Hall Ticket Number:

Code No.: 7215 M

VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

M.E. I Year (EEE) II-Semester (Make Up) Examinations, August-2016

(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 X 2=20 Marks)

1. What is a state-transition matrix?
2. Explain the SISO with neat sketch.
3. What are singular points?
4. What is describing function?
5. Define the stability in the sense of Lyapunov.
6. Discuss the variable gradient method.
7. Define the principle of optimality.
8. List the different types of optimal control problems.
9. What is an adaptive control?
10. List the types of adaptive control.

Part-B (5 × 10 = 50 Marks)

(All bits carry equal marks)

11. a) Explain the concepts of state, state variables, state model and state diagram with suitable examples.
    b) State the duality between controllability and observability.
12. a) What are the various types of non-linearities that occur in control systems?
    b) Describe the measurement of time on phase plane trajectories.
13. a) Consider the 2nd order system described by

$$\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \end{bmatrix} = \begin{bmatrix} 5 & 8 \\ 10 & 12 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

    The equilibrium state is the origin. Determine the stability of the system using Lyapunov's method.
    b) Explain Lyapunov stability and instability with their details.
14. a) Find the optimal control value using Hamiltonian method

$$J = \frac{1}{2}\int_0^{\pi/4} (x_1^2 + \dot{x_2}^2 + \dot{x_1}\,\dot{x_2})dt$$

    The Boundary Conditions are $x_1(0)=0$, $x_1(\pi/4)=1$, $x_2(0)=0$, $x_2(\pi/4) = -1$.
    b) What is the procedure followed for solving optimal control problem using Hamilton-Jacobi method?
15. a) Write the details of the modern reference adaptive control.
    b) A nonlinear system governed by the equations given $\dot{x}_1 = -x_1 + 2x_2^1 x_2$, $\dot{x}_2 = -x_2$
    Given data $V = x_1^2 + x_2^2$ and prove that $\frac{DV}{dt}$ is negative definite.
16. a) Explain the concept of pole placement by state feedback.
    b) Compare the isocline and delta methods with their details.
17. Write short notes on any **two** of the following:
    a) Asymptotic Stability
    b) Pontryagins minimum principle.
    c) Lyapunov stability criterion.

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