Code: 13A02402 **R13**

B.Tech II Year II Semester (R13) Supplementary Examinations December/January 2015/2016

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) List all electrical analogs of rotational mechanical systems using force-current analogy.

(b) A closed loop control system has an open loop gain of 100. Its feedback loop has a gain of 0.005. Find its sensitivity for negative feedback.

(c) Write the expressions for the response of first order system to the unit step input signal and unit ramp input signal in time domain.

(d) What is a type 1 system? What is its steady state error for unit ramp input?

(e) Determine the stability of the system with the characteristic equation $S^4 + S^3 + S^2 + 4S + 6 = 0$.

(f) Discuss the effect of addition of open loop poles on the root loci.

(g) Define gain margin.

(h) Define gain cross-over point.

(i) Define the state of a system.

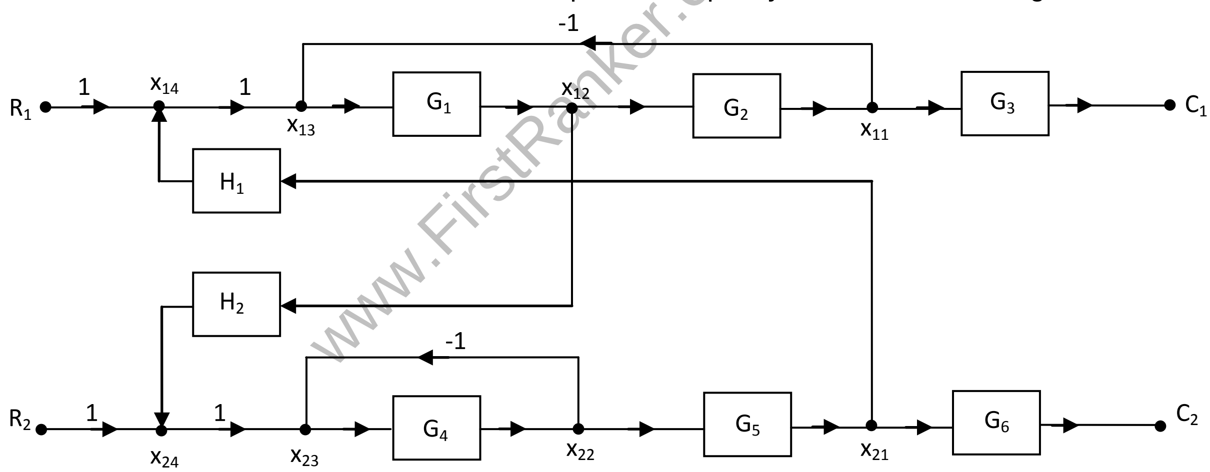
(j) Derive the response of unforced system.

PART – B

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

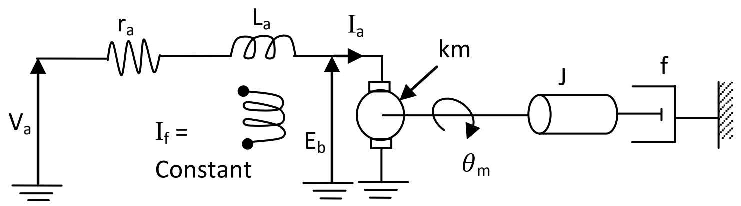
UNIT – I

2 Find the transfer function matrix for the two input two output system shown in the figure below.



OR

3 Develop a signal flow graph for the motor shown in figure below with the given constants. Find the transfer function $\frac{\theta_m(s)}{V_a(s)}$ using Mason's formula.



Where r_a is armature resistance; L_a is armature inductance; J is motor inertia; f is motor friction and km is motor constant.

Contd. in page 2

UNIT – II

4 A unity feedback system has an open loop transfer function $G(s) = \frac{25}{s(s+8)}$. Determine its damping ratio, peak overshoot and time required to reach the peak output. Now a derivative component having transfer function of $\frac{s}{10}$ is introduced in the system. Discuss its effect on the values obtained.

OR

5 A unity feedback system having open loop transfer function as $G(s) = \frac{k(s+2)}{s(s^3+7s^2+12s)}$, determine: (i) Type of system. (ii) k_p, k_v and k_a. (iii) Steady state error for parabolic input.

UNIT – III

6 Sketch the root locus for a unity feedback system having $G(s) = \frac{k(s+1)}{s^2(s+5)}$.

OR

7 The open loop transfer function of a unity feedback system is given by $G(s) = \frac{k}{s(s+2)(s^2+6s+25)}$. Sketch the root locus for $0 \le k \le \infty$.

UNIT – IV

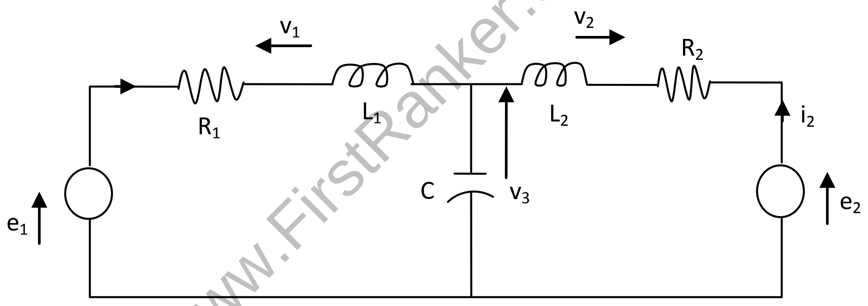
8 Consider the transfer function $GH(s) = \frac{60}{(s+1)(s+2)(s+5)}$. Comment on stability of the system using the sketch of its Nyquist plot.

OR

9 Explain Nyquist criterion. Write the procedure for determining Nyquist plot.

UNIT – V

10 Consider the electric circuit shown in the figure below, where e_1 and e_2 are the inputs and v_1, v_2, v_3 are outputs. Choosing i_1, i_2 and i_3 as the state variables, determine the system equations and write the state model.



OR

11 Consider the system $\dot{X} = AX \; with \; X_0 = X(0)$ where $A = \begin{bmatrix} -2 & -4 \\ 1 & -2 \end{bmatrix}$. Find $\phi(t)$ and the solution for $X_0 = [1 \quad 1]^T$.

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