Seat No.: ________ Enrolment No.______________

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2013

Subject code: 714702 **Date: 04-06-2013**

Subject Name: Advanced Control System

Time: 10.30 am – 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.**

Q.1 **(a)** Consider a Unity-feedback type-1 system with open loop transfer function **07**

$$G(s) = \frac{k}{s(s+2)}$$

It is desired to designed a cascade lead compensator such that the dominant closed-loop poles provide a damping ratio $\xi = 0.5$ and have undamped natural frequency $\omega n = 4 rad/s$.

(b) Explain the design step for the cascade lag compensator. **07**

Q.2 **(a)** The Uncompensated system transfer function is given by **07**

$$G(s) = \frac{k}{s(s+2)}$$

The system is to be compensated to meet the following specification.
Damping ratio, $\xi = 0.707$
Settling Time, $t_s \leq 5 \sec$
Velocity error constant, $k_v \geq 4$
Design a suitable lag compensator for the desired specification

(b) Consider a plant with transfer function **07**

$$G(s) = \frac{4}{s(s+0.5)}$$

Design a suitable lead-lag compensator to meet the following specification:
Damping ratio of dominant closed loop poles, $\xi = 0.5$
Undamped natural frequency of dominant closed loop poles, wn=5 rad/s.
Velocity error constant=80 $\sec^{-1}$.

OR

(b) Consider a unity-feedback control system with open-loop transfer function **07**

$$G(s) = \frac{k}{s^2(0.2s+1)}$$

The system is required to compensate to meet the following specification.
Acceleration error constant Ka=10.
Phase Margine $\geq$ 35ę
Design a suitable lead compensator for the system.

Q.3 **(a)** Derive the solution of state equation by Laplace transform method. **07**

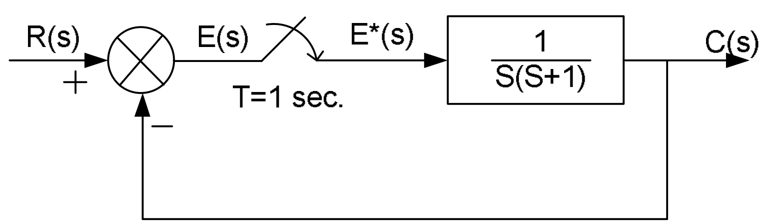
(b) Derive the model conversion from state space to transfer function. **07**

OR

Q.3	**(a)**	Obtain the time response of the system given below: $$A=\begin{pmatrix} 0 & 1 \\ -2 & 0 \end{pmatrix};\text{given } x(0)=\begin{bmatrix} 1 \\ 1 \end{bmatrix};$$ $$Y=[1\ -1]\begin{bmatrix} x1 \\ x2 \end{bmatrix}$$	**07**
	(b)	Explain the properties of state transition matrix.	**07**
Q.4	**(a)**	Explain the stability analysis of sampled-data control system and mapping from-plane to z-plane	**07**
	(b)	Describe the following common nonlinear system behaviors: 1. Limit cycle 2.Jump response.	**07**

OR

Q.4	**(a)**	Describe the isoclines method of construction of phase portraits. Illustrate through an example.	**07**
	(b)	Define the definition of z-transform and find the z transform of the following function: $$f(t)=e^{-\alpha t}\cos wt$$ $$f(t)=\sin wt$$	**07**
Q.5	**(a)**	Find the pulse transfer function for the error sampled system shown in fig.	**07**



	(b)	Draw and explain the block diagram of a control scheme employing the pole placement technique using state feedback controller.	**07**

OR

Q.5	**(a)**	Describe the common nonlinearities in control system.	**07**
	(b)	What are singular points on phase plane? Describe the behavior of trajectory in the vicinity of commonly found singular points in phase portraits.	**07**

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