Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – WINTER • 2014

Subject Code: 171701 **Date: 25-11-2014**

Subject Name: Control System Design

Time: 10:30 am - 01:00 pm **Total Marks: 70**

Instructions:

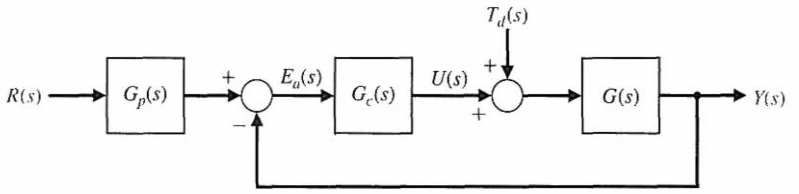
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** With suitable example discuss about stability of uncertain system. **07**

(b) Draw root locus and comment about stability for $kG(z)=\frac{k(z+0.8)}{(z-0.4)(z-0.2)}$ **07**

Q.2 **(a)** Discuss about design for deadbeat response of a linear system. **07**

(b) Consider a system given by **07**



If pre-filter is not available and $G(s)=\frac{1}{(s+1)^2}$,design to obtain optimum ITAE performance using PID controller. For design, Use characteristic equation $s^3+1.75\omega_n s^2+2.15\omega_n^2 s+\omega_n^3$ for the optimum coefficients.

OR

(b) With suitable example discuss PID control of a system with delay for robust design. **07**

Q.3 With bode plot design a suitable compensator for unity feedback system to meet following performance specifications. **14**

Natural frequency $t_s \leq 4$ sec and Peak overshoot $\leq 20\%$.

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

OR

Q.3 Design a suitable compensator in time domain for unity feedback system to meet following performance specifications. **14**

Natural frequency t_s=10 sec, Damping factor ζ=0.4 and $K_v \geq 5$ sec^{-1}.

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

Q.4 **(a)** Using suitable example explain full state observer design. **07**

(b) Write a note on pseudo-quantitative feedback system. **07**

OR

Q.4 **(a)** A System is presented by differential equation $\dddot{y}+5\ddot{y}+3\dot{y}+2y=u$ **07**

Design the Full State feedback control system and determine state feedback

vector 'K'. Take ζ = 0.8, and ω_n=6. Step response should have no overshoot and settling time of less than 1 second for 2% tolerance band.

(b) Derive z domain transfer function of PI controller using forward-rectangular difference rule and discuss implementation of it. **07**

Q.5 **(a)** Check the controllability of the system given with state matrices as **07**

$$A=\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -9 & -4 & -5 \end{bmatrix},\ B=\begin{bmatrix} 0 \\ 1 \\ 2 \end{bmatrix}, C=\begin{bmatrix} 1 & 1 & 2 \end{bmatrix}$$

(b) Write a note on robust internal model control system. **07**

OR

Q.5 **(a)** Check the observability of the system given with state matrices as **07**

$$A=\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -5 & -3 & -5 \end{bmatrix},\ B=\begin{bmatrix} 2 \\ 2 \\ 1 \end{bmatrix}, C=\begin{bmatrix} 1 & 2 & 3 \end{bmatrix}$$

(b) Give difference between phase lead, phase lag and phase lag-lead Compensation. **07**

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