criterion for stability analysis of a closed loop system. 8

b. Sketch the Nyquist plot for the open loop transfer function $G(S)H(S)=\frac{10}{S^2(1+0.25S)}$ 12

Discuss the stability of the closed loop system using Nyquist plot.

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