

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 6 – EXAMINATION – SUMMER 2026

Subject Code: 3161707

Date: 01/06/2026

Subject Name: Control System Design

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) List and explain different types of compensator. **03**
 - (b) Define the following terms: (i) Controllability (ii) Observability **04**
 - (c) Explain the procedural steps for designing a phase lag compensator in time domain. **07**
- Q.2**
- (a) Give the S- Plane Representation of Lead, Lag and Lag-Lead compensator. **03**
 - (b) Design a Phase lag compensator using Electric network. **04**
 - (c) With the help of illustrative bode diagram, discuss the basic characteristics of lead compensator. **07**
- OR**
- Q.2**
- (c) Design a suitable compensator for the system having the open loop transfer function $G(S) = K / S(S+2)$ to meet the following specifications: (i) Damping ratio $\zeta=0.707$ (ii) Settling Time $t_s \leq 5$ Sec (iii) $K_v \geq 4$ **07**
- Q.3**
- (a) Define linear dependence and independence of vectors. **03**
 - (b) Design a Phase Lead compensator using Electric network. **04**
 - (c) With suitable example, discuss about the robust PID controller **07**
- OR**
- Q.3**
- (a) Compare state space method and conventional method. **03**
 - (b) Derive the equation to obtain the transfer function from the state space model. **04**
 - (c) Explain the procedural steps for designing a phase lag compensator in Frequency domain. **07**
- Q.4**
- (a) What are the considerations that are to be kept in mind while designing the robust control system? **03**
 - (b) Briefly explain observable canonical form. **04**
 - (c) Briefly describe the parameters used to analyse robustness of control system. **07**
- OR**
- Q.4**
- (a) Write a short note on system sensitivity in robust control system. **03**
 - (b) Briefly explain controllable canonical form in state space. **04**
 - (c) Write a short note on Optimal control system. **07**
- Q.5**
- (a) Define the following terms: (i) state (ii) state vector (iii) state space **03**

- (b) Design a lag-lead compensator using RC network. **04**
(c) write a short note on Riccati Equation. **07**

OR

- Q.5** (a) Obtain the state space model of field controlled DC motor. **03**
(b) Explain the use of observer in state feedback control system. **04**
(c) Explain the design of Linear Quadratic Regulator **07**
