

**R15**

Code No: 125DU

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B. Tech III Year I Semester Examinations, May - 2018**

**CONTROL SYSTEMS ENGINEERING**

(Common to ECE, ETM)

Time: 3 hours

Max. Marks: 75

**Note:** This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

**PART - A**

(25 Marks)

- 1.a) What are the feed-back characteristics? [2]
- b) State and write the Mason's gain formula. [3]
- c) What are the time domain specifications? [2]
- d) What are the demerits of static error coefficient method? [3]
- e) What is the concept of stability? [2]
- f) States the Routh's stability criterion? [3]
- g) States the Nyquist stability criterion. [2]
- h) What is meant by Compensation in control systems? [3]
- i) States the properties of STM. [2]
- j) What are the merits of state variable technique? [3]

**PART - B**

(50 Marks)

- 2.a) What do you mean by a block diagram? What is meant by summing point and takeoff point? List the merits of block diagram representation.
- b) Determine the transfer function of the system given in below figure 1. [5+5]

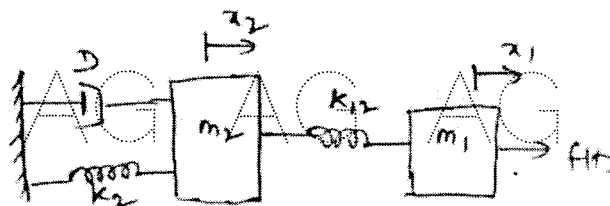


Figure 1

OR

- 3.a) Compare the open loop and closed loop control systems
- b) Using block diagram reduction technique find the transfer function for the system shown in below figure 2. [5+5]

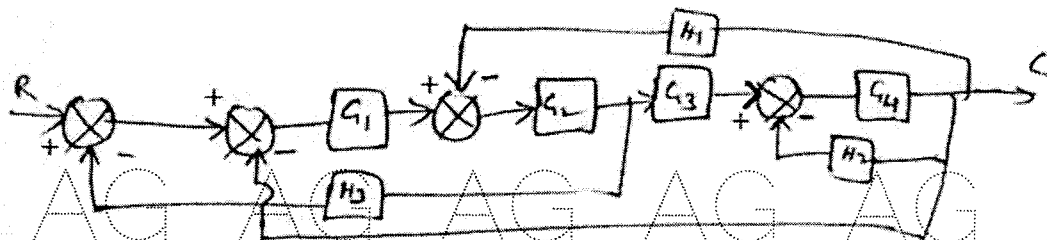


Figure 2

4.a) Derive the expression for response of second order system with unit step input.

b) For a negative feedback control system  $G(s) = \frac{8}{s(0.2s+1)}$  and  $H(s) = \frac{3}{s+2}$ . Using generalized error series determine the steady state error of the system when the input applied is  $r(t) = 1+2t+5t^2$ . [5+5]

OR

5.a) What is meant by step input, ramp input and impulse input? How do you represent them graphically?

b) A unity feedback control system has an open loop transfer function

$$G(s) = \frac{7}{s(s+2)}. \text{ Determine the time domain specifications for a step input of 10 units.}$$

[5+5]

6.a) Describe the effects of adding poles and zeros to  $G(s)$ ,  $H(s)$  on the root loci with necessary diagrams.

b) Determine the stability of a closed loop control system whose characteristic equation is

$$s^5 + 3s^4 + 2s^3 + 6s^2 + 6s + 9 = 0$$

[5+5]

OR

7. For a unity feedback system, the open loop transfer function is

$$G(s) = \frac{k}{s(s+1)(s^2+4s+13)}$$

Sketch the root locus and find the value of  $k$  to maintain the stability.

[10]

8. Sketch the bode plot and determine the following:

- Gain cross over frequency,
- Phase cross over frequency,
- Gain margin
- Phase margin.

For the transfer function is given  $G(s) = \frac{8}{s(s+3)(s+5)}$ .

[10]

OR

9. A unit feedback system has an open loop transfer function  $G(s) = \frac{k}{s(s+4)(s+2)}$ .

Design a phase lag compensator to meet the specifications, velocity error constant = 7 and phase margin  $\geq 35^\circ$ . [10]

10.a) Write the general procedure to determine the state space models of a control system.

b) A system is described by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ 2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u, \quad y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Check the controllable and observability of the system.

[5+5]

OR

11. The state variable formulation of a system is given by

$$\dot{x} = \begin{bmatrix} -2 & 1 \\ -1 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \text{ and } y = \begin{bmatrix} 1 & 0 \end{bmatrix} x. \text{ Determine the following}$$

- Transfer function of the system
- State transition matrix and
- State equation for a unit step input under zero initial condition.

[10]

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