

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-V (NEW) EXAMINATION – WINTER 2024

Subject Code:2150909

Date:25-11-2024

Subject Name:Control System Engineering

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) | Describe the basic three objectives of any control system. | 03 |
| (b) | Give difference between open loop and close loop control system. | 04 |
| (c) | Simplify the block diagram shown in Figure 1 using block diagram reduction technique and obtain $C(s)/R(s)$. | 07 |

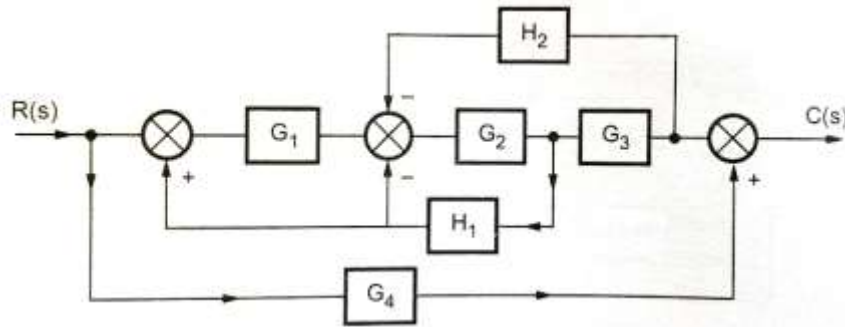


Figure 1

- Q.2**
- | | | |
|-----|--|-----------|
| (a) | With suitable example, explain self-loop, sink node and forward path. | 03 |
| (b) | Explain any two properties of Laplace transform. | 04 |
| (c) | Obtain the transfer function C/R from the signal flow graph for the block diagram shown in Figure 2. | 07 |

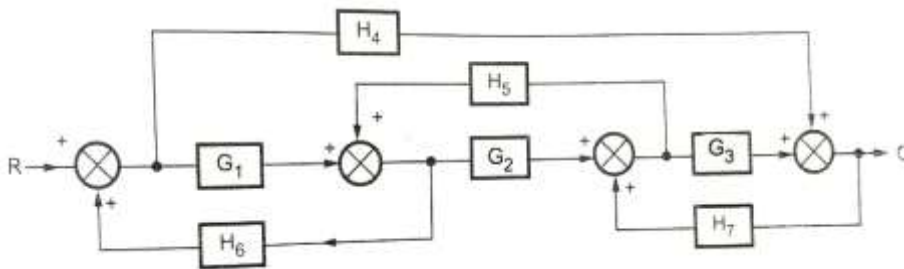


Figure 2

OR

- (c) For the mechanical system shown in Figure 3 write down F-V and F-I analogy and draw equivalent electric network. **07**

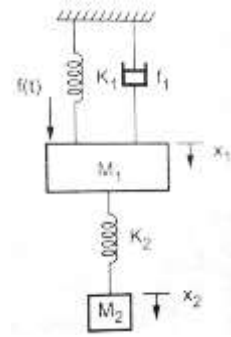


Figure 3

- Q.3** (a) Define: State variable, state vector and state space **03**
 (b) Derive steady state error constants of the Type-0 system for a Ramp input. **04**
 (c) Derive Overall transfer function of Field controlled DC motor. **07**

OR

- Q.3** (a) Explain standard test signals used in the control system. **03**
 (b) Distinguish between type and order of a control system. **04**
 (c) The closed loop transfer function of unity feedback control system is given by **07**

$$\frac{C(s)}{R(s)} = \frac{100}{s^2 + 10s + 100}$$

Determine

- (1) Damping ratio (2) Rise time
 (3) Settling time (4) Natural undamped resonance frequency
 (5) Percentage peak overshoot.

- Q.4** (a) State and explain Nyquist stability criteria. **03**
 (b) Explain the significance of proportional control. **04**
 (c) The unity feedback system has **07**

$$G(s)H(s) = \frac{K}{s(s^2 + 2s + 2)}$$

Draw the rough sketch of the Root locus.

OR

- Q.4** (a) Define: Phase margin and Gain margin. **03**
 (b) Briefly explain about Polar plots. **04**
 (c) Sketch the Bode plots for the unity feedback transfer function given below: **07**

$$G(s) = \frac{800(s + 2)}{s^2(s + 10)(s + 40)}$$

- Q.5** (a) List at least three advantages and three disadvantages of a lag compensator. **03**
 (b) Draw and explain the pole zero plot and bode plot of a lag compensator. **04**
 (c) Explain in detail the steps to design a lag compensator. **07**

OR

- Q.5** (a) List at least three advantages and three disadvantages of a lead Compensator. **03**
 (b) Draw and explain the pole zero plot and bode plot of a lead compensator. **04**
 (c) Explain in detail the steps to design a lead compensator. **07**
