Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2024

Subject Code:3140313 **Date:03-07-2024**

Subject Name:Control System and Analysis

Time:10:30 AM TO 01:00 PM **Total Marks:70**

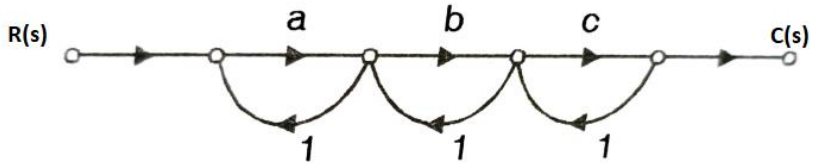
Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1 **(a)** Define Control system. Explain one biomedical application of control system. **03**

(b) Explain the comparison between Block diagram reduction technique and Signal Flow Graph method. **04**

(c) Find the transfer function of given control system using signal flow graph. **07**

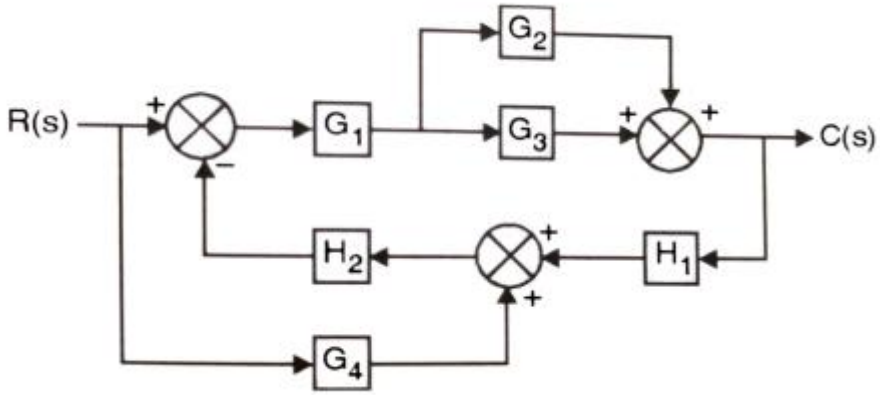


Q.2 **(a)** Give the 2-2 examples of open loop and close loop control systems. **03**

(b) Define Laplace Transform and Find out the Laplace transform of **04**

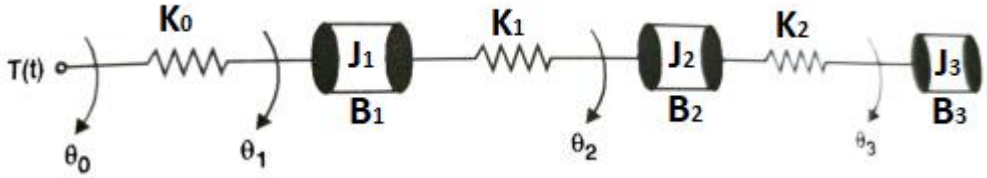
$$x(t) = e^{-2t}u(t) - e^{2t}u(-t)$$

(c) Using Block diagram Reduction technique, find the transfer function for the system shown in below figure. **07**



OR

(c) Draw the Mechanical network. Write differential equations of performance and also draw the analogous electrical circuit of the system shown in below figure. **07**



Q.3 **(a)** Determine the stability of system $s^3 + 6s^2 + 12s + 8 = 0$. **03**

(b) Explain effect of Damping factor in Second Order System Performance. **04**

(c) A control system having unity feedback has $G(s) = \frac{20}{s(1+4s)(1+s)}$. **07**

Determine Static error coefficients and Steady state error

if input r(t) = $2 + 4t + \frac{t^2}{2}$

OR

Q.3 **(a)** Explain order of the system and Type of the system. **03**
What is the order and type of below system $G(s)H(s) = \frac{36}{s(s+1)}$?

(b) Determine the stability to $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16$. **04**

(c) For a unity feedback system $G(s) = \frac{36}{s(s+0.72)}$. Determine the characteristic equation of the system. Calculate damping ratio, peak time, settling time, peak overshoot. Consider H(s) =1. **07**

Q.4 **(a)** What is PID controller? Explain in short. **03**

(b) Define the terms: **04**

1. Gain Margin
2. Phase margin
3. Gain crossover frequency
4. Phase crossover frequency

(c) Draw the root locus for a unity feedback control system with **07**

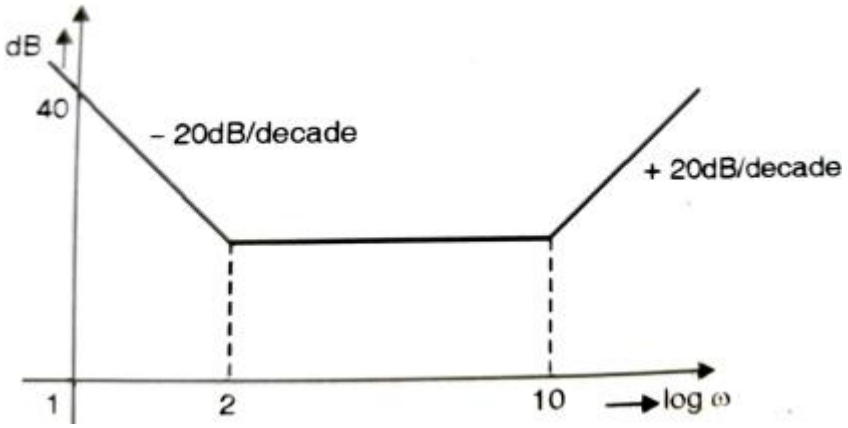
$$G(s) = \frac{k}{s(s+3)(s+5)}$$

OR

Q.4 **(a)** Derive impulse response of first order control system. **03**

(b) A unity feedback system has the loop transfer function **04**
$G(s) = \frac{k}{s(s+1)(s+3)(s+4)}$. Determine poles and zeros, angle of asymptotes and centroid of the given system.

(c) Determine the transfer function from the magnitude plot as shown in fig. (Assume that it is of minimum phase type.) **07**



Q.5 **(a)** Draw the polar plot of the given transfer function $G(s)H(s) = \frac{10}{(s+2)}$. **03**

(b) Draw the Nyquist plot for the system whose open loop transfer function is $G(s)H(s) = \frac{1}{s(s+2)}$. **04**

(c) Draw Bode plot for the given $G(s)\,H(s) = \frac{100\,(1+\frac{s}{10})(1+\frac{s}{100})}{s^2+s+4}$. Find gain and phase margin. **07**

OR

Q.5 **(a)** Write needs of Frequency Domain Analysis for Control system. **03**

(b) Define State Variables, State Vectors and State Space. **04**

(c) Find transfer function of **07**

$$\begin{bmatrix}\dot{x_1}\\ \dot{x_2}\end{bmatrix} = \begin{bmatrix}-5 & -1\\ 3 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}2\\ 5\end{bmatrix} r(t); \qquad y = [1,2]\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

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