PAPER ID-410571

Subject Code: KEC602

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

BTECH
(SEM VI) 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.

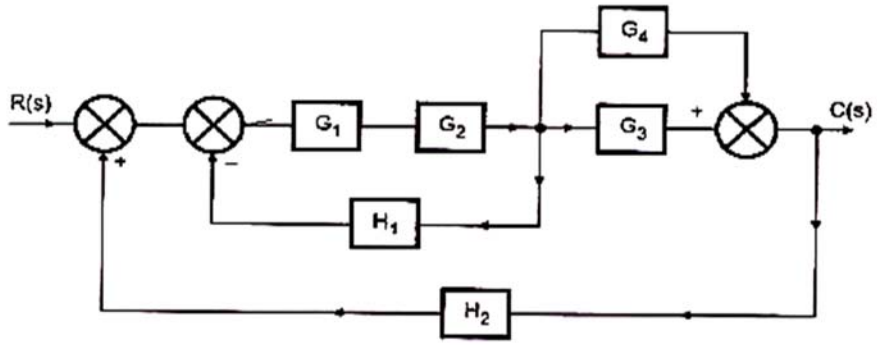
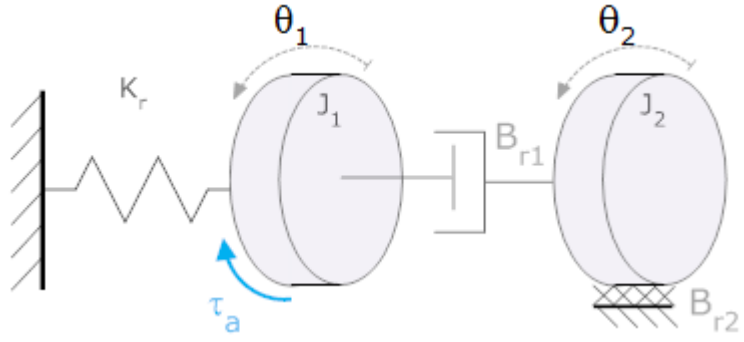
SECTION A

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

Q no.	Question	Marks	CO
a.	What is the difference between an open and closed loop system?	2	1
b.	In most of the cases, disturbances are introduced in process in closed loop control system. Why?	2	1
c.	What are the conditions for a system to be controllable?	2	2
d.	What are the advantages of state-space model over transfer function?	2	2
e.	What is the advantage of calculating overshoot control system?	2	3
f.	What is the difference between fall time and rise time?	2	3
g.	How location of poles is related to stability?	2	4
h.	How is departure angle measured?	2	4
i.	What is the significance of gain and phase margin?	2	5
j.	What is the significance of polar coordinates?	2	5

SECTION B

2. Attempt any *three* of the following:

a.	Obtain the Transfer function of the given block diagram 	10	1
b.	Derive a state space model for the system shown. The input is τa and the output is θ1. 	10	2

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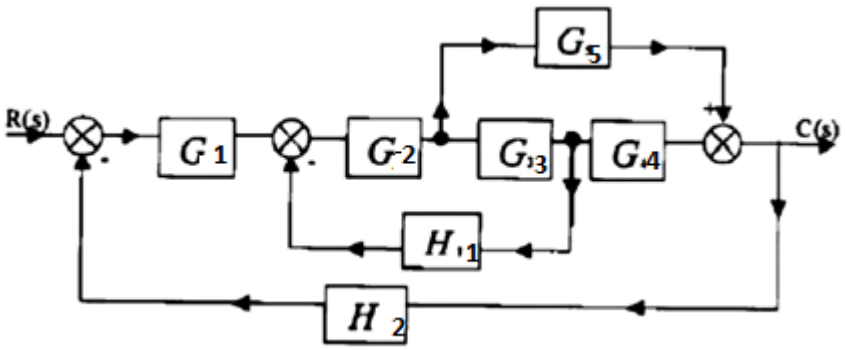
c.	The open loop transfer function of a unity feedback system is given by $$G(S) = \frac{K}{S(1+ST)}$$ Where 'K' & 'T' are positive constants. By what factor should the amplifier gain be reduced so that the peak overshoot of unit step response of the system is reduced from 75% to 25%..	10	3
d.	Using Routh Hurwitz Criterion, discuss the stability of the characteristic equation: $2s^5 + 2s^4 + s^3 + 2s^2 + 2$	10	4
e.	What is gain margin, phase margin, gain crossover frequency, and phase cross frequency? What is the practical use of these parameters?	10	5

SECTION C

3. Attempt any *one* part of the following:

a.	Construct the signal flow graph for the following set of simultaneous equations and obtain the overall transfer function using Mason's gain formula. X2 = A21X1 + A23X3 X3 = A31X1 + A32X2 + A33X3 X4 = A42X2 + A43X3	10	1
b.	Reduce the block diagram to its canonical form and obtain C(S)/R(S). 	10	1

4. Attempt any *one* part of the following:

a.	For a single input system $$\dot{X} = AX + BU$$ $$Y = CX$$ $$A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix};\ B = \begin{bmatrix} 0 \\ 1 \end{bmatrix};\ C = [1 \quad 1]$$ Check the controllability & observability of the system.	10	2
b.	Examine the Controllability and Observability of the following system: $$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} \quad C = [10 \quad 5 \quad 1]$$	10	2

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5. Attempt any *one* part of the following:

a.	Consider a standard second order system given by $\frac{w_n^2}{s^2+2\zeta w_n s+w_n^2}$ The correlation between the maximum peak overshoot in the time domain and the resonant peak in the frequency domain exists when:	10	3
b.	The output of a standard second-order system for a unit-step input is given as $y(t) = 1 - \frac{2}{\sqrt{3}} e^{-t} \cos\left(\sqrt{3}t - \frac{\pi}{6}\right)$ What is the transfer function of the system?	10	3

6. Attempt any *one* part of the following:

a.	Using Routh Hurwitz Criterion, discuss the stability of the characteristic equation: $F(s) = 2s^5 + 3s^4 + 2s^3 + s^2 + 2s + 2$	10	4
b.	Consider a unity-feedback control system with the following feedforward transfer function: $G(s) = \frac{K}{s(s+1)(s+2)}$ Draw plot the root locus.	10	4

7. Attempt any *one* part of the following:

a.	Sketch the Bode Plot for the given system and comment on stability of the used systems: $G(s)H(s) = \frac{4}{s\,(1+0.5s)(1+0.08s)}$	10	5
b.	Construct the Bode plots for a unity feedback system whose open-loop transfer function is given by [0.25(1+0.5s)]/ [s(1+2s)(1+4s)]. From the Bode plot, determine the following: a) Gain and phase crossover frequencies, b) Gain and phase margin, and c) Comment on the stability of the system.	10	5