Printed Pages: 02 Sub Code:KEE-502

Roll No. | | | | | | | | | | | | | |

B.Tech.
(SEM-V) THEORY EXAMINATION 2022-23
CONTROL SYSTEM

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

Note: Attempt all Sections. If you require any missing data, then choose suitably.

SECTION A

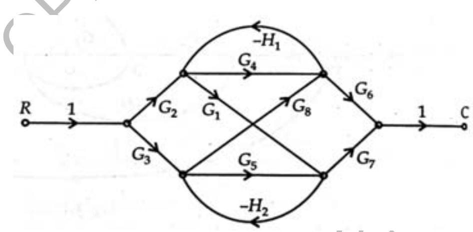
1. Attempt *all* questions in brief. **2x10 = 20**

(a) Define transfer function of a control system.
(b) What is Mason's gain formula? Explain.
(c) A unity feedback system with open-loop transfer function $G(s) = 2/[s(s+p)]$ is critically damped. Calculate the value of p?
(d) Explain the effects of PD and PI control action on a second order system performance.
(e) Explain the special cases of Routh Hurwitz criterion.
(f) Define the Centroid and Breakaway point.
(g) Define relative stability of the system.
(h) Explain gain margin and phase margin in terms of Bode plot.
(i) Define state variable and state vector.
(j) Mention any four properties of state transition matrix.

SECTION B

2. Attempt any *three* of the following: **10x3 = 30**

(a) Find C(s)/R(s) using Mason's gain formula for the given signal flow graph given below.



(b) With neat sketch explain all time domain specifications for a second order control system and derive the formula for peak time.
(c) What do you mean by the root locus? State and explain all the steps used for drawing the root locus plot.
(d) Sketch the polar plot and determine the gain crossover frequency, phase crossover frequency, gain margin and phase margin with given open loop transfer function given below. Also comment on the stability of the system.

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

(e) Find the state transition matrix for matrix A given below-

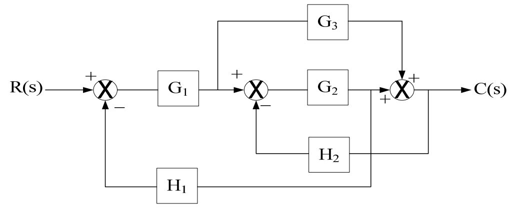
$$A = \begin{bmatrix} 0 & -1 \\ 2 & -3 \end{bmatrix}$$

SECTION C

3. Attempt any *one* part of the following: **10x1 = 10**

(a) Explain open loop and closed loop control system with a suitable example in each case.

(b) Using block reduction technique calculate transfer function of the block diagram given below-



4. Attempt any *one* part of the following: 10 x1 = 10

(a) Derive the time response of a second order control system for unit step input.

(b) The open loop transfer function of a unity feedback control system is given by.

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

The system input is a unit step function. Determine-

(i) By what factor amplifier gain K should be multiplied so that the damping ratio is increased from 0.3 to 0.9.

(ii) By what factor the time constant T should be multiplied so that the damping ratio is reduced from 0.8 to 0.2.

5. Attempt any *one* part of the following: 10x1 = 10

(a) Sketch the root locus plot and give the stability conditions for the system when open loop transfer function is given by

$$G(s)H(s)=\frac{K}{s(s+1)(s+2)(s+3)}$$

(b) The open loop T.F. of certain unity feedback system is

$G(s)=\dfrac{K(s+1)}{s(s-1)(s+6)}$ Determine

(i) Range of K for stability (ii) Marginal value of K (iii) Location of roots for marginal stability

6. Attempt any *one* part of the following: 10x1 = 10

(a) Define resonant peak (M_r) resonant frequency (ω_r) and derive the formula for them.

(b) Draw the Bode plot for the open loop T.F.

$$G(s)=\frac{1000}{s(1+0.1s)(1+0.001s)}$$

and from thegraph determine

(i) Gain cross-over frequency (ii) Phase cross-over frequency (iii) Gain margin (iv) Phase margin (v) Stability of the system

7. Attempt any *one* part of the following: 10x1 = 10

(a) What are the different types of compensators used in control system? Discuss lead compensator and derive the relation between maximum lead angle Φ_m and α.

(b) Examine the controllability and observability of a system with

$$A=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix},\quad B=\begin{bmatrix}1\\0\\1\end{bmatrix},\quad C=\begin{bmatrix}10 & 5 & 1\end{bmatrix}$$