BTS-IV-04-19-0339 Reg. No. [ ]

C

B.Tech. Degree IV Semester Examination April 2019

EE 404 LINEAR SYSTEM ANALYSIS
(2006 Scheme)

Time: 3 Hours Maximum Marks: 100

PART A
(Answer ***ALL*** questions)

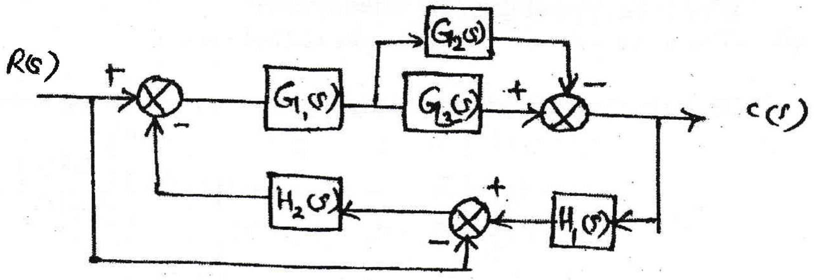
$(8 \times 5 = 40)$

I.
- (a) Derive the transfer function of a positive feedback control system.
- (b) State and explain Mason's gain formula.
- (c) What are analogous systems? Explain the Force-Voltage analogy in mechanical translational systems.
- (d) Write short notes on thermal systems.
- (e) Explain standard test signals with neat diagram.
- (f) Explain the steady state error constants Kp, Kv and Ka.
- (g) State and explain Lyapunov stability criterion.
- (h) State and prove the properties of state transition matrix.

PART B

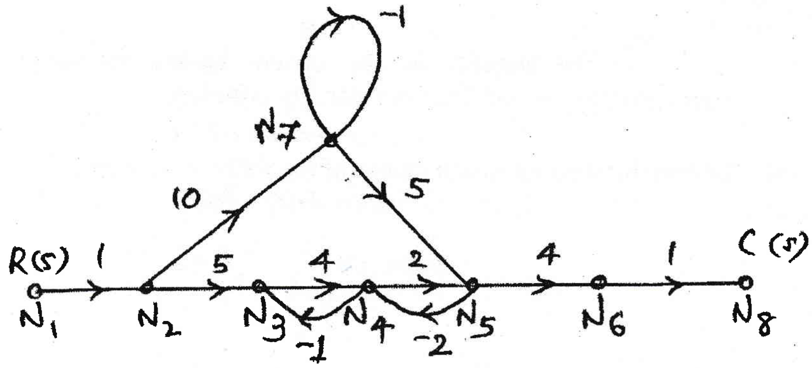
$(4 \times 15 = 60)$

II. Using block diagram reduction technique find C(s)/R(s) (15)



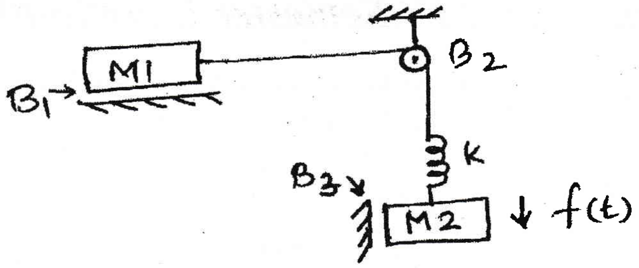
OR

III. Find the transfer function of the system shown below using Mason's gain formula. (15)



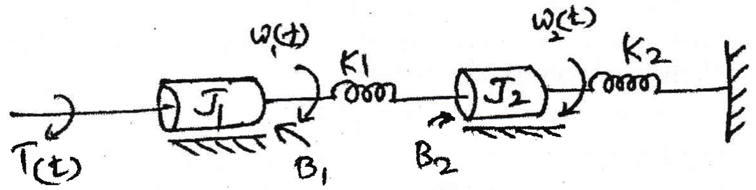
(P.T.O)

IV. Write down the dynamic equations for the mechanical system shown below. Also draw Force-current and Force-voltage analogous electric circuits. (15)



OR

V. Write the differential equations for the mechanical rotational system shown in figure. Draw torque-current and torque-voltage analogous electric circuits. (15)



VI. Derive the expressions for Delay time, Rise time, Peak time, Peak overshoot and settling time for a second order under damped system. (15)

OR

VII. (a) A closed loop transfer function of a second order system is $c(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$, input is unit step. What is the type of damping in the system? (7)

(b) Obtain step response of a first order control system. (8)

VIII. Obtain the transfer function of the system whose governing equations are (15)

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \\ \dot{x}_3(t) \end{bmatrix} = \begin{bmatrix} -1 & 1 & -1 \\ 0 & -2 & 1 \\ 0 & 0 & -3 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \\ x_3(t) \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} u_1(t) \\ u_2(t) \end{bmatrix}$$

$$\begin{bmatrix} y_1(t) \\ y_2(t) \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \\ x_3(t) \end{bmatrix}$$

OR

IX. (a) Determine the stability of the system having following characteristic equation using Routh-Hurwitz stability criterion. (7)

$$s^4 + s^3 + s^2 + s + 2 = 0$$

(b) Obtain the state transition matrix of the following system. (8)

$$\dot{x}(t) = Ax(t) + Bu(t)$$

$$\text{where } A = \begin{bmatrix} 2 & 0 \\ -1 & -1 \end{bmatrix}, B = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

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