

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-IV EXAMINATION – SUMMER 2025

Subject Code:3141708

Date:12-05-2025

Subject Name: Control Theory

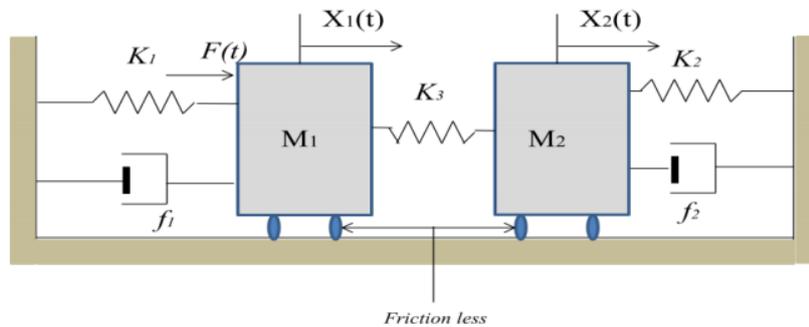
Time: 10:30 AM TO 01:00 PM

Total Marks:70

Instructions:

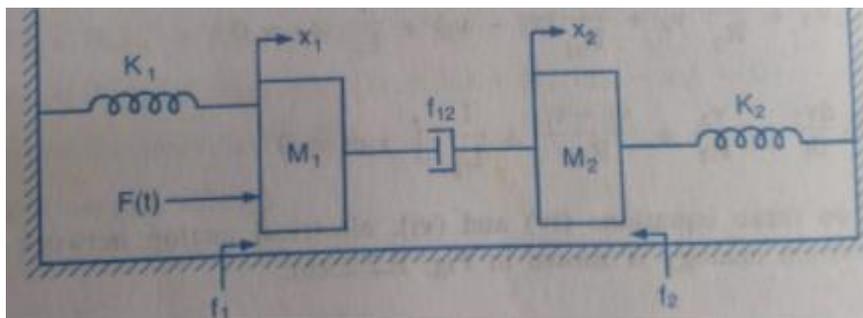
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

- | | | MARKS |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Q.1 | (a) Define transfer function and Explain importance of Laplace transform in control system. | 03 |
| | (b) Write short notes on open loop control systems and closed loop control | 04 |
| | (c) Draw sketches of three time responses of a second order system for a unit step input for under damped, critically damped and over damped systems. Give definitions of five performance indices with the help of sketch drawn for under damped system. | 07 |
| Q.2 | (a) Derive Impulse response of a first order system. | 03 |
| | (b) Explain standard Test signals & derive equation of steady state error. | 04 |
| | (c) Find the transfer function $X_2(s)/F(s)$ of given mechanical system | 07 |



OR

- (c) For the given mechanical obtain force-current analogy. **07**

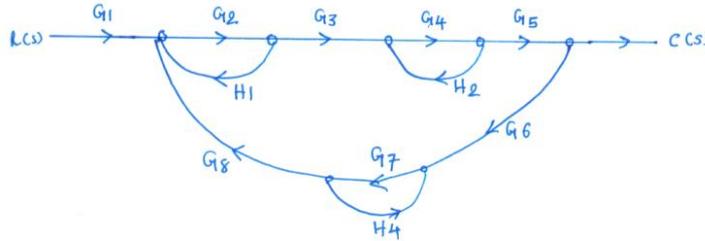


- Q.3**
- (a) What is analogous of all variables in mechanical network in force current analogy? **03**
- (b) By means of Routh criterion, determine the stability of the system described by characteristic equations.
 $S^5 + 1.5 S^4 + 2 S^3 + 4 S^2 + 5S + 10 = 0$ **04**
- (c) Write the rules for block diagram Reduction technique. **07**

OR

- Q.3** (a) Explain each term of the Mason's gain formula. **03**
(b) Derive the mathematical model of thermal system. **04**
(c) Sketch the root locus for the given open loop transfer function $G(s)H(s)=$ **07**
- $$\frac{k}{s(s+2)(s+3)}$$

- Q.4** (a) Define pole, zero and order of a system. **03**
(b) Explain Performance Indices. **04**
(c) Find the transfer function using signal flow graph. **07**



OR

- Q.4** (a) Derive expression of KP, KV, KA for Type '0' control system **03**
(b) State the limitation of Routh criterion and how these limitations are overcome by Root Locus. **04**
(c) Sketch Bode plots of a unity feedback control system having open loop transfer function as $G(S)H(S)=$ **07**
- $$\frac{100}{s(s+1)(s+2)}$$

- Q.5** (a) Define : 1) state variable, 2) state vector, 3) state space **03**
(b) Sketch polar plot for the system with open loop transfer function is **04**
- $$G(S)=\frac{10}{s(s+1)}$$
- (c) List all the rules to construct a root locus and explain them. **07**

OR

- Q.5** (a) Explain the Nyquist stability criterion. **03**
(b) Find the transfer function for the following system **04**
- $$\dot{x} = \begin{bmatrix} 0 & 1 \\ -5 & -10 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$
- $$y = [0 \quad 10]x$$
- (c) What is state space model? Define states. Derive the expression for converting state model to transfer function? **07**
