Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII(OLD) • EXAMINATION – WINTER 2016

Subject Code: 171701 **Date: 29/11/2016**

Subject Name: Control System Design

Time: 10:30 AM to 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) Write short note on linear quadratic regulator **07**

(b) Write short note on a system with a prefilter. **07**

Q.2 (a) Develop the state model for Cart and Inverted pendulum system. Choose cart position, velocity and pendulum angular position and velocity as state variable and cart position as output. (Make necessary assumption and mention it.) **07**

If following are the system parameters(as per usual meaning):

$\ell = 0.08$ m , g = 9.8 m/s^2 , m = 0.725 kg , M = 9.015 kg

Then find T.F. and roots of system.

(b) Define controllability and observability. Find controllability and observability of the system given with state matrices as **07**

$$A = \begin{bmatrix} 2 & 5 & 0 \\ 1 & 0 & 7 \\ -6 & -14 & -25 \end{bmatrix},\ B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, C = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$$

OR

(b) For above question 2(b), Design a suitable State feedback controller gain matrix K to obtain desired response of zeta=0.45 and settling time=1.3 seconds using Ackerman's gain formula **07**

Q.3 (a) Design a suitable compensator using Root locus for the system defined by as below. Draw the both -compensated and uncompensated root locus. **07**

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

Which satisfy following specifications

Settling time $\leq$ 3.5 sec (2% tolerance band)

Peak Overshoot for step input 15%.

(b) Explain feedback system design with integration networks. **07**

OR

Q.3 (a) Write short not on a dead beat response. **07**

(b) Design a suitable compensator in frequency domain for unity feedback system to meet following performance specifications. **07**

Settling time Kv $\geq$5 Sec^{-1} , phase margin $\geq 43^o$, W_b=1.02 rad/sec

$$G(s) = \frac{5}{s(s+1)(0.25s+1)}$$

Q.4 (a) Write short note on sampled data system in details. **07**

	(b)	Find the z-transform of the output for the linear discrete system described below. Take $r(k) = 0$ and $c(k) = 0$ for $k < 0$. $c(k+2) + a_1 c(k+1) + a_2 c(k) = b_0 r(k+2) + b_1 r(k+1) + b_2 r(k)$.	**07**
		OR	
Q.4	**(a)**	Explain closed loop systems with digital computer compensation.	**07**
	(b)	Define Inverse Z transform and determine the z-transforms of the following finite duration signals. (1) $x_1(n) = \{3,4,\underline{\underline{5}},7,0,1\}$ (2) $x_3(n) = \delta(n+k)$;k>0 (3) $x_4(n) = \{0,1,2,5,7,0,3,0,\underline{\underline{0}}\}$	**07**
Q.5	**(a)**	Write short note on the robust internal model control system.	**07**
	(b)	Explain design of a robust PID controlled systems.	**07**
		OR	
Q.5	**(a)**	Explain pseudo quantitative feedback system in details.	**07**
	(b)	Write short note on a systems with uncertain parameters.	**07**

****