

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VIII (NEW) EXAMINATION – WINTER 2017

Subject Code: 2180913

Date: 10/11/2017

Subject Name: Advanced Control Systems(Departmental Elective - III)

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) What are the advantages of state space modeling technique over the transfer function modeling technique in control system analysis? **03**

(b) With neat block diagram representations discuss cascade decomposition **04**

(c) Determine the necessary and sufficient condition for a system to be completely state controllable using Kalman's Controllability test. **07**

Q.2 (a) Define the terms State Variable and State Transition Matrix. **03**

(b) Explain State Space Representation of Nth Order Linear Differential Equation **04**

(c) Explain why do we need state variable approach to control system analysis? How it is superior to classical approach? **07**

OR

(c) Explain Cayley Hamilton Theorem and discuss how it can be used to find the state transition matrix. **07**

Q.3 (a) Write and prove the properties of State Transition Matrix (STM). **03**

(b) Explain Pell's Method in Phase Plane Analysis **04**

(c) Discuss the concept of Kalman's controllability and observability test in detail. **07**

OR

Q.3 (a) When is a system said to be completely controllable? **03**

(b) Explain Lienard's Method in Phase Plane Analysis **04**

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

Q.4 (a) Explain Cascade decomposition method. **03**

(b) Obtain a state space model of the system with transfer function **04**

$$\frac{Y(s)}{U(s)} = \frac{6}{s^3 + 6s^2 + 11s + 6}$$

(c) Prove that the necessary and sufficient condition for arbitrary pole placement is that the system is completely state controllable. **07**

OR

Q.4 (a) Explain the design procedure of a full state observer. **03**

(b) Discuss basic feature of following non linearities 1).non linear friction 2).on off controller **04**

(c) Use Krasovski's theorem to show that the equilibrium state $x=0$ of system described by **07**

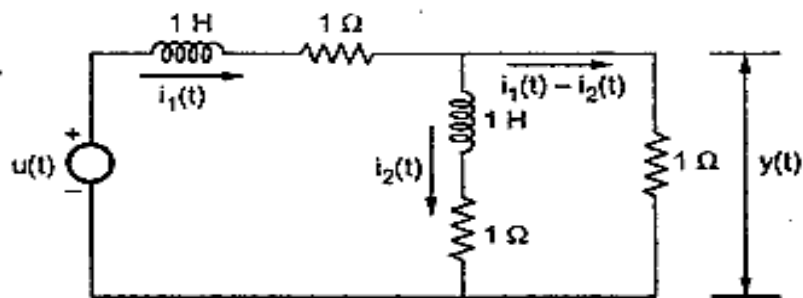
$$\begin{aligned}\dot{x}_1 &= -3x_1 + x_2 \\ \dot{x}_2 &= x_1 - x_2 - x_2^3\end{aligned}$$

Is asymptotically stable in the large.

Q.5 (a) Explain the construction of a phase trajectories by delta method **03**

(b) Explain Liapunov's second method and his stability theorem. **04**

- (c) For the network show in figure-1, choosing $i_1(t)=x_1(t)$ and $i_2(t)=x_2(t)$ as state variables, obtain the state equation and output equation in vector matrix form. **07**



OR

- Q.5 (a) Explain positive definite, positive semi definite and indefinite function **03**
 (b) Discuss necessary and sufficient condition for state observation **04**
 (c) What are the singular points? Explain different singular points adopted in non linear control system? **07**
