Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**B. E. - SEMESTER – IV • EXAMINATION – WINTER 2012**

**Subject code: 141701** **Date: 29/12/2012**

**Subject Name: Control Theory**

**Time: 02.30 pm - 05.00 pm** **Total Marks: 70**

**Instructions:**

1. **Attempt any five questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** Give one example of an open loop stable system and open loop unstable system. Explain about stability of the system. **07**

**(b)** Obtain mathematical model for one electrical system and one mechanical system. Obtain their transfer functions. **07**

**Q.2** **(a)** Explain about state space modeling and obtain state variable model for dc motor. **07**

**(b)** Explain about time constant of first order and second order system. **07**

**OR**

**(b)** Explain about signal flow graph with suitable example. **07**

**Q.3** **(a)** Find out the output response c(t) of the transfer function shown below for the step input. **07**

$$\frac{C(s)}{R(s)} = \frac{5}{(s+1)}$$

Plot the step response on a graph paper

**(b)** Explain about thermal system giving suitable example. Obtain its transfer function. **07**

**OR**

**Q.3** **(a)** For the second order system with transfer function as given below, obtain Maximum percentage overshoot $M_p$ and peak time $T_p$. **07**

$$G(s) = \frac{4}{s^2 + 2s + 4}$$

**(b)** Explain about liquid level system giving suitable example. Obtain its transfer function. **07**

**Q.4** **(a)** For the unity feedback control system with **07**

$$G(s) = \frac{K(s+15)}{s(s+2)(s+3)}$$

Determine the range of *K* for stability using R-H criteria

**(b)** For a unity feedback control systems shown below, obtain steady state error for step input. **07**

$$G_1(s) = \frac{10}{s^2 + 14s + 50} \text{ and } G_2(s) = \frac{10}{s(s^2 + 14s + 50)}$$

**OR**

**Q.4** **(a)** For the unity feedback control system with **07**

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

Find the range of $K$ for system that will cause the system to be stable, marginally stable and unstable. Make suitable comments.

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**(b)** State and explain Nyquist Stability criteria. Explain about phase margin and gain margin using Nyquist plot. **07**

**Q.5** **(a)** Obtain root-locus plot for the unity feedback system with transfer function. **07**

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

**(b)** Explain about integral action and derivative action on system performance. Can integral action be used alone ? **07**

**OR**

**Q.5** **(a)** Obtain gain crossover frequency and phase crossover frequency for the system having transfer function as shown below using Bode Plots. **07**

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$$G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$$

**(b)** Explain with suitable example, one method for linearization of nonlinear mathematical model. **07**

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