Code: 15A02303 **R15**

B.Tech II Year I Semester (R15) Regular Examinations November/December 2016

CONTROL SYSTEMS ENGINEERING

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Write the analogous electrical elements in force-current analogy for Mass (M), Friction (B), spring constant (K) and displacement(x).

(b) What is synchro?

(c) Mention any four time domain specifications.

(d) What is the difference between type and order of a system?

(e) State the necessary and sufficient conditions of Routh-Hurwitz criterion for stability.

(f) What is the effect of addition of zero to the system?

(g) Define 'resonant frequency'.

(h) Write the transfer function of lag/lead compensator?

(i) Define 'state' and 'state variables'.

(j) Define 'controllability'.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

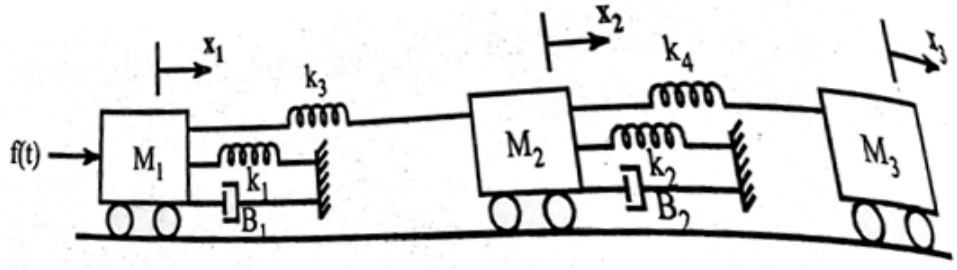
UNIT – I

2 (a) What are the effects of feedback on system performance? Explain.

(b) Derive the transfer function of A.C servo motor.

OR

3 A mechanical translational system is shown in figure below. Write the analogous electrical equations based on force-voltage analogy and draw the corresponding electrical network.



UNIT – II

4 (a) What is the location of poles for different types of damped systems?

(b) An experiment conducted on a servo mechanism shows the error response to be:

e(t) =1.4 e^{-4t} sin (2.86t+43^0)

Where the input is a sudden unit displacement. Determine the natural frequency, damping ratio and damped angular frequency of the system.

OR

5 The open loop transfer function of a unity feedback control system is G(s) = $\frac{K}{s(1+sT)}$. When unit step input is given to system, the maximum value 1.26 is obtained at time 4sec. Find damping ratio, undamped natural frequency, K and T.

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UNIT – III

6 For the unity feedback system whose open loop transfer function is: G(s) = $\frac{K}{s(s+1)(s+2)(s+5)}$

(a) Find the range of 'K' for stability.

(b) Find the value of 'K' for marginal stability.

(c) Find the actual location of the closed loop poles when the system is marginally stable by using Routh-Hurwitz criterion.

OR

7 Sketch the Root locus of a feedback system whose open loop transfer function is given by:

G(s) H(s) = $\frac{K}{s(s+3)(s+5)}$

UNIT – IV

8 (a) Derive the expression for resonant peak in the frequency response of a second-order system.

(b) Sketch the polar plot of G(s) = $\frac{10}{s(s+1)}$.

OR

9 The open loop transfer function of a unity feedback system is:

G (s) = $\frac{K}{s(1+0.02s)(1+0.04s)}$,

Draw the Bode plot & find the gain margin and phase margin. Also find the value of open loop gain so that the system has a phase margin of 45^0.

UNIT – V

10 (a) State and prove the properties of state transition matrix.

(b) Test whether the following system is completely state controllable and observable or not.

$$\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -3 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} U$$

$$Y = \begin{bmatrix} 0 & 1 & -1 \end{bmatrix} X$$

OR

11 Obtain the state variable representation of an armature-controlled D.C motor.

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