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**B.Tech. (Sem. - 7<sup>th</sup> / 8<sup>th</sup>)**

**NON LINEAR AND DIGITAL CONTROL SYSTEMS**

**SUBJECT CODE : EE - 404**

**Paper ID : [A0430]**

[Note : Please fill subject code and paper ID on OMR]

**Time : 03 Hours**

**Maximum Marks : 60**

**Instruction to Candidates:**

- 1) Section - A is **Compulsory**.
- 2) Attempt any **Four** questions from Section - B.
- 3) Attempt any **Two** questions from Section - C.

**Section - A**

**Q1)**

**(10 x 2 = 20)**

- a) Define state of a system.
- b) What are the differences between linear system and non-linear system?
- c) State the conditions for completely controllable system.
- d) What is meant by singular points? Mention their importance.
- e) State disadvantages of digital control system.
- f) Find the Z transform of  $F(s) = 4/s^2 + 4$ .
- g) Define describing function.
- h) What do you mean by the problem of aliasing?
- i) Give significance of zero order hold device.
- j) What is meant by adaptive control?

## Section - B

(4 x 5 = 20)

Q2) Obtain the time response of the following system

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

where  $u(t)$  is a unit step occurring at  $t = 0$  and  $x^T(0) = [1 \ 0]$

Q3) Consider  $\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$ ,  $y = [1 \ 1 \ 0]x$

Investigate observability of system.

Q4) State and explain Liapunov's main stability theorem.

Q5) What are sample and hold circuits? Obtain the transfer function and frequency response of zero order hold.

Q6) State and explain Jury's stability test.

## Section - C

(2 x 10 = 20)

Q7) (a) What is state transition matrix? List out the properties and advantages of state transition matrix.

(b) Consider the system described by the equations

$$\dot{x}_1 = x_2$$

$$\dot{x}_2 = -x_1 - x_2 + 2$$

Investigate the stability of the equilibrium state. Use the direct method of Lyapunov.

Q8) (a) Derive describing function of a relay with dead zone and hysteresis.

(b) Discuss the applicability of Routh Hurwitz criterion to discrete time systems.

Q9) Write short notes on :

(a) Controllability.

(b) Krasovskii's theorem.

