Enrolment No./Seat No_____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–V EXAMINATION – SUMMER 2025**

**Subject Code:3151908 Date:13-05-2025**

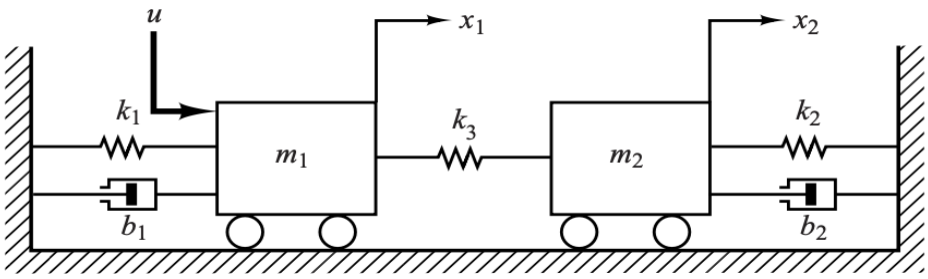
**Subject Name:Control Engineering**

**Time:02:30 PM TO 05:00 PM Total Marks:70**

**Instructions:**

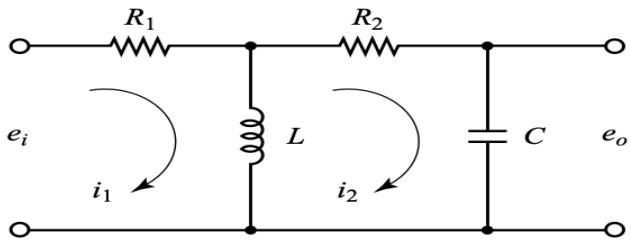
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | Define: (i) Manipulated variable (ii) Disturbance (iii) Controlled variable. | **03** |
| | **(b)** | Compare open loop control system and closed loop control system. | **04** |
| | **(c)** | Explain the working principle of a closed loop control system with the help of schematic of an air conditioner. | **07** |
| **Q.2** | **(a)** | Define following for a signal flow graph: (i) Node (ii) Path (iii) Branch (iv) Loop (v) non-touching loop (vi) Self-loop. | **03** |
| | **(b)** | Explain following test signals with their plot and transfer function: (i) Impulse function (ii) Unit step function (iii) Unit Ramp function (iv) Parabolic function. | **04** |
| | **(c)** | Obtain Transfer function $X_1(S)/U(S)$ and $X_2(S)/U(S)$ for following mechanical system. | **07** |




**OR**

| | | | |
|---|---|---|---|
| | **(c)** | Find transfer function $E_0(S)/E_i(S)$ for following electrical circuit: | **07** |




| | | | |
|---|---|---|---|
| **Q.3** | **(a)** | List and explain the conditions for linearity of a mathematical equation representing a system. | **03** |
| | **(b)** | Plot the poles and zeroes of a system represented by following transfer function: $G(S) = (S+2)/S^2+2S+3$ | **04** |

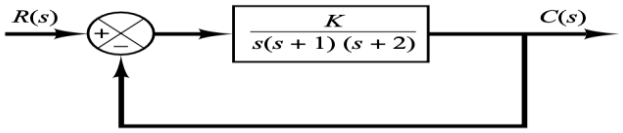
**(c)** Determine the range of K for which a control system represented by the polynomial $S^4+3s^3+3s2+2s+K=0$ will be stable. **07**

**OR**

**Q.3** **(a)** Define transfer function. List its properties. **03**

**(b)** Determine the transfer functions of: (i) P-type controller (ii) P-I type controller (iii) P-I-D type controller. **04**

**(c)** Plot the root locus of a control system represented by: **07**




**Q.4** **(a)** Define: (i) Lead compensation (ii) Lag compensation **03**

**(b)** Explain relative stability analysis in frequency response analysis. **04**

**(c)** Explain Ziegler-Nichols rule for tuning of P-I-D controller. **07**

**OR**

**Q.4** **(a)** Describe the need of tuning PID controllers. **03**

**(b)** Explain Nyquist stability criterion in detail. **04**

**(c)** Draw the Bode plot of following transfer function: **07**

$$G(j\omega) = \frac{e^{-j\omega L}}{1 + j\omega T}$$

**Q.5** **(a)** List the sources of hydraulic power for hydraulic control systems. **03**

**(b)** Compare Hydraulic control system with Pneumatic control system. **04**

**(c)** Explain the working of Pneumatic Nozzle-Flapper device with the help of its characteristic curve. **07**

**OR**

**Q.5** **(a)** List and explain various components of pneumatic control system. **03**

**(b)** Explain any Force-balance type controller with neat diagram. **04**

**(c)** With the help of neat diagram, Explain the working of Hydraulic integral controller and derive its transfer function. **07**

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