Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER-1 (NEW) EXAMINATION – WINTER 2016

Subject Code: 2714702 **Date:06/01/2017**

Subject Name: Advance control systems

Time: 2:30 pm to 5:00 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)** Derive an ideal derivative compensator to yield a 16% overshoot, with a threefold reduction in settling time for a given open loop transfer function. **07**

$$G(s) = \frac{k}{s(s+4)(s+6)}$$

(b) Explain the Design procedure to construct the lead compensator using the root locus technique. **07**

Q.2 **(a)** What kind of compensation improves both steady-state error and transient response? Explain in details. **07**

(b) What difference on the s-plane is noted between using PD controller or using a lead network to improve the transient response? **07**

OR

(b) The unity feedback system with **07**

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

is to be designed for a settling time of 1.667 seconds and a 16.3% overshoot. If the compensator zero is placed at -1, do the following.

a. Find the coordinates of the dominant poles.

b. Find the compensator pole.

Q.3 **(a)** The unity feedback system is given by **07**

$$G(s) = \frac{k}{(s+1)(s+3)(s+5)}$$

is operating with 10% overshoot.

a. What is the value of the appropriate static error constant?

b. Find the lag compensator transfer function.

(b) Explain the design procedure to construct the lag compensator using root locus technique. **07**

OR

Q.3 **(a)** Consider the system with the transfer function **07**

$$G(s) = \frac{1}{s(s+2)}.$$

Design a lead compensator using frequency response technique to satisfy the following requirement.

a. Velocity error constant Kv ≥ 10.

b. Phase Margin ≥ 60.

(b) An uncompensated control system with unity feedback has a plant transfer function **07**

$$G(s) = \frac{k}{s(1+0.s)(1+0.2s)}$$

The system must satisfy the following performance specifications.

a. steady state error is 0.01

b. Phase margin ≥ 40.

Q.4	**(a)**	Derive the solution of state space equation using Laplace transform technique.	**07**
	(b)	Construct the state space model of the system using parallel decomposition technique using suitable example.	**07**

OR

Q.4	**(a)**	Explain the significance of the Observability. Derive the condition for the system observability.	**07**
	(b)	Describe the following common nonlinear system behaviors: a.Limit cycle b. Jump response	**07**
Q.5	**(a)**	What are singular points on phase plane? Describe the behavior of trajectories of common singular points in phase portraits.	**07**
	(b)	Derive the describing function of on-off controller with dead-zone.	**07**

OR

Q.5	**(a)**	Explain the stability analysis of sampled data control system using Jury's stability test.	**07**
	(b)	Phase Plane analysis applies primarily to second order systems, while the describing function method gives satisfactory results for higher-order systems. Why?	**07**

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