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M S RAMAIAH INSTITUTE OF TECHNOLOGY

(AUTONOMOUS INSTITUTE, AFFILIATED TO VTU)

BANGALORE – 560 054

SEMESTER END EXAMINATIONS – JANUARY 2015

Course & Branch	: B.E: Electrical & Electronics Engg.	Semester	: V
Subject	: Control System	Max. Marks	: 100
Subject Code	: EE502	Duration	: 3 Hrs

Instructions to the Candidates:

- Answer one full question from each unit.

UNIT – I

1\. a) For the electromechanical system shown in fig 1a) find the transfer function $\frac{X(s)}{E(s)}$ (08)

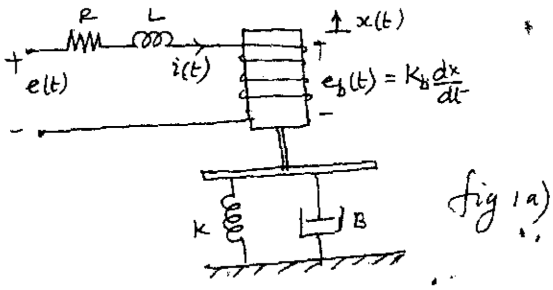

fig 1a)

b) For the mechanical system shown in fig 1b) (12)

i)Draw the mechanical network

ii)Write the differential equations governing its dynamic behavior

iii)Draw the force-voltage (F-V) analogous electric network

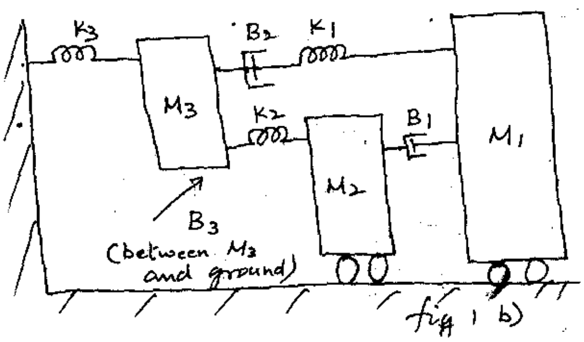

fig 1 b)

2 a) Draw the F-V analogous mechanical system for the electrical network shown in fig 2 a) writing the loop equations for the electrical circuit then transforming them to their mechanical analog. (10)

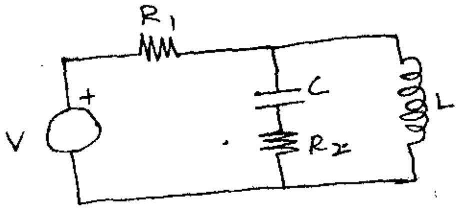

fig 2 a)

b) For the rotational system shown in fig 2b) (10)

i)Draw the mechanical network

ii)Write the differential equations governing its dynamic behavior

iii)Draw the force-voltage (F-V) analogous electric network

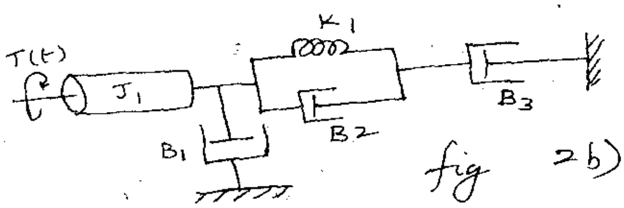

fig 2b)

UNIT - II

3. a) Explain Mason's Gain formula. Using Mason's gain formula determine the transmittance of the signal flow graph shown in fig 3 a) (10)

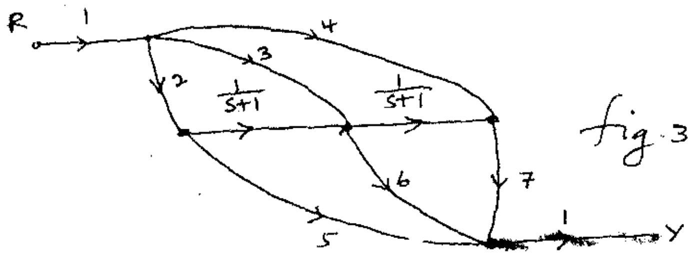

fig 3a)

b) Fig 3 b) shows a mechanical vibratory system. When a force of 8.9Nw is applied to the system, the mass oscillates as shown in fig 3c) . Find the values of M,B and K. (10)

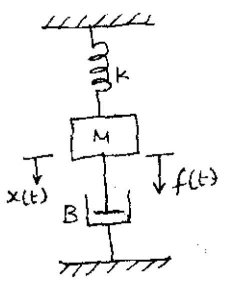

fig 3 b)

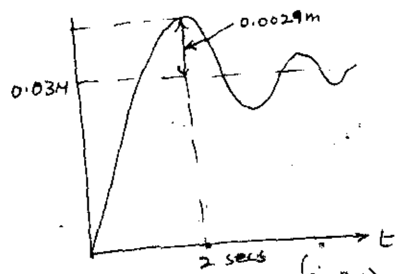

fig3c)

4\. a) The performance equations of a controlled system are given by the following set of linear algebraic equations . Draw the block diagram and determine **(12)**

$C(s) / R(s)$

$E_1(s) = R(s) - H_3(s)\, C(s)$

$E_2(s) = E_1(s) - H_1(s)\, E_4(s)$

$E_3(s) = G_1(s)\, E_2(s) - H_2(s)\, C(s)$

$E_4(s) = G_2(s)\, E_3(s)$

$C(s) = G_3(s)\, E_4(s)$

b) Illustrate how to perform the following in connection with a block diagram reduction techniques i) moving a summing point ahead of a block and behind a block ii) moving a take-off point ahead of a block and behind a block iii) transforming a non unity feedback for a unity feedback **(08)**

UNIT – III

5\. a) The block diagram of a feedback control system is shown in the fig. 5 (a). Apply RH criterion to determine the range of K for stability if $G(s)= \dfrac{K}{(s+4)(s+5}$ **(08)**

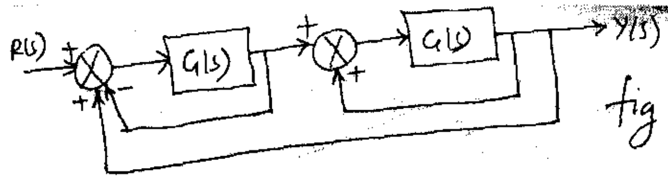

fig 5a)

b) For a unity feedback system t **(12)**

he OLTF is given by $G(s) = \dfrac{K}{s(s+2)(s^2+6s+25}$ i)Sketch the root locus for $0 \le K \le \infty$ ii) At what value of K the system becomes unstable? iii) At this point of instability determine the frequency of oscillation of the system

6 a) What are the conditions to be satisfied for the root locus to exist at any point on the s-plane **(06)**

b) Consider a closed loop feedback control system shown in fig 6b) Using RH criterion determine the range of K for which the system is stable. Find also the number of roots of the characteristic equation that are in the right half of s-plane for K = 0.5 **(08)**

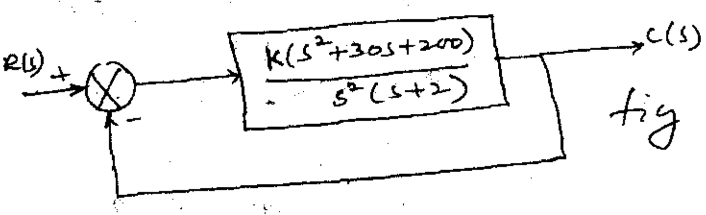

fig 6 b)

c) Show that that the root loci of OLTF $G(s) = \dfrac{K(s+1)}{s(s-1)}$ is a circle with centre (-1,0) and radius = $\sqrt{2}$ **(06)**

UNIT - IV

7. a) Obtain expressions for i) Peak resonance ii) Resonance frequency and iii) Bandwidth of a 2^{nd} order system (10)

   b) Sketch Nyquist plot of a unity feedback control system having a open loop transfer function $G(s) = \frac{5}{s(1-s)}$. Determine the stability of the system using Nyquist stability criterion. (10)

8. a) Define the terms Gain Margin and Phase Margin. Explain how these can be determined using polar plot. (06)

   b) Given $G(s)H(s) = \frac{12}{s(s+1)(s+2)}$. Draw the polar plot and hence determine if the system is stable. (08)

   c) State and explain Nyquist Stability Criterion. (06)

UNIT - V

9. a) The OLTF of a unity feedback system is $G(s) = \frac{K}{s(1+0.2s(1+0.05s}$. Draw the Bode Plots. From the graph i) determine the value of K for a Gain Margin of 10dB. ii) determine the value of K for a phase Margin of 40°. (14)

   b) Design a lead network for a maximum phase angle lead of 45° at 4.5Khz.Assume suitable datas. (06)

10. a) Determine the transfer function which has asymptotic bode magnitude plot shown in fig 10 a) (06)

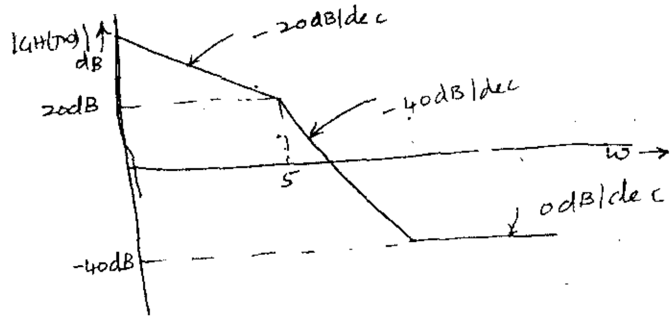

fig10 a)

   b) Plot the Bode Plots for the OLTF $G(s) = \frac{100(s+2)}{s(s+4)(s+5)}$. Discuss the stability of the system (10)

   c) Obtain the transfer function of a lag-lead network. (04)

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