PAPER ID-410833

Roll No:

B.TECH
(SEM V) THEORY EXAMINATION 2021-22
CONTROL SYSTEM

Time: 3 Hours   *Total Marks: 100*

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

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

   a.   Draw the block diagram, which represent a driver driving a car.

   b.   Define: Self loop & non-touching loop in signal flow graph by suitable example.

   c.   What do you mean by Settling Time, write expression for 2nd order system?

   d.   The OLTF of a unity feedback system is G(s) = 1/s(s+1)(s+4) find the steady state error (ess) due to a unit step.

   e.   What are the limitations of Routh Hurwitz criterion?

   f.   State Absolute Stability & Relative Stability.

   g.   Draw the polar plot G(s)=1/(s+ 2)

   h.   Write advantages of Bode Plot.

   i.   Find the eigenvectors of the matrix

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

   j.   Why compensators are used in control system, what is effect of lag compensator?

SECTION B

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

   a.   Write down various rules involve in Block Diagram Reduction method.

   b.   The unity feedback system is characterized by an open loop transfer function is G(S) = K/s(s+20).Determine the gain K, so that the system will have a damping ratio of 0.6. For this value of K, determine unit step response, time domain specifications: settling time (2% criterion), Peak overshoot, Rise time,Peak time, Delay time for a unit-step input.

   c.   Explain the effect of addition of pole & zero on Root Locus & time domain specifications.

   d.   Sketch the polar plot of the following function, also determine Gain Margin, Phase Margin, H(s) =1:

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

   e.   State properties of State Transition Matrix (STM) , find out State Transition Matrix for

$$A = \begin{bmatrix} 0 & 1 \\ -8 & -6 \end{bmatrix}$$

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SECTION C

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

(a) Find out C/R by using Block Diagram Reduction method.

(b) Find the overall gain of the system whose signal flow graph is shown below.

OR

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

(a) Compare Proportional (P)control action with Integral (I)control action & Prove That By Using Proportional Integral PI controller Steady State error Become zero in a system.

(b) Find out various error coefficients: Kp, Kv Ka & steady state error for standard step, ramp, and parabolic inputs for system shown below:

$$\frac{500(s + 2)(s + 5)}{(s + 8)(s + 10)(s + 12)}$$

(a)

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

(a) Explain the effect of pole location on stability of a system by suitable diagram, Determine range of K & frequency of sustained oscillations for a given unity feedback system.

(b) Sketch the root locus of the system whose open loop transfer function is G(S)= K / s(s+2)(s+5).Find the value of K so that system is marginal stable , find out damped frequency of oscillation, also find K when the damping ratio of the closed loop system is 0.5.

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

   (a) Sketch Bode plot for the following transfer function and determine the gain cross over frequency & phase cross over frequency, comment on stability.
   G(s) H(s)= 10 / s (1+s)(1+0.002s)

   (b) Draw the complete Nyquist plot for a unity feedback system having the open loop Function, from this plot obtain all the information regarding stability.
   G(s) H(s) = k/ s(s+3)(s+5)

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

   (a) Design a lead compensator for a system whose open loop transfer function is
   G(s)H(s) =4/ s(s+2)
   It will fulfill following requirement-
   (i)Static velocity error constant =20sec⁻¹ (ii) P.M at least 50° (iii)G.M.at least 10db

   (b) Determine The State controllability & Observiability of the system described

$$\dot{x} = \begin{bmatrix} 0 & 1 & 1 \\ 0 & 0 & 3 \\ -7 & 5 & 9 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u \text{ and}$$

$$y = \begin{bmatrix} 5 & 2 & 7 \end{bmatrix} x$$

as: