PAPER ID-410853

Subject Code: REE503

Roll No: | | | | | | | | | | | | | |

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

Time: 3 Hours ***Total Marks: 70***

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

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a. Explain the Mason's gain formula.
b. Describe open loop system with an example.
c. Explore the effect of ξ on second order system's performance for unit step input when
(i) $\xi = 0$, (ii) $0 < \xi < 1$, (iii) $\xi = 1$, (iv) $1 < \xi < \infty$
d. Explain the minimum & non minimum phase system.
e. Write the special case of Routh-Hurwitz criterion.
f. Distinguish between cut off rate and cut off frequency.
g. Explain the properties of state transition matrix.

SECTION B

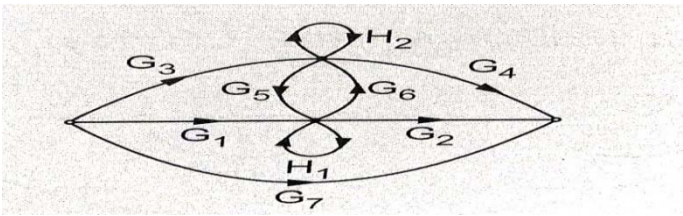
2. Attempt any *three* of the following: 7 x 3 = 21

a. Using Laplace Transform Method obtain the solution of non-homogenous state equations.
b. Demonstrate the significance of gain margin and phase margin on a polar plot. Also, draw and properly label the polar plot for stable and unstable system.
c. Discuss the working of a synchro receiver and transmitter with a neat sketch.
d. Describe the standard test signals and plot their variation with time.
e. Describe the rules of Block diagram algebra with suitable example.

SECTION C

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

(a) Describe Mason's gain formula and obtain the transfer function of the SFG given below



(b) For mechanical system shown in Fig, draw mechanical network, write differential equation of performance and also draw force-current and force-voltage analogous network.

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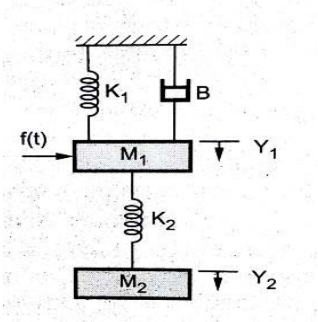

4. Attempt any *one* part of the following: 7 x 1 = 7

(a) Discuss proportional derivative (PD) controller and show that the steady state error increases by using the derivative feedback controller.

(b) Discuss what do you mean by settling time. A FBCS has $G(s)H(S) = \frac{15}{(s+1)(s+3)}$ and H(s) = 1. Determine peak-time, rise- time, maximum overshoot, settling-time and number of cycles completed before steady state is reached.

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

(a) Use the root locus method of plotting to sketch the loci of the roots of a unity feedback open loop transfer function given below. Find the range of K that yields a stable system.

$$G(s)H(S) = \frac{K}{s(s+1)(s+3)}$$

(b) Determine the value of K such that the roots of the characteristics equation given below lie to the left of line s = -1.

$s^3 + 10s^2 + 20s + K = 0$

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

(a) Show that the loci for constant phase-angle of closed loop system with a unity feedback is a series of circles whose centre is at x_0=-1/2, y_0= 1/(2N) and radius

$$r_0 = \frac{1}{2N}\sqrt{N^2+1}$$

(b) Distinguish between mapping theorem and Nyquist stability criterion with suitable example. Write the steps of drawing the Nyquist plot for predicting the relative stability of system.

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

(a) Compute the transfer function from the given state model

$$\dot{\boldsymbol{X}}(\boldsymbol{t}) = \begin{bmatrix} -3 & 1 \\ 0 & -1 \end{bmatrix}\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(t) \text{ and } y(t) = [1 \quad 1]\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$$

(b) Explain & derive the transfer function of lead-lag compensator and also compare all three compensation techniques available in control system.