Paper id: 251064

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

BTECH
(SEM VI) THEORY EXAMINATION 2024-25
CONTROL SYSTEM

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

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

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

Q No.	Question	CO	Level
a.	What is a free body diagram, and how is it useful in system modeling?	1	K2
b.	What are the main components of a feedback control system?	1	K1
c.	Define state-transition matrix.	2	K1
d.	What are eigenvalues and eigenvectors?	2	K1
e.	Name different types of standard test inputs used in control systems.	3	K1
f.	Define delay time , rise time and settling time.	3	K1
g.	What is the Routh-Hurwitz criterion used for?	4	K1
h.	Elaborate about the (i) assymptotes (ii) breakaway point.	4	K2
i.	What is the definition of bandwidth in a closed-loop system?	5	K1
j.	State the Nyquist stability criterion.	5	K1

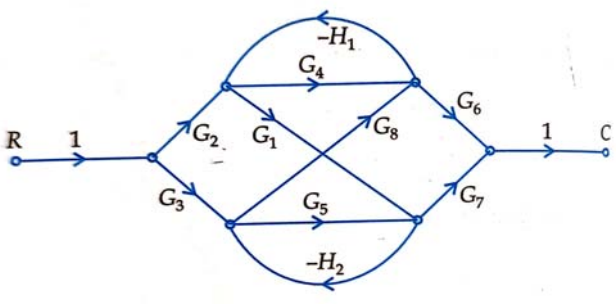
SECTION B

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

a.	Describe the modeling of physical systems using the analogous system method. Provide electrical and mechanical analogies with examples.	1	K2
b.	A single input single output system is given as $\dot{x}(t) = \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix} x(t) + \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} u$ $y = [1 \quad 0 \quad 2]x(t)$ Test for controllability and observability.	2	K4
c.	Derive the time response of a first-order system to a unit step input.	3	K3
d.	Explain concept of stability in detail and also explain the effect of location of poles on stability.	4	K2
e.	Sketch the polar plot of $G(s) = \frac{s}{(1+sT)}$	5	K3

SECTION C

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

a.	Draw the block diagram and derive the transfer function of armature controlled dc motor.	1	K2
b.	Obtain the transfer function C/R from the signal flow graph 	1	K3

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

a.	The system equations are given by $\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$ $y(t) = [1 \quad 0]x(t)$ Find the transfer function of the system.	2	K2
b.	A system is characterized by the equation $\frac{y(s)}{u(s)} = \frac{20(4s+2)}{s^3+5s^2+8s+2}$ Find the state and output equation of the system and express in matrix form.	2	K3

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

a.	When a second order control system is subjected to a unit step input, the values of $\xi = 0.5$ and $\omega_n = 6$ rad/sec. Determine the rise time, peak time, settling time and peak overshoot.	3	K2
b.	For a unity feedback control system the forward path transfer function is given by $G(s) = \frac{20}{s(s+2)(s^2+2s+20)}$ Determine the steady state error of the system, when the inputs are : (i) 5, (ii) 5t, (iii) $3t^2/2$	3	K3

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

a.	What is root locus? Explain the various rules to sketch root locus.	4	K2
b.	The characteristic equation of feedback control system is $s^4 + 20s^3 + 15s^2 + 2s + k = 0$ (a) Determine the range of K for the stable to be stable. (b) Can the system be marginally stable? If so, find the required value of K and the frequency of sustained oscillations.	4	K4

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

a.	The forward path transfer function of a unity feedback control system is $G(s) = \frac{100}{s(s+6.54)}$ Find the resonance peak, resonant frequency and bandwidth of the closed loop system.	5	K2
b.	Sketch the bode plot for the transfer function (on semi log paper) $G(s) = \frac{50}{s(1+0.25s)(1+0.1s)}$ From the graph determine : 1. Gain crossover frequency 2. Phase cross over frequency 3. G.M. & P.M.	5	K5