Registration No: | | | | | | | | | | |

Total Number of Pages: 01 **M.TECH**
P2AECC08

2nd Semester Regular Examination 2016-17
Non-Linear Systems
BRANCH: APPLIED ELECTRONIC & INSTRUMENTATION ENGG, ELECTRONIC & INSTRUMENTATION ENGG

Time: 3 Hours
Max Marks: 100
Q-Code: Z832

Answer Question No.1 which is compulsory and any FOUR from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: ***Short answer type*** **(2 x 10)**

a) What are the inherent non-linearities?
b) What is limit cycle?
c) What is phase-plane?
d) Differentiate among phase trajectory and phase portrait.
e) What is phase plane and the limitation of phase-plane method ?
f) Define Describing function?
g) Differentiate between relative and absolute stability.
h) What is the specific features of Liapunov's function?
i) What is the importance of Circle criterion?
j) What do you mean by positive definite and positive semi-definite functions?

Q2 **a)** Discuss in detail about type of non-lineraities. **(10)**
b) Explain jump phenomena and critical jump resonance curve **(10)**

Q3 **a)** How phase-plane is constructed using Isocline method. **(10)**
b) Draw phase-plane for following non-linear equations **(10)**

$dx_1/dt = x_2 - x_1(x_1^2 + x_2^2 - 1)$
$dx_2/dt = -x_1 - x_2(x_1^2 + x_2^2 - 1)$

Q4 **a)** Find describing function for Dead-zone non-linearity. **(10)**
b) Derive describing function for Relay with dead zone. **(10)**

Q5 **a)** What is Popov Criterion? What is its limitation? **(10)**
Differentiate between Popov and Circular criterion.
b) Verify Popov criterion for stability and obtain conditions for unknown element. **(10)**

$$A = \begin{matrix} 0 & 2 \\ \alpha & 6 \end{matrix} \qquad B = \begin{matrix} 0 \\ -1 \end{matrix} \qquad C = [1 \quad 0]$$

Q6 **a)** Determine stability of the system for an autonomous system. **(10)**
Find Liapunov Function for +ve definite for following linear system matrix

$$A = \begin{matrix} -1 & -2 \\ 2 & -4 \end{matrix}$$

b) Discuss how Lipunov's method is explained by four theorms. **(10)**

Q7 **Write short notes on any two.** **(10X2)**

a) Delta Method of Phase trajectory construction.
b) Construction of Liapunov's function for Non-linear system
c) Describing Function of Saturation Non-linearity