Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII EXAMINATION – WINTER 2015

Subject Code: 172007 **Date:04/12/2015**

Subject Name: Modern Control System

Time: 10:30am to 1:00pm **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)** Discuss the compensation characteristic of cascade lead compensator. **07**

(b) Explain the design procedure of cascade lag compensator. **07**

Q.2 **(a)** Consider a unity feedback type-I system with open loop transfer function **07**

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

It is desired to design a cascade lead compensator such that the dominant closed loop poles provide damping ratio=0.5 and undamped natural frequency=4 rad/sec.

(b) A unity feedback system with open loop transfer function **07**

$$G(s) = \frac{k}{s^2(s+1.5)}$$

Design a suitable double lead cascade compensator to satisfy the following specification.

Settling time =4 sec,Peak overshoot for step input=25%.

OR

(b) Explain the design procedure of cascade lag-lead compensator. **07**

Q.3 **(a)** The uncompensated open-loop transfer function is **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,ts ≤ 5 sec

Velocity error constant,kv ≥ 4. Design a suitable lag compensator.

(b) Consider a plant with transfer function $G(s) = \dfrac{4}{s(s+0.5)}$ **07**

Design a lag-lead compensator to meet the following specification:

1.damping ratio=0.5

2.wn=5 rad/sec

3.kv=80 sec^{-1}

OR

Q.3 **(a)** The uncompensated transfer function is given by **07**

$$G(s) = \frac{k}{s(s+1)(s+4)}$$

The specification of the system are as follows:

Damping ratio=0.5

Undamped natural frequency=2 rad/sec

Velocity error constant Kv $\geq 5\ sec^{-1}$.

Design a suitable lag-lead compensator for the above system.

(b) Explain the design procedure for a frequency response design of lead compensator. **07**

Q.4 **(a)** The uncompensated system with an open loop transfer function is given by **07**

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

It is desired to have the velocity error constant Kv=10.
Phase margin of the system=45
Design a suitable lead compensator for frequency response method.

(b) Explain the design procedure for a lag compensator design of frequency response method. **07**

OR

Q.4 **(a)** Define the term: state, state variable, state vector and state space, eigen values, eigen vector. **07**

(b) Derive the state space representation of a series R-L-C circuit. **07**

Q.5 **(a)** Explain the transfer function decomposition. Obtain the cascade decomposition with suitable example. **07**

(b) Derive the solution of state equation by Laplace transform technique. **07**

OR

Q.5 **(a)** Briefly describe the configuration of a state feedback control design using pole placement technique. **07**

(b) Explain the term controllability. Derive the controllability of a system with the help of controllability test matrix. **07**

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