

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE SEMESTER 7 EXAMINATION – SUMMER 2018**

**Subject Code: 171701****Date: 08-05-2018****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 Robust Internal Model control system in detail. **07**  
(b) Explain controllability and observability with suitable example. **07**

- Q.2** (a) Explain linear quadratic regulator in detail. **07**  
(b) Find the Z - Transform and ROC of  $X(n) = -n a^n u(-n)$  **07**

**OR**

- (b) Determine inverse z transformation using partial fraction expansion **07**

$$X(z) = \frac{1 + z^{-1}}{1 - z^{-1} + 0.5 z^{-2}}$$

- Q.3** (a) Design a suitable compensator in time domain to meet following specification **10**  
for the given transfer function.

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

The specifications are,

1. Damping ratio  $\zeta = 0.5$
2. Settling time  $t_s \leq 10$  sec
3.  $K_v \geq 5$  sec<sup>-1</sup>

- (b) Define: dead beat response **04**

**OR**

- Q.3** (a) Design a suitable compensator in frequency domain to meet following **10**  
specification for the given transfer function.

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

Specifications are

1. Phase margin  $\geq 45$
2.  $K_v \geq 10$  sec<sup>-1</sup>

- (b) Write short note: Zero Order Hold **04**

- Q.4** (a) Define controllability and observability. Find controllability and **07**  
observability of the system given with state matrices as

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

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

**OR**

- Q.4** (a) Explain design of Robust PID control system in detail. **07**  
(b) Explain optimal control for full state feedback control. **07**

- Q.5** (a) Explain closed loop control with digital computer compensation. **07**  
(b) Write short note on systems with uncertain parameters. **07**

**OR**

- Q.5** (a) Define Inverse Z transform and determine the z-transforms of the following finite duration signals. **07**
- (1)  $x_1(n) = \{3, 4, \underline{5}, 7, 0, 1\}$
- (2)  $x_2(n) = \delta(n+k) ; k > 0$
- (3)  $x_3(n) = \{0, 1, 2, 5, 7, 0, 3, 0, \underline{0}\}$
- (b) Explain feedback system design with integration networks. **07**

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