

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER- IV(NEW) EXAMINATION – SUMMER 2023****Subject Code:3142407****Date:27-07-2023****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.

- Q.1 (a)** Give any one example of closed loop control system. **03**
(b) Draw neat block diagram of closed loop control system and explain its blocks **04**
(c) Derive step response for second order system. **07**

- Q.2 (a)** Give comparison of open loop and closed loop control system. **03**
(b) Define following. (1) Type of a system (2) Order of a system **04**
(c) Derive step response for second order system. **07**

OR

- (c)** Derive state space model of LRC series circuit given in fig. 1. **07**

- Q.3 (a)** Find the transfer function relating displacements by y and x for the mechanical system shown in fig.2. **03**
(b) Describe basic principles of block diagram reduction for obtaining overall transfer function of a system. **04**
(c) Determine the stability of the system shoes overall transfer function is given below. **07**

$$\frac{C(s)}{R(s)} = \frac{2s + 5}{s^5 + 1.5s^4 + 2s^3 + 4s^2 + 5s + 10}$$

If the system is found unstable, how many roots it has with positive real parts ?

OR

- Q.3 (a)** Draw the generalized block diagram of PID controlled system. **03**
(b) Discuss absolute and relative stability with respect to location of poles of a closed loop control system. **04**
(c) Determine the stability of a closed loop control system whose characteristic equation is $s^5 + s^4 + 2s^3 + 2s^2 + 11s + 10 = 0$. **07**

- Q.4 (a)** Derive steady state velocity error coefficient for type 1 control system. **03**
(b) Define (1) Gain Margin (2) Phase Margin (3) Gain Cross Over Frequency (4) Phase Cross Over Frequency **04**
(c) For $G(s) = \frac{K}{s(s+50)}$ and $r(t) = 0.5t$, determine the value of K for steady state error $e_{ss} \leq 0.1$ **07**

OR

- Q.4 (a)** Derive steady state positional error coefficient for type 2 control system. **03**
(b) Discuss rise time, peak time and peak overshoot for second order closed loop control system. **04**
(c) Derive state space model from transfer function given below. **07**

$$\frac{Y(s)}{U(s)} = \frac{1}{s^2 + 2s + 5}$$

- Q.5 (a)** Explain lag-lead compensation with reference to control system. **03**

- (b) Define state variables, state, state vector and state space. 04
 (c) Discuss the step by step procedure for plotting root locus. 07

OR

- Q.5 (a) State Ziegler-Nicholas tuning rules for PID controller. 03
 (b) What is polar plot? Discuss in brief. 04
 (c) Sketch the root locus for the open loop transfer function of a unity feedback control system given below. 07

$$\frac{K}{s(s+1)(s+3)}$$


