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Question Paper Code : 51402

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2014.

Fourth Semester

Electronics and Communication Engineering

EC 2255/EC 46/EE 1256 A/080290023/10144 EC 406 — CONTROL SYSTEMS

(Regulation 2008/2010)

Time : Three hours Maximum : 100 marks

(Bode plot, Graph Sheet, Semi–log, Nichol's chart are permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the characteristics of negative feedback?

2. State Mason's Gain formula.

3. What are type 0 and type 1 systems?

4. What is meant by rise time?

5. The damping ratio and the undamped natural frequency of a second order system are 0.5 and 5 respectively. Calculate the Resonant frequency.

6. What is Corner frequency?

7. What is meant by relative stability?

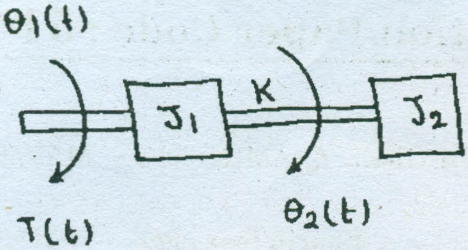
8. Define phase margin.

9. Draw the circuit diagram of sample and hold circuit.

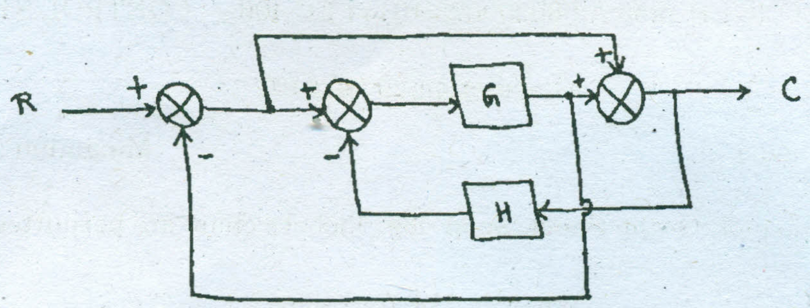
10. What are the properties of State Transition matrix?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Write the torque equation of the rotational system shown below and derive the expression for transfer function $\theta_1(s)/T(s)$. (8)



(ii) Determine the overall transfer function of the system represented by the block diagram. (8)



Or

(b) (i) Derive the expression for the Transfer function of Armature controlled DC motor. (8)

(ii) Draw the signal flow graph for the following system and obtain the Transfer function using Mason Gain formula. (8)

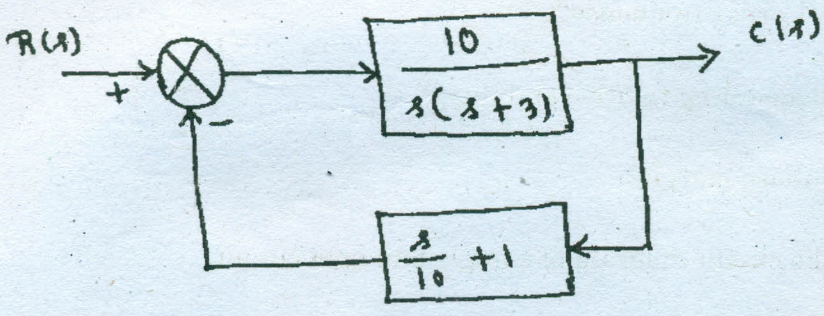
$$x_2 = a_{12}x_1 + a_{22}x_2 + a_{32}x_3$$

$$x_3 = a_{23}x_2 + a_{43}x_4$$

$$x_4 = a_{24}x_2 + a_{34}x_3 + a_{44}x_4$$

$$x_5 = a_{25}x_2 + a_{45}x_4$$

12. (a) (i) Determine the unit step response of the control system shown in the following figure. (8)

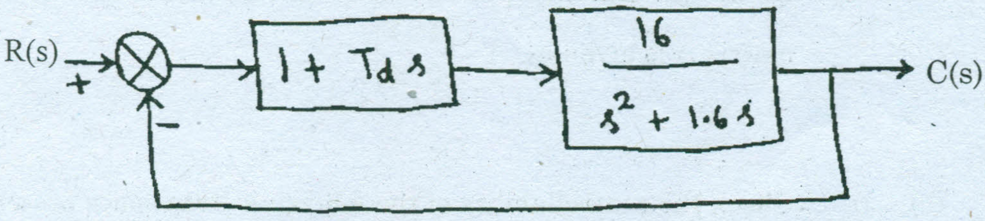


(ii) The open loop transfer function of a unity feedback system is given by $G(s) = \frac{20}{s(s+2)}$. The input function is r(t) = 2 +3t +t². Determine generalized error coefficient and steady state error. (8)

Or

(b) (i) A unity feedback system is characterized by an open loop transfer function $G(s) = \frac{k}{s(s+10)}$. Determine the gain k so that the system will have a damping ratio of 0.5. For this value of k, determine peak overshoot and peak time for a unit step input. (8)

(ii) The following diagram shows a unity feedback system with derivative control. By using this derivative control the damping ratio is to be made 0.5. Determine the value of Td. (8)



13. (a) The open loop transfer function of a system is given by

$$G(s)H(s) = \frac{30}{s(1+0.5s)(1+0.08s)}$$

Draw the Bode plot and determine Gain margin and Phase margin. (16)

Or

(b) (i) Sketch the polar plot of the unity feedback system with open loop transfer function $G(s) = \frac{1}{s(s+1)^2}$. Also find the frequency at which $|G(jw)| = 1$. (10)

(ii) What are the advantages and disadvantages of frequency response analysis? (6)

14. (a) Draw the root locus plot for the system whose open loop transfer function is given by $G(s)H(s) = \frac{k}{s(s+4)(s^2+4s+13)}$.

Find the marginal value of k which causes sustained oscillations and the frequency of these oscillations. (16)

Or

(b) (i) The open loop transfer function is given by

$$G(s) = \frac{k}{s(1+0.1s)(1+s)}$$

For this unity feedback system, determine the value of k so that the gain margin is 6dB. (8)

(ii) By using Routh Criterion, determine the stability of the system represented by following characteristic equation

$$s^5 + s^4 + 2s^3 + 2s^2 + 11s + 10 = 0$$ (8)

15. (a) (i) Obtain the state model of the system described by the following transfer function. $\frac{y(s)}{u(s)} = \frac{5}{s^3 + 6s + 7}$. (8)

(ii) Obtain the state transition matrix for the state model whose system matrix A is given by $A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$. (8)

Or

(b) (i) Check the controllability of the following state space system

$$\dot{x}_1 = x_2 + u_2$$
$$\dot{x}_2 = x_3$$
$$\dot{x}_3 = -2x_2 - 3x_3 + u_1 + u_2$$ (8)

(ii) Obtain the transfer function model for the following state space system. (8)

$$A = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$C = \begin{bmatrix} 1 & 0 \end{bmatrix} \qquad D = \begin{bmatrix} 0 \end{bmatrix}$$
