Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII EXAMINATION – SUMMER 2016

Subject Code:171701 **Date:16/05/2016**

Subject Name:Control System Design

Time:02:30 PM to 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)** Explain controllability and observability with suitable example. **07**

(b) Draw the root locus in z plane. And also comment on stability of system. **07**

$$G(z)=\frac{K(Z+1)}{(Z-1)^2}$$

Q.2 **(a)** Obtain full state feedback controller gain matrix K to place desired poles at s_1= -2+j and s_2= -2-j for the system given below, **07**

$$A=\begin{bmatrix}0 & 1\\ 0 & 0\end{bmatrix},\ B=\begin{bmatrix}0\\ 1\end{bmatrix}$$

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

OR

(b) Explain optimal control for full state feedback control. **07**

Q.3 **(a)** Find the Z - Transform and ROC if $X(n)= -n\, a^n u(-n)$ **07**

(b) Find inverse Z transform of **07**

$$X(z) = \frac{1}{(1+z^{-1})(1-z^{-1})^2}$$

OR

Q.3 **(a)** Find the Z - Transform of $x(n) = a^n (\cos w_0 n)u(n)$ **07**

(b) Determine causal signal x(n) if z transform is given by **07**

$$X(z)=\frac{1+3z^{-1}}{1+3z^{-1}+2z^{-2}}$$

Q.4 Design a suitable compensator in time domain to meet following specification for the given transfer function. **14**

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

Specifications are

1. Damping ration =0.5
2. Settling time ts ≤ 10 sec
3. Kv≥ 5 sec^{-1}

OR

Q.4 Design a suitable compensator in frequency domain to meet following specification for the given transfer function. **14**

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

Specifications are

1. Phase margin ≥ 45
2. Kv≥ 10 sec^{-1}

Q.5 **(a)** Explain design of a dead beat response of a system. **07**

(b) Explain the compensator design with integrated full-state feedback and observer. **07**

OR

Q.5 **(a)** For a second order system described as under, **08**

$A = \begin{bmatrix} 0 & 1 \\ 0 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ design optimal feedback controller using Ricatti's equation for R= [1] and $Q = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$

(b) Explain closed loop control with digital computer compensation. **06**

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