Subject Code: KEE502

PAPER ID-310683

Roll No:

BTECH
(SEM V) THEORY EXAMINATION 2023-24
CONTROL SYSTEM

TIME: 3 HRS **M.MARKS: 100**

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

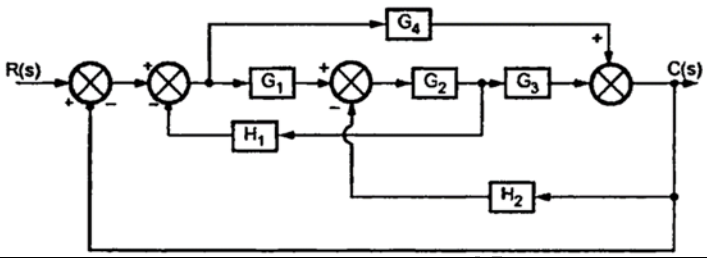
SECTION A

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

Q no.	Question	Marks	CO
a.	Explain the properties of signal flow graph.	2	1
b.	Define transfer function of a control system.	2	1
c.	Mention the effect of ξ on second order system performance for unit step input when (i) $\xi = 0$, (ii) $0 < \xi < 1$, (iii) $\xi = 1$, (iv) $1 < \xi < \infty$	2	2
d.	What are the standard test signals? Explain.	2	2
e.	On the basis of bounded input bounded output stability define stable system and unstable system.	2	3
f.	List the disadvantages of Routh-Hurwitz criterion.	2	3
g.	Describe the resonant peak and resonant frequency.	2	4
h.	Explain the minimum and non-minimum phase system.	2	4
i.	List the advantages of state variable approach for the analysis of a control system.	2	5
j.	Define state space and state trajectory.	2	5

SECTION B

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

Q no.	Question	Marks	CO
a.	Determine the transfer function for the block diagram given below by Mason's gain formula. 	10	1
b.	Explain the following terms in detail. a) PD controller b) PI controller	10	2
c.	The open loop T.F. of certain unity feedback system is $G(s) = \frac{K(s+1)}{s(s-1)(s+6)}$ Determine- i. Range of K for stability ii. Marginal value of K iii. Location of roots for marginal stability	10	3
d.	What is mapping theorem? Also explain the Nyquist stability criterion to determine the stability of a control system.	10	4

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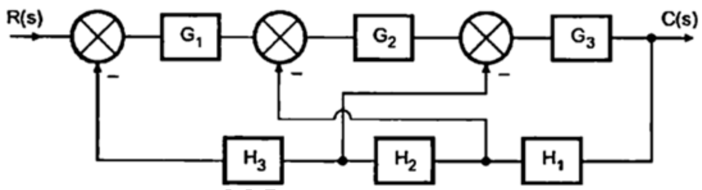
e.	Determine the transfer function from the state model given below- $$\begin{bmatrix}\dot{x}_1 \\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}-3 & 1 \\ 0 & -1\end{bmatrix}\begin{bmatrix}x_1 \\ x_2\end{bmatrix} + \begin{bmatrix}1 \\ 1\end{bmatrix}u$$ $$y = \begin{bmatrix}1 & 1\end{bmatrix}\begin{bmatrix}x_1 \\ x_2\end{bmatrix}$$	10	5

SECTION C

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

a.	What do you understand by open loop and closed loop control systems? Discuss the comparative statements between open loop and closed loop control systems. Also explain the practical examples of open loop and closed loop control systems.	10	1
b.	Determine C(S)/R(S) for the following system using block reduction method.  	10	1

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

a.	Define peak time and peak overshoot of a second order control system and derive the formula for the same with unit step input.	10	2
b.	The maximum overshoot for a unity feedback control system having its forward path transfer function as $G(s) = \frac{K}{s(sT+1)}$ is to be reduce from 75% to 25%. The system input is a unit step function. Determine the factor by which K should be reduced to achieve the above reduction.	10	2

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

a.	What do you mean by the root locus? State and explain all the steps used for drawing the root locus plot.	10	3
b.	Sketch the root locus plot and comment on stability for the system when open loop transfer function is given by- $$G(s)H(S) = \frac{K}{s(s+2)(s+4)(s+8)}$$	10	3

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

a.	Draw the Nyquist plot and determine the stability of the system whose open loop transfer function is given as. $$G(s)H(s) = \frac{(4s+1)}{s^2(s+1)(2s+1)}$$	10	4

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b.	Draw the Bode plot for the open loop T.F. $G(s) = \frac{2(s+0.25)}{s^2(s+1)(s+0.5)}$ and from the graph determine- (i). Gain cross-over frequency, (ii). Phase cross-over frequency (iii). Gain margin, (iv).Phase margin, (v). Comment on the stability of the system	10	4

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

a.	What are the different types of compensators used in control systems? Also show that the frequency corresponding to the maximum lead angle (ω_m) is the geometric mean of the two corner frequencies of the lead compensator.	10	5
b.	Examine the controllability and observability of a system with $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -4 & -3 & -2 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$, $C = \begin{bmatrix} 0 & 5 & 1 \end{bmatrix}$	10	5