Seat No.: _____                                              Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY
## PDDC - SEMESTER – IV • EXAMINATION – WINTER 2012

**Subject code: X 41102**                                         **Date:  27/12/2012**
**Subject Name: Control Theory**
**Time: 02.30 pm - 05.00 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)** Compare open loop & close loop control system. Discuss the effect of feedback on time constant of a control system. **07**

**(b)** Determine the over all transfer function using block diagram reduction technique. Also verify the result using signal flow graph.(Refer Fig. 1) **07**

**Q.2** **(a)** Draw the mechanical circuit diagram for the system. Write the equilibrium equations & draw the Force to Voltage analogous circuit.(Refer Fig. 2) **07**

**(b)** Draw & Discuss the time response of a first order control system subjected to unit step & ramp input function also explain the effect of time constant on the speed of the time response of a control system. **07**

**OR**

**(b)** Define following terms. **07**
1) Transfer function.
2) Maximum overshoot.
3) Damping ratio.
4) State.
5) Rise time.
6) State vector.
7) Settling time.

**Q.3** **(a)** Define steady state error. Derive the steady state error in terms of static error coefficients $K_p$, $K_v$ & $K_a$ & discuss for Type 0 system. **07**

**(b)** For unity feedback control system open loop transfer function $G(s) = 25/(s(s+5))$. Determine natural frequency of oscillations, damped frequency of oscillations, damping factor, damping ration, maximum overshoot for a unit step as input & steady state error for unit ramp input. **07**

**OR**

**Q.3** **(a)** Define the term stability. Explain the Routh Hurwitz criterion. Investigate the stability using RH criterion for closed loop control system having a characteristic equation given by $s^3 + 4.5s^2 + 3.5s + 1.5 = 0$. **07**

**(b)** Explain thermal system in brief. **07**

**Q.4** **(a)** Discuss the salient features of Root Locus Plot & Sketch the root locus & determine the value of K if $\zeta = 0.707$ for the open loop transfer function of a unity feedback control system $G(s) = K/(s(s+4))$ & comment on stability. **07**

**(b)** Draw the bode plot for system whose open loop transfer function is given by $G(s) = (2(s+0.25))/(s^2(s+1)(s+0.5))$.  Determine the Gain Margin & Phase Margin & Comment on stability. **07**

**OR**

**Q.4** **(a)** Draw the nyquist plot to examine the closed loop stability of a system whose open loop **07**
transfer function is given by
G(s) H(s) = 50/((s+1)(s+2)) .

**(b)** Define gain margin & phase margin. Draw the polar plot for G(s)H(s) =100/(s+2). **07**

**Q.5** **(a)** Discuss the correlation between transient response & frequency response. **07**
**(b)** What is analogous system? Explain force to current analogy with suitable example.
**OR**
**Q.5** **(a)** Explain standard test signals. **07**
**(b)** Write a short note on observability. **07**

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