B.TECH SEM – VI (2007 COURSE) (ELECTRICAL ENGG.) :
SUMMER - 2018
SUBJECT: MODERN CONTROL SYSTEMS

Day: **Friday** | **S-2018-2717** | Time: **02.30 PM TO 05.30 PM**
Date: **08/06/2018** | Max Marks: 80

N.B:

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

SECTION-I

Q.1 **a)** What is Jordan Canonical form? Explain with example. **(04)**
b) State Cayley Hamilton Theorem **(04)**
c) State three different types of nonlinearity .Sketch it with its input and output waveforms. **(06)**

Q.2 **a)** Obtain state model by direct decomposition of system with transfer function **(07)**
$\frac{Y(s)}{U(s)} = \frac{(5s^2+6s+8)}{s^3+3s^2+7s+9}$.

b) A system is represented by the following state and output equations. **(06)**
Find poles of the system
$\dot{X} = \begin{bmatrix} -3 & -2 \\ -1 & -2 \end{bmatrix} X + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(t),\ Y = [1 \quad 2] X$.

Q.3 **a)** Find controllability and observability of the state model **(08)**
$A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix},\ B = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix},\ C = [1 \quad 1 \quad 1],\ D = 0$.

b) State Gilbert's test for controllability and observability. **(05)**

Q4 **a)** Show different types of singular points and phase plane trajectory. **(06)**
b) Describe limit cycle phenomenon in phase plane method. **(07)**

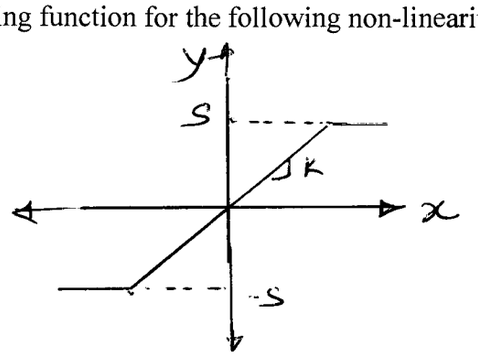
SECTION-II

Q5 **a)** Compare describing function method with phase plane method for stability analysis of non-linear systems. **(05)**

b) Calculate z transform of **(05)**
(i) $e^{-at} \sin\omega t$ (ii) a^n

c) State initial and final value theorem for z transform. **(04)**

Q.6 **a)** Derive describing function for the following non-linearity. **(08)**



b) Explain limit cycle using describing function analysis. **(05)**

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Q.7 **a)** Find the solution of **(07)**

$c(k+2) + 3c(k+1) + 2 = r(k)$

$r(k) = 0$ for $k = 0$

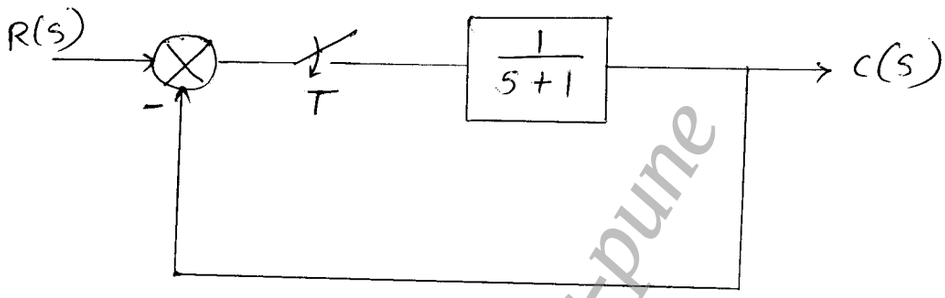
$r(k) = 1$ for $k > 1$

$c(1) = 0$

b) Draw block diagram of discrete time system and explain function of each block. State advantages of it over continuous time system. **(06)**

Q.8 **a)** Solve $2z^4 + 7z^3 + 10z^2 + 4z + 1 = 0$. Use Jury's stability test. **(06)**

b Write pulse transfer function C(z)/R(z) for the given system. **(07)**



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