Printed Pages: **Sub Code: PEE-22**

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M.TECH
(SEM-II) THEORY EXAMINATION 2017-18
ADVANCED CONTROL SYSTEM

Time: 3 Hours ***Total Marks: 100***

Note: **1.** Attempt all Sections. If require any missing data; then choose suitably.
2. Any special paper specific instruction.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a. What are the advantages of state space analysis?
b. What are the properties of state transition matrix?
c. What are linear system and non linear system give example?
d. Explain sufficient conditions for stability?
e. Discuss the concept of formulation of the optimal control problem?
f. What is intelligent control?
g. What is need for observability test?
h. Define controllability?
i. Define asymptotic stability?
j. What is singular point?

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. Derive the expression for n^{th} order system characteristic polynomial when conversion takes place from state variable model to transfer function model.
b. A system characterized by following state space equation:

$$A=\begin{bmatrix}-3 & 1 & 1\\ -1 & 0 & 1\\ 0 & 0 & 1\end{bmatrix}, B=\begin{bmatrix}0 & 1\\ 0 & 0\\ 2 & 1\end{bmatrix}\ C=\begin{bmatrix}0 & 0 & 1\\ 1 & 1 & 0\end{bmatrix}$$

Investigate its controllability and obsrevability.
c. Find the lyapunov function for the following system:

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}-1 & 1\\ 2 & -4\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

d. Discuss linearization of non-linear system.
e. Write short notes on: (i) deadzone non linearity (ii) saturation non linearity

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

(a) Write the statement of sampling theorem. Draw the block diagram representation of S/H device.
(b) Using Liapunov method investigate the stability of the following system

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

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) Define optimal control for performance index. Write the performance indices of minimum time, minimum fuel, and minimum energy.

(b) Discuss relationship between Z-domain and S-domain.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) Explain the concept of stability in Z- plane.

(b) Discuss (i) limit cycle (ii) jump resonance

6. Attempt any *one* part of the following: 10 x 1 = 10

(a) Derive the Gilbert's test for checking observability and controllability of the system

(b) What is adaptive control? What are the schemes in adaptive control? Discuss in brief.

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) Explain how to study the stability of the system through describing function analysis.

(b) Explain jury stability criterion. Consider characteristic polynomial: **$F(Z) = 2Z^4 + 7Z^3 + 10Z^2 + 4z + 1$.** Check stability of this system.