Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2018

Subject Code: 2172007 **Date: 03/12/2018**

Subject Name: Modern Control Systems

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.**

			MARKS
Q.1	**(a)**	Using suitable block diagram, explain ON-OFF control systems.	**03**
	(b)	Using suitable block diagrams, explain disturbance signals and their effects on the control systems?	**04**
	(c)	List various characteristics of feedback control systems and explain any two of them using block diagram and mathematical equations.	**07**
Q.2	**(a)**	Define (i) centroide (ii) asymptotes (iii) dominant pole	**03**
	(b)	How locations of closed-loop pole decide the transient response of the system? Explain using suitable examples.	**04**
	(c)	What is lag compensator? What are the effects of lag compensator? Explain design steps for design of lag compensator using root locus technique.	**07**
		OR	
	(c)	For the control system represented by block diagram in Figure 1, design a lead compensator using root locus technique, such that wn=4 rad/sec and damping ratio= 0.5 for the compensated system.	**07**

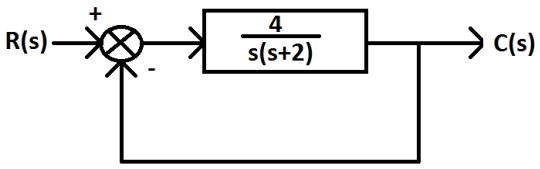

Figure 1

Q.3	**(a)**	List the advantages of frequency domain analysis of a control system.	**03**
	(b)	With suitable diagrams define (i) Phase crossover frequency (ii) Gain crossover frequency (iii) Phase margin (iv) gain margin.	**04**
	(c)	A unit step input is applied to a unity feedback control system having open loop transfer function $\frac{K}{s(1+sT)}$ Determine the value of K and T to have Mp=20% and resonant frequency wr= 6 rad/sec. Calculate the resonant peak (Mr).	**07**
		OR	
Q.3	**(a)**	List various effects of adding a pole in a given control system.	**03**
	(b)	Explain various effects of phase lead compensation.	**04**
	(c)	Explain design procedure to design phase lead compensation using bode plot technique.	**07**
Q.4	**(a)**	List the advantages of state space approach of analyzing the control systems.	**03**
	(b)	Draw and explain block diagram of a linear system in state variable form for	**04**

MIMO system.

(c) A system is described by the following differential equation. Represent the system in state space. **07**

$$\frac{d^3x}{dt^3} + 3\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 4x = u_1(t) + 3u_2(t) + 4u_3(t)$$

And outputs are:

$$y_1 = 4\frac{dx}{dt} + 3u_1$$

$$y_2 = \frac{d^2x}{dt^2} + 4u_2 + u_3$$

OR

Q.4 **(a)** Define (i) state variables (ii) state vector (iii) state space **03**

(b) Compute state transition matrix for $A=\begin{pmatrix} -1 & 1 \\ 0 & 2 \end{pmatrix}$ **04**

(c) Explain Taylor series expansion for computing the state transition matrix. **07**

Q.5 **(a)** For sampled data control system, explain the effect of sampling period on steady state error. **03**

(b) Derive solution of state equation using Laplace transform method **04**

(c) Using suitable block diagram, explain sampling process of a continuous time system. **07**

OR

Q.5 **(a)** Explain observability for a state space system using suitable block diagram. **03**

(b) Using suitable block diagram, explain pulse transfer function of systems in series. **04**

(c) Determine the stability of a sampled data control system having following characteristic polynomial **07**

$$2z^4 + 3z^3 + 2z^2 - z + 1 = 0$$

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