

**B.TECH SEM – VI (2007 COURSE) (ELECTRICAL ENGG.)  
: WINTER - 2017**

**SUBJECT: MODERN CONTROL SYSTEMS**

Day: **Thursday**  
Date: **23/11/2017**

Time: **10.00 AM TO 01.00 PM**  
Max Marks. 80

**W-2017-2512**

**N.B.**

- 1) **Q. No. 1 and Q. No. 5 are COMPULSORY.** Out of remaining questions attempt any **TWO** questions from each section.
- 2) Figures to the right indicate **FULL** marks.
- 3) Draw neat and labeled diagrams **WHEREVER** necessary.
- 4) Assume suitable data if necessary.
- 5) Answer to both the sections should be written in the **SEPARATE** answer book.

**SECTION - I**

**Q.1 a)** Derive the relationship between the state equation, output equation and the transfer function of a feedback control system. **(05)**

**b)** Define and explain the state transition matrix. State and prove the properties of state transition matrix. **(05)**

**c)** State and explain types of Non linearity. **(04)**

**Q.2 a)** Obtain Eigen Values, Eigen Vector and Model Matrix for **(07)**

$$A = \begin{bmatrix} -9 & 1 & 0 \\ -26 & 0 & 1 \\ -24 & 0 & 0 \end{bmatrix}$$

**b)** Obtain the transfer function of the system represented by the state space model. **(06)**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 5 \end{bmatrix} u; \quad y = [1 \quad 2] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

**Q.3 a)** Investigate the controllability and observability of the continuous time system represented by **(07)**

$$\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & -1 & 1 \\ 0 & 0 & 4 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u, \quad y = [1 \quad 0 \quad 0] x$$

**b)** Determine the state transition matrix of the state equation. **(06)**

$$\dot{X} = \begin{bmatrix} 1 & 4 \\ -2 & -5 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

**Q.4 a)** Discuss different types of Singular points that occur in phase plane method. **(05)**

**b)** Explain isocline method for constructing phase plane trajectory. **(04)**

**c)** Explain the terms : **(04)**

- i) Phase plane
- ii) Phase plane plot
- iii) Phase plane Trajectory
- iv) Phase plane portrait

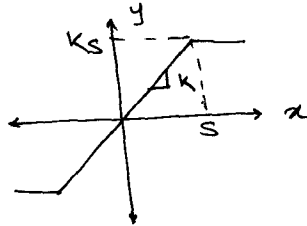
## SECTION - II

Q.5 a) Compare phase plane method with describing function method for stability analysis of none near system (06)

b) Define 'Z transform and its significance digital control system. (04)

c) What are the advantages and limitations of discrete time system over continuous time system? (04)

Q.6 a) Derive describing function of (07)



Draw input and output wave terms.

b) What is limit cycle? With simple sketches explain different types of limit cycles? (06)

Q.7 a) Find  $G(Z)$  for (04)

$$G(S) = \frac{s+4}{(s+2)(s+5)}$$

b) State and explain Shannon's sampling Theorem. (04)

c)  $y(k+2) + 3y(k+1) + 2y(k) = u(k)$  (05)  
 $y(0) = 1$   $y(k) = 0$  for  $k > 0$   
 Find  $y(k)$

Q.8 a) Determine range pf K for stability by Jury's test for (07)

$$G(Z) = \frac{K(0.3679Z + 0.2642)}{(Z - 0.3679)(Z - 1)}$$

b) Obtain pulse transfer function (06)