

Enrolment No./Seat No _____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3142003

Date:22-11-2024

Subject Name:Control Theory

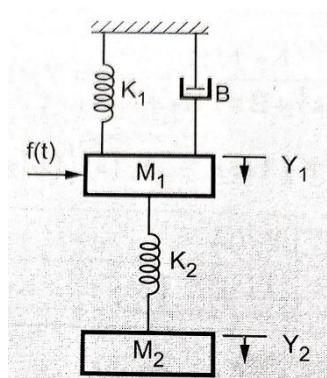
Time:02:30 PM TO 05:00 PM

Total Marks:70

Instructions:

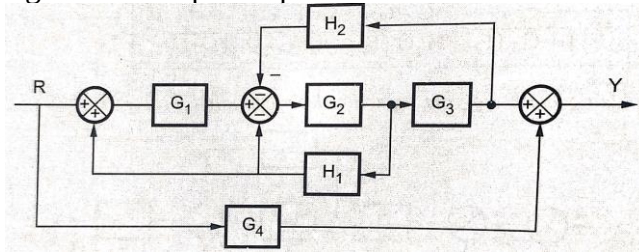
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

- | | | Marks |
|------------|---|--------------|
| Q.1 | (a) Explain the use of Laplace transform in control system. | 03 |
| | (b) Distinguish between: (1) Static and Dynamic Systems, (2) deterministic and Stochastic control systems. | 04 |
| | (c) Explain what is close loop control system with an example. | 07 |
| Q.2 | (a) The transfer function of a system is given by
$T(S) = \frac{K(s+8)}{s(s+4)(s+9)(s^2+8s+16)}$
Determine: (1) Poles, (2) Zeros & (3) Characteristic Equation. | 03 |
| | (b) State and explain the basic elements used for modelling of mechanical translational system? | 04 |
| | (c) What is force-voltage analogous system? Which are the analogous quantities according to this method? | 07 |
| | OR | |
| (c) | Determine the transfer function $Y_2(S)/F(S)$ of the system shown in fig. | 07 |



- | | | |
|------------|---|-----------|
| Q.3 | (a) Define : Transfer Function, Source Node, Sink Node, Summing Point, Take-off Point. | 03 |
| | (b) Explain how to construct signal flow graph from Set of equations with suitable example. | 04 |

- (c) Using BLOCK diagram reduction rules, convert the block diagram of given fig. in to a simple loop. 07



OR

- Q.3** (a) State the properties of Signal Flow Graph. 03
 (b) State and explain the meson's Gain Formula to determine the overall transfer function of the closed-loop system. 04
 (c) Construct the signal flow graph for the following set of system equations. 07
 $Y_2 = G_1 Y_1 + G_3 Y_3$
 $Y_3 = G_4 Y_1 + G_2 Y_2 + G_5 Y_3$
 $Y_4 = G_6 Y_2 + G_7 Y_3$
 Where Y_4 is output, find transfer function Y_4/Y_1 .

- Q.4** (a) Discuss the various standard input used in control system analysis. 03
 (b) What is the difference between steady state response and transient response of a control system? 04
 (c) Evaluate the static error constants for a unity feedback system having a forward path function $G(s) = \frac{50}{s(s+10)}$. 07
 Estimate the steady state errors of the system for the input $r(t)$ given by $r(t) = 1 + 2t + t^2$.

OR

- Q.4** (a) Derive the expressions for static error coefficient when reference input is parabolic of magnitude 'A'. 03
 (b) Define the following systems by sketching their output waveform for a unit step input: 04
 (1) Underdamped system, (2) Undamped system
 (3) Overdamped system, (4) Critically damped system
 (c) With a neat sketch explain all the time domain specification. 07

- Q.5** (a) What do you understand by absolute stability and relative stability? Which method indicates what type of stability? 03
 (b) With suitable example explain how relative stability can determine from Nyquist Plot? 04
 (c) Sketch the root locus of the system whose open transfer function is $G(s) = \frac{K}{s(s+1)(s+3)}$. Determine the value of K for damping ratio equal to 0.5. 07

OR

- Q.5** **(a)** Define Routh's stability criterion. **03**
- (b)** Construct Routh array and determine the stability of the system whose **04**
 characteristic equation is: $S^5 + S^4 + 2S^3 + 2S^2 + 3S + 15 = 0$
- (c)** Determine the root locus of the system with **07**
 $G(s)H(s) = \frac{K(s+2)(s+3)}{s(s+1)}$.
