Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E. SEMESTER I (old course)–EXAMINATION (Remedial) – WINTER 2015

Subject code: 710703 **Date: 10/12/2015**

Subject Name: Modern control System

Time: 10:30 AM to 1:00 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) Attempt following.

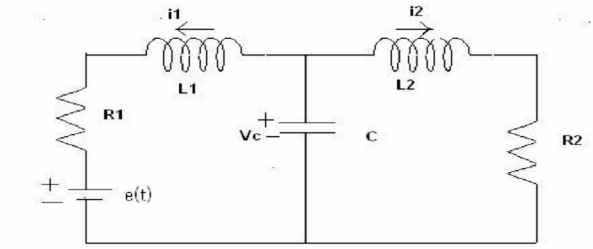
1. Find The Eigen values and corresponding Eigen vector of the following matrix. 07

$$A=\begin{bmatrix} -1 & -3 \\ 0 & 2 \end{bmatrix}$$

2. Define following terms related to state space analysis
   1.State
   2.State Variables
   3.State Vector
   4.State Space

(b) Define and explain state transition matrix and list the useful properties of it. 07

Q.2 (a) Obtain the state model of the system given in Figure 1. Consider the state variables as i_1 , i_2 and v_c 07



(b) Prove that the Eigen values are invariant under a linear transformation. 07

OR

(b) With neat block diagram representations discuss cascade decomposition method. 07

Q.3 (a) Write a short note on advantages and limitations of state variable approach. 07

(b) Explain the principle of duality that clarify apparent analogy between controllability and observability. 07

OR

Q.3 (a) Obtain State Transition matrix associated with the state matrix 07

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

(b) Obtain the state equation for the close loop unity feedback system if the feed forward transfer function is given by 07

$$\frac{Y(s)}{U(s)} = \frac{1}{(s+2)(s+3)(s+4)}$$

Use Parallel decomposition method.

Q.4 (a) Explain the method of determining stability by applying Liapunovôs direct method 07

(b) Define óState Controllabilityô. A system is defined as 07

$$\dot{x} = \begin{bmatrix} 0 & 4 \\ 1 & 3 \end{bmatrix} x + \begin{bmatrix} 2 & 4 \\ -1 & -2 \end{bmatrix} u$$ Check its controllability.

OR

Q.4 (a) State the Observability and also derive the condition for checking the same for a given system. 07

(b) Define the following (support your answer with suitable figures) 07

1.Asymptotic Stability in the sense of Lyapunov

2.Exponential stability in the sense of Lyapunov

3.Asymptotic stability in large

Q.5 (a) Discuss the necessary and sufficient condition for state observation and hence write the procedure for designing a full state observer. 07

(b) Explain positive definite, positive semi definite and indefinite function 07

OR

Q.5 (a) Define asymptotic stability and also check for the asymptotic stability of the system given by 07

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

(b) Explain the pole placement method for SISO LTI system using Ackermannôs method. 07

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