Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) - EXAMINATION – SUMMER 2016

Subject Code: 2161707 Date: 06/05/2016

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)** For a series RLC circuit, derive the state space model with following variable values. And also check the controllability and observability. **07**

R = 1 ohm, C= 1 Farad, L=1 H.

(b) For the given transfer function derive state space model and matrices A, B, C using cascade and parallel decomposition. **07**

$$G(s) = \frac{1}{(s+1)(s+2)(s+3)}$$

Q.2 **(a)** Explain dead beat response with suitable example. **07**

(b) Derive the state transition matrix for given matrix A. **07**

$A = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}$ and also prove its properties.

OR

(b) Compare merits and demerits of convential control theory versus modern control theory. **07**

Q.3 Design a suitable compensator in time domain for the open loop transfer function to meet the following specifications. **14**

$$G(s) = \frac{K}{s(s+2)}$$

1. Damping ratio=0.707
2. Settling time $\leq$ 5 sec
3. Kv $\geq$ 4

Implement the compensator using electronic circuit.

OR

Q.3 Design a suitable compensator in frequency domain for the open loop transfer function to meet the following specifications. **14**

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

1. Phase margin $\geq$ 40
2. Kv $\geq$ 5

Implement the compensator using electronic circuit.

Q.4 Determine the optimal feedback gain matrix K using ricatti's equation so that performance index J is minimize. Where **14**

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

And also obtain desired pole location for u=1.

OR

Q.4 **(a)** Explain optimal control with suitable example. **07**

(b) Explain Lyapunav stability criteria with suitable example. **07**

Q.5 **(a)** Explain Robust PID controller. **07**

(b) Explain robustness of the system with reference to system sensitivity. **07**

OR

Q.5 **(a)** For the plant equation given by dx/dt = Ax + Bu where **07**

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

Obtain desire feedback gain matrix K to place closed loop poles at s = -2 + 4j,

s = -2 - 4j and s = 10.

(b) Write a short note on full state observer design. **07**

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