

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER- III (NEW) EXAMINATION – SUMMER 2022**

**Subject Code:3131101**

**Date:13-07-2022**

**Subject Name:Control Systems**

**Time:02:30 PM TO 05:00 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) What is feedback? Explain the effect of feedback.  | 03    |
| (b) Define: Transfer function, Self loop, Steady-state error   | 04    |
| (c) What is control system? What are the different types of control systems? Compare open-loop and closed-loop control system. | 07    |
| Q.2 (a) List properties of the Transfer Function.  | 03    |
| (b) Compare Block diagram and Signal flow graph methods.   | 04    |
| (c) What is an analogous system? Establish force-current and force-voltage analogy.  | 07    |
| <b>OR</b>  |       |
| (c) Obtain Transfer function of the mechanical system shown in figure 1.   | 07    |

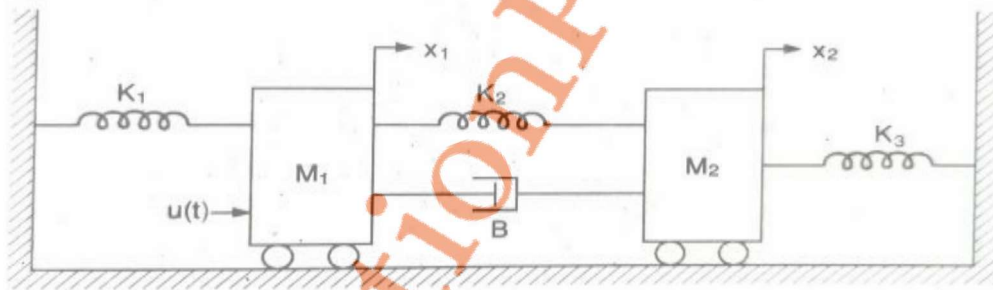


Figure 1.

- |  |    |
|--|----|
| Q.3 (a) Explain: Frequency response, Root locus, Centroid.   | 03 |
| (b) Discuss standard Test signals used in control system.  | 04 |
| (c) Derive the closed loop transfer function using block diagram reduction technique for the figure 2. | 07 |

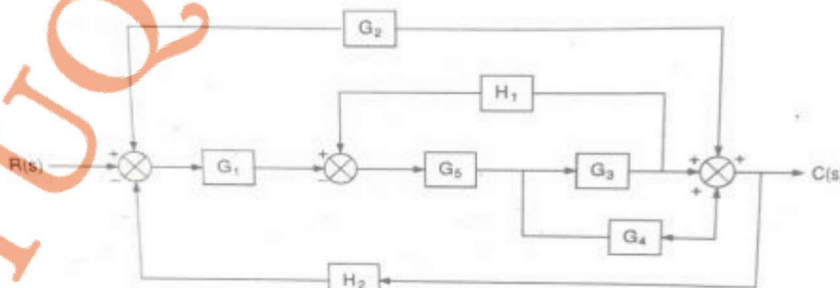


Figure 2.

**OR**

- |  |    |
|--|----|
| Q.3 (a) Discuss Hurwitz's stability criteria.                            | 03 |
| (b) Define: (1) Delay time (2) Rise time (3) Peak time (4) Settling time | 04 |

- (c) Obtain the transfer function  $C/R$  of the block diagram shown in figure 3. Using Mason's gain formula. 07

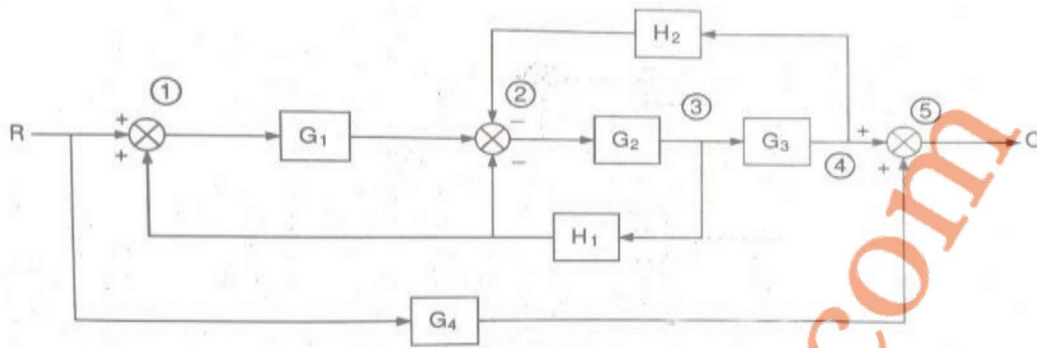


Figure 3.

- Q.4 (a) Explain: Gain margin, Phase margin, Polar plot. 03  
 (b) Apply Routh-Hurwitz criterion to determine stability of a control system whose open-loop transfer function is given below. 04

$$G(s)H(s) = \frac{5}{s(s^2 + 2Ks + K + 4)}$$

- (c) For the given type-2 system, find root locus and comment on stability. 07

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

OR

- Q.4 (a) Explain: State, State variable, state trajectory. 03  
 (b) Write short note on PID controller. 04  
 (c) For the given type-2 system, Draw the polar plot. 07

$$G(s) = \frac{40}{(s^2)(s + 4)}$$

- Q.5 (a) Derive an expression for the rise time for a 2nd order control system subjected to a unit step input. 03  
 (b) Derive the expression for peak time  $T_p$  for a second order control system subjected to a unit step input. 04  
 (c) State and explain nyquist stability criteria. 07

OR

- Q.5 (a) Derive Correlation Between Transfer Functions and State-Space Equations. 03  
 (b) List Advantages of State variable analysis. 04  
 (c) For the given open-loop unstable system with transfer function 07

$$G(s)H(s) = \frac{s + 2}{(s^2 - 1)}$$

Draw Nyquist contour and plot.

\*\*\*\*\*