Code: 13A02402

R13

B.Tech III Year I Semester (R13) Supplementary Examinations June 2017

CONTROL SYSTEMS ENGINEERING

(Common to ECE and EIE)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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

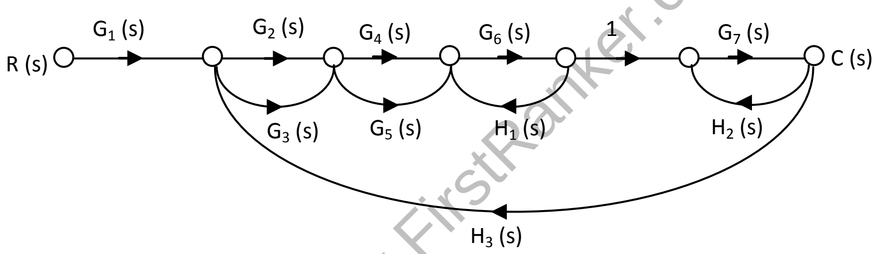
(a) If a forward path touched all closed loops, what would be the value of Δ_k?
(b) Write the analogous electrical elements in force voltage analogy for the elements of mechanical translational system.
(c) Define impulse signal with its waveform.
(d) How the system was classified depending on the value of the damping?
(e) Why marginally stable systems are considered unstable under the BIBO definition of stability?
(f) What kind of compensation improves the steady-state error?
(g) Write a short note on the correlation between the time and frequency response.
(h) How closed loop frequency response is determined from open loop frequency response using M and N circles?
(i) How can the poles of a system be found from the state equations?
(j) Write the general form of the state-transition matrix. How many constants would have to be found?

PART – B

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

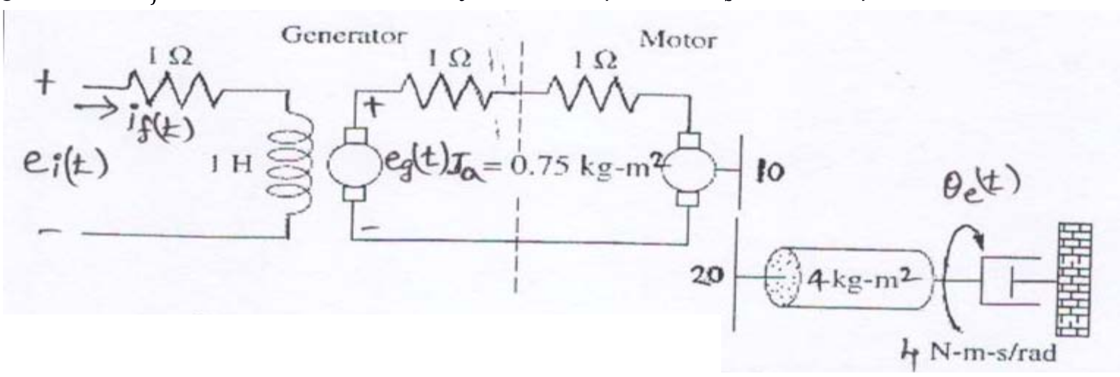
UNIT – I

2 Using Mason's rule, find the transfer function, $(s) = \frac{C(s)}{R(s)}$, for the system represented by figure below.



OR

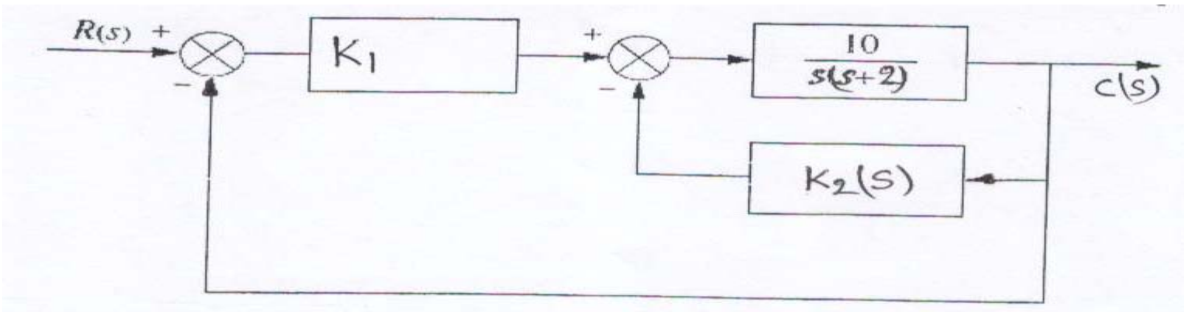
3 A motor and generator are set up to drive a load as shown in figure below. If the generator output voltage is $e_g = K_f i_f(t)$, where $i_f(t)$ is the generator's field current, find the transfer function $G(s) = \frac{\theta_0(s)}{E_i(s)}$. For the generator, $K_f = 2\,\Omega$. For the motor, $K_t = 1\,N-m/A$, and $K_b = 1\,V-s/rad$.



Contd. in page 2

UNIT – II

4 For the system of figure below, find the values of K_1 and K_2 to yield a peak time of 1.5 second and a settling time of 3.2 seconds for the closed-loop system's step response.



OR

5 (a) What pole locations characterize: (i) The under damped system. (ii) The over damped system. (iii) The critically damped system.

(b) A system has a damping ratio of 0.5, a natural frequency of 100 rad/s and a DC gain of 1. Find the response of the system to a unit step input.

UNIT – III

6 Consider the unity feedback system shown with transfer function $(s) = \frac{K}{s(s+4)(s+6)}$. Draw the root locus and identify the stability.

OR

7 Using the Routh-Hurwitz criterion and the unity feedback system with $G(s) = \frac{K}{s(s+1)(s+2)(s+5)}$. (i) Find the range of K for stability. (ii) Find the value of K for marginal stability. (iii) Find the actual location of the closed-loop poles when the system is marginally stable.

UNIT – IV

8 Make a polar plot of the frequency response for the transfer function given by: $G(s) = \frac{(s+5)}{s(s+2)(s+4)}$

OR

9 Given a unity feedback system with the forward-path transfer function $G(s) = \frac{K}{s(s+1)(s+3)(s+6)}$ and a delay of 0.5 second, find the range of gain, K, to yield stability. Use Bode plots.

UNIT – V

10 Give the following state-space representation of a system, find Y(s):

$$\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ -2 & -4 & 1 \\ 0 & 0 & -6 \end{bmatrix} X + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} e^{-1}$$

$$Y = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix} X; \quad X(0) = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

OR

11 Solve for y(t) for the following system represented in state space, where u(t) is the unit step. Use the Laplace transform approach to solve the state equation.

$$\dot{X} = \begin{bmatrix} -3 & 1 & 0 \\ 0 & -6 & 1 \\ 0 & 0 & -5 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u(t)$$

$$Y = \begin{bmatrix} 0 & 1 & 1 \end{bmatrix} X; \quad X(0) = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

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