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Roll No.

B.TECH
(SEM V) THEORY EXAMINATION 2017-18
CONTROL SYSTEM

Time:3 Hours

Total Marks:100

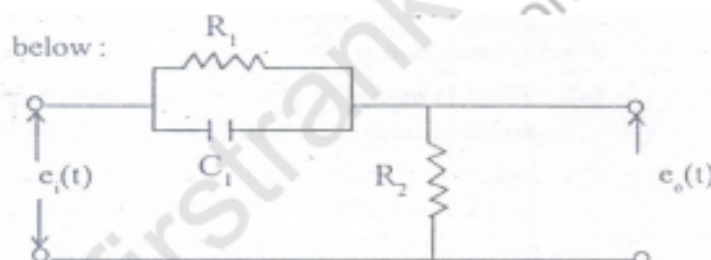
Note:Attempt all Sections. If any missing data is required, then choose suitably.

SECTION-A

Attempt all questions in brief.

2 x 10 = 20

- What are the major types of control systems? Explain them in detail with examples.
- Define the P, PI and PID controllers.
- Determine the stability of the system whose characteristics equation is given by $2S^4 + 2S^3 + S^2 + 3S + 2 = 0$.
- Derive the transfer function $E_0(S)/E_i(S)$ of network shown



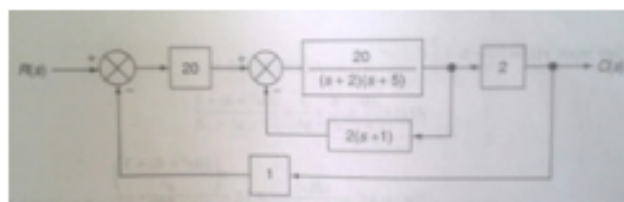
- Show that the polar plot of $G(s) = k/(s+a)$ is a semicircle. Also find its centre and radius.
- Draw the block diagram and explain the open loop control system and closed loop control system.
- The OLTF of a unity feedback system is $G(s) = 4(s+a)/s(s+1)(s+4)$ find the expression for error $E(s)$ and hence find the value of a so that the e_{ss} due to a unit ramp is 0.125.
- What is a signal flow graph?
- Why is negative feedback invariably preferred in a closed loop systems?
- 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

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

$$B = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix} ; C = [0 \ 0 \ 1]$$

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

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

Draw the root locus.

- d. Write short note on:

- Centroid
- Breakaway points
- Steady state error

- e. For a unity feedback system having

$$G(s) = \frac{24(s-3)}{s^2(s+2)(s+5)}$$

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.

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

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

- 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 Hurwitz criterion?

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 $G(s) = \frac{k(s+1)}{s^2(s+7)}$

6.Attempt any one part of the following:

10 x 1 = 10

- a. Sketch the RL for a unity feedback system with OLTF $G(s) = \frac{k(s^2 + 4s + 10)}{(s^2 + 4s + 3)}$
 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 $s = -15 \pm j20$.

7.Attempt any one part of the following:

10 x 1 = 10

- a. A unity feedback system has an OLTF

$$G(s) = \frac{k(s+2)}{s(s^3 + 7s^2 + 4s)} \text{ . Find the static error constant and } e_{ss} \text{ due to an input } r(t) = t^2 u(t).$$

- b. Sketch the polar plot for (i) $G(s) = \frac{10s^{-3}}{s+1}$ (ii) $G(s) = \frac{32}{(s+2)(s^2+4s+10)}$ and find its points of intersection with the real and imaginary axes.