Hall Ticket Number:

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VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

M.E. (EEE: CBCS) II-Semester Main Examinations, July-2017

(Power Systems & Power Electronics)

Modern Control Theory

Time: 3 hours Max. Marks: 70

*Note: Answer **ALL** questions in **Part-A** and any **FIVE** from **Part-B***

Part-A (10 × 2 = 20 Marks)

1. Write short note on Single input and Single output systems (SISO).
2. Explain controllable companion forms.
3. What is phase plane analysis?
4. Briefly discuss isocline method.
5. Discuss generation of Liapunov functions.
6. Define concept of stability.
7. Write notes on Formulation of optimal control problems.
8. Discuss about behavior of dynamic systems.
9. Sketch the block diagram of adaptive control system.
10. Explain the importance of Liapunov stability theory in adaptive control.

Part-B (5 × 10 = 50 Marks)

11. a) Is the following system completely state controllable? [5]

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}-1 & -2 & -2\\ 0 & -1 & 1\\ 1 & 0 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}2\\ 0\\ 1\end{bmatrix}u, \quad [Y] = [1\ 1\ 0]\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$

b) Examine the observability of the given system. [5]

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 0 & -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 0\\ 1\end{bmatrix}U = AX + BU, \quad [Y] = [3\ 4\ 1]\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} = CX$$

12. a) Describe in detail about Jump resonance with neat diagram [5]

b) Write short notes on the following:

i) Measurement of time on phase plane trajectories. [3]

ii) Sub harmonic oscillations. [2]

13. a) List out the characteristics of Liapunov's first method. [5]

b) Consider a non-linear system described by the equations: [5]

$$\dot{x}_1 = -3x_1 + x_2$$

$$\dot{x}_2 = -x_1 + x_2\, x_2^3$$

By using the Krasoviskii's method, investigate the stability of the system.

Contd... 2

14. a) Explain Jacobi bellman equation & Potryagins minimum principle in detail. [5]

b) Consider a system described by the equations [5]

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

$x_1(O) = x_2(O) = 1$

Chose the feedback law

$u = -x_1 - kx_2$

Find the value of k so that

$J = \frac{1}{2}\int_0^\infty (x_1^2 + x_2^2)\,dt$ is minimized.

15. a) Explain M/T rule and Liapunov stability theory in adaptive control. [5]

b) Drive the identification of the dynamic characteristics of the plant. [5]

16. a) Describe the determination of matrix K using Ackermanns formula technique by pole placement method. [5]

b) Discuss the phase plane analysis by singular points method. [5]

17. Answer any ***two*** of the following:

a) Discuss about variable gradient method. [5]

b) Find the optimal control value using Hamiltonian method [5]

$J(x) = \int_0^{\pi/4} (x_1^2 + \dot{x}_2^2 + \dot{x}_1\dot{x}_2)dt$

The boundary conditions are $x_1(0) = 0;\ x_1(\frac{\pi}{4}) = 1;\quad x_2(0) = 0;\quad x_2(\frac{\pi}{4}) = -1$

c) Explain adaptive control system using Liapunov stability theorem. [5]