

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI (NEW) EXAMINATION – SUMMER 2023****Subject Code:3161707****Date:14-07-2023****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.

	MARKS
Q.1 (a) Determine state transition matrix of the system matrix $A = \begin{bmatrix} 0 & 1 \\ -2 & 0 \end{bmatrix}$	03
(b) Explain system sensitivities to parameter perturbations.	04
(c) What are the effects of lag compensation? Give the steps of lag compensation design for time response compensation.	07
Q.2 (a) List out procedure to design robust PID controlled systems.	07
(b) For Type-2 system given in differential form as $\ddot{y} + 5\dot{y} + 3y + 2y = u$. Find two state space models.	07
OR	
(b) For the given transfer function. Obtain two state space models.	07
$\frac{Y(s)}{U(s)} = \frac{s^3 + 8s^2 + 17s + 8}{s^3 + 6s^2 + 11s + 6}$	
Q.3 (a) Explain the optimal solution using Riccati equation.	04
(b) For an open loop transfer function $G(s)=K/s^2(s+2)$ design compensator such that damping ratio 0.7, settling time 1.4 sec and $K_a=5 \text{ sec}^{-2}$.	10
OR	
Q.3 (a) Describe the full state feedback control system scheme with observer design.	04
(b) An open loop transfer function $G(s)= 4/s(s+2)$. Design suitable compensating network to achieve damping ratio =0.5 and $t_s= 2$ sec.	10
Q.4 Design lag compensator for the transfer function $G(s) = \frac{40}{s(s+2)}$	14
Such that $PM \geq 45$. Draw the lead network.	
OR	
Q.4 Design lead compensator for the transfer function $G(s) = \frac{1}{s^2}$	14
Such that $PM \geq 45$. Draw the lead network.	
Q.5 (a) Explain RLC series circuit state space model.	03
(b) Explain the Linear Quadratic Regulator based optimal design.	04
(c) Check the controllability and observability of following system	07
$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -9 & -4 & -5 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u(t)$	
$y = [1 \quad 1 \quad 3]x(t)$	
OR	
Q.5 (a) Define Controllability and Observability with equations to find it.	03
(b) Explain need of compensation and types of compensation.	04
(c) Consider the system with $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix} x(t) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(t)$	07
Determine the state feedback gain matrix for placing poles on -5 and -6.	
