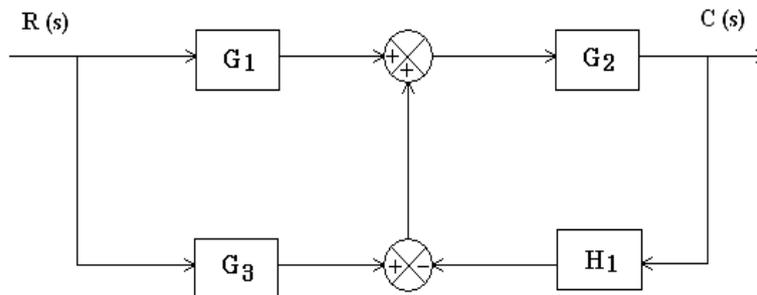


GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV (NEW) EXAMINATION – WINTER 2021****Subject Code: 3141708****Date: 01/01/2022****Subject Name: Control Theory****Time: 10:30 AM TO 01:00 PM****Total Marks: 70****Instructions:**

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.

	MARKS
Q.1 (a) Explain green engineering with suitable example.	03
(b) Classify control systems.	04
(c) Discuss the roll of automatic control system in engineering applications with suitable example.	07
Q.2 (a) Explain linearization with suitable example.	03
(b) Find Laplace transform of unit step and impulse signal.	04
(c) Find transfer function $C(s)/R(s)$ of a system represented in below figure.	07

**OR**

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|---|-----------|
| (c) Consider the system with forward path transfer function $G(S)=\frac{K}{S+2}$ and feedback $H(S) = a$, find sensitivities(magnitude only) of overall feedback system for variations in K and a . Frequency of operation is 0.5 rad/sec. | 07 |
| Q.3 (a) Explain state, state variables and state vector. | 03 |
| (b) Find the dimensions of state matrix and output matrix for the system with two state variables, two outputs and single input. | 04 |
| (c) Find state transition matrix for the system $\dot{x} = Ax + Bu$ and $y = Cx + Du$ with $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, $C = [0 \ 1]$ and $D = [0]$. | 07 |
| OR | |
| Q.3 (a) Find error constant and steady state error for type-1 system for unit step input. | 03 |
| (b) Explain rise time and peak time with suitable formula. | 04 |
| (c) Find the value of K at breakaway point for the system with open loop transfer function $G(S)=\frac{K}{S(S+1)(S+4)}$. Consider unity feedback system. | 07 |
| Q.4 (a) Explain bounded input bounded output (BIBO) stability. | 03 |

- (b) Determine the stability of the system with characteristic equation $Q(S)$: $S^4 + 6S^3 + 23S^2 + 40S + 50 = 0$ using Routh's stability criteria. **04**
- (c) For the unity feedback system with $G(S) = \frac{20K}{s(s+2)(s+10)}$, find restrictions on K for system to be absolutely stable. **07**

OR

- Q.4** (a) Explain negative gain root locus. **03**
- (b) Explain gain margin and phase margin. **04**
- (c) For unity feedback system $G(S) = \frac{10K}{s(s+1)(s+10)}$, find the value of K for gain margin 10 db and phase margin 50° . **07**

- Q.5** (a) Explain self loop, forward path and loop gain with respect to signal flow graph. **03**
- (b) Explain dynamics of PID controller in frequency domain. **04**
- (c) Find stability of the system with open loop transfer function $G(S) = \frac{1}{s(s+1)(s+2)}$ using Nyquist stability criteria. Consider unity feedback. **07**

OR

- Q.5** (a) Explain role of time delay on stability of control systems. **03**
- (b) Explain the principal of argument and Nyquist stability criteria. **04**
- (c) Comment on stability for the system with open loop transfer function $G(S) = \frac{K}{s(s+0.1)(s+10)}$ using bode plot. Consider unity feedback. **07**
