

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV (NEW) EXAMINATION – SUMMER 2024****Subject Code:3142407****Date:10-07-2024****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) What is a control system? Briefly describe the same with an example. **03**
 (b) Compare Open Loop Control System with Closed Loop Control System. **04**
 (c) With neat diagram explain Missile Defense System and role of control engineering in the same. **07**
- Q.2** (a) Define following (1) State (2) State Space (3) State Space Model **03**
 (b) Obtain State Space model for the system described by the mathematical equation $\ddot{y} + 7\dot{y} + 19y + 13y = 13\dot{u} + 26u$, where y is output and u is input. **04**
 (c) For the mechanical system given in figure 1, obtain TF $Y(S)/U(S)$. **07**
- OR**
- (c) Obtain state space model for the mechanical system given in figure 2 considering V_i as input and V_o as output. **07**
- Q.3** (a) What is Type and Order of a system? Describe same giving example for each. **03**
 (b) What is characteristics equation of a system? Define following considering zeros of characteristics equation. (1) Absolutely stable system (2) Marginal Stable system (3) Unstable system **04**
 (c) Determine stability of following systems. **07**
 (1) $S^4 + 4S^3 + 13S^2 + 36S + k = 0$
 (2) $S^6 + 3S^5 + 5S^4 + 9S^3 + 4S^2 - 8S^2 - 6S$
- OR**
- Q.3** (a) State time domain specifications for 2nd order system. **03**
 (b) Define terms related to following symbols in time response. **04**
 (1) t_r (2) t_p (3) t_d (4) t_s
 (c) A UFB control system has an open loop TF $G(S) = K/[(S+2)(S+4)(S^2+6S+25)]$. Discuss the stability of the closed loop system as a function of K. Find out values of K for which cause sustained oscillations in the closed loop system. Also find frequency of sustained oscillations. **07**
- Q.4** (a) What is inherent disadvantage of Proportional control action? **03**
 (b) What is steady state error? How it can be minimized? **04**
 (c) Draw approximate root locus for the UFB system having forward path TF $G(S) = k(S+1)/(S^2 + 2S)$. Also comment on stability of the system. **07**
- OR**
- Q.4** (a) What are disadvantages of Integral control action? **03**
 (b) Which control action can be used to improve dynamic response of a closed loop control system? Explain. **04**
 (c) Draw approximate root locus for the control system having open loop TFG(S) $= k/[S(S+1)(S+2)]$. Comment on stability of the system. **07**

- Q.5 (a)** Draw polar plot for the TF. $1/(S+1)$ mentioning all necessary details on graph paper. **03**
- (b)** Define following. 1. Phase cross over frequency 2. Gain Cross Over frequency 3. Phase margin 4. Gain Margin **04**
- (c)** Explain relative stability. **07**
- OR**
- Q.5 (a)** Draw bode diagram for the TF. $1/(S+1)$. **03**
- (b)** State Ziegler-Nicholas rules for tuning of a controller. **04**
- (c)** Explain how Zero-Placement Approach can be used to improve response of a control system. **07**

Figure 2

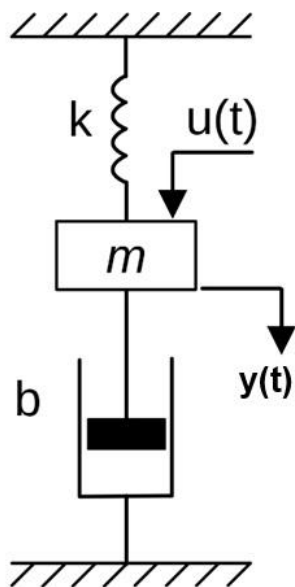


Figure 1

