Prined pages:3 **Sub Code: NEE503**

Paper Id: 2 0 3 3 **Roll No.**

B.TECH

(SEM V) THEORY EXAMINATION 2017-18

CONTROL SYSTEM

Time:3 Hours ***Total Marks:100***

Note: Attempt all Sections. If any missing data is required, then choose suitably.

SECTION-A

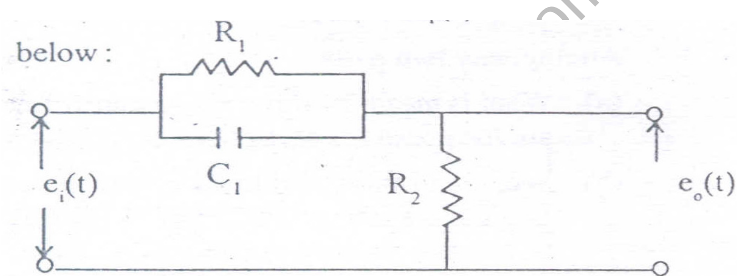
Attempt *all* questions in brief. **2 x 10 = 20**

a. What are the major types of control systems? Explain them in detail with examples.

b. Define the P, PI and PID controllers.

c. Determine the stability of the system whose characteristics equation is given by $2S^4 + 2S^3 + S^2 + 3S + 2 = 0$.

d. Derive the transfer function $E_0(S)/E_i(S)$ of network shown



e. Show that the polar plot of $G(s)=k/(s+a)$ is a semicircle. Also find its centre and radius.

f. Draw the block diagram and explain the open loop control system and closed loop control system.

g. The OLTF of a unity feedback system is $G(s)=4(s+a)/s(s+1)(s+4)$ find the expression for error E(s) and hence find the value of a so that the e_{ss} due to a unit ramp is 0.125.

h. What is a signal flow graph?

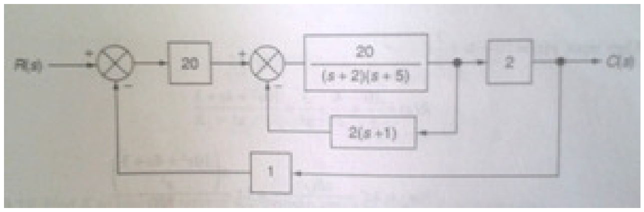
i. Why is negative feedback invariably preferred in a closed loop systems?

j. What is the basis for framing the rules of block diagram reduction technique?

SECTION - B

2. Attempt any *three* of the following: **10 x 3 = 30**

a. For the system shown in figure , determine the type of system, error coefficient and the error for the following inputs:
(i) r(t)=6, (ii) r(t) = 8t (iii) r(t) = 10+4t+1.5t^2



b. A linear time invariant system is characterized by the state variable model. Examine the controllability and observability of the system

$$A = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix}$$

$$B = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix} \quad ; \quad C = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix}$$

c. Consider a unity feedback system with a forward path transfer function,

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

Draw the root locus.

d. Write short note on:

i.Centroid

ii.Breakaway points

iii.Steady state error

e. For a unity feedback system having

$$G(s) = \frac{35(s-4)}{s(s+2)(s+5)},$$

find (i) the type of the system, (ii) all error coefficients and (iii) errors for ramp input with magnitude 5.

SECTION - C

3.Attempt any one part of the following: 10 x 1 = 10

a. A system is described by the following differential equation . Represent the system in the state space.

$$\frac{d^3x}{dt^3} + 3\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 4x = u_1(t)+3u_2(t)+4u_3(t) \quad \text{and outputs are}$$

$$Y_1 = 4\frac{dx}{dt} + 3u_1, \qquad Y_2 = \frac{d^2x}{dt^2} + 4u_2 + u_3$$

b. Define state and state variable? What are the advantage of state space techniques?

4.Attempt any one part of the following: 10 x 1 = 10

a. Define stability? State the necessary conditions for system to be absolutely stable?

b. What are the limitations of Routh Hurwitzcriterion?

5.Attempt any one part of the following: 10 x 1 = 10

a. The characteristics equation of a system is given by ($s^4+20s^3+15s^2+2s+k=0$) , determine the range of the k, for system to stable.

b. Construct the RL for a unity feedback system with OLTF G(s)= $\frac{k(s+1)}{s^2(s+9)}$

6.Attempt any one part of the following: 10 x 1 = 10

a. Sketch the RL for a unity feedback system with OLTF G(s)=$\frac{k(s^2+2s+10)}{(s^2+4s+5)}$

b. A unity feedback system shown in figure find the controller gain K_c and K_d so that the closed loop poles are placed at s=-15±j20.

7.Attempt any one part of the following: 10 x 1 = 10

a. A unity feedback system has an OLTF

G(s)=$\frac{K(s+2)}{s(s^3+7s^2+42s)}$ .Find the static error constant and e_{ss} due to an input $r(t)=t^2u(t)$.

b.Sketch the polar plot for (i) G(s)=$\frac{10e^{-s}}{s+1}$ (ii) G(s)=$\frac{32}{(s+4)(s^2+4s+8)}$ and find its points of intersection with the real and imaginary axes.