

Code No: A4903, A4303/C4903, C4210, C4303

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech I Semester Examinations, March/April-2011

MODERN CONTROL THEORY

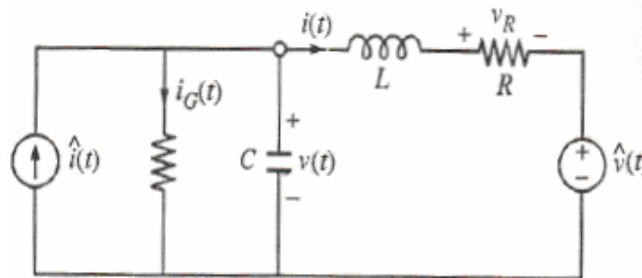
(COMMON TO ELECTRICAL POWER ENGINEERING, POWER ELECTRONICS, POWER AND INDUSTRIAL DRIVES)

Time: 3hours

Max. Marks: 60

Answer any five questions
All questions carry equal marks

- Explain the concepts of state, state variables, state model and state diagram with suitable examples.
 - What are the advantages and disadvantages of state space analysis. [8+8]
- Derive the solution of Non-homogeneous state equations.
 - Obtain the state model of the electrical network shown in figure by choosing minimum number of state variables [8+8]



Figure

- Define controllability and observability. Give the Kalman Test for both of them.
 - Consider a system having transfer function $G(s) = \frac{2s+10}{s^2+5s+6}$. Write the controllable canonical form of representation of the system. [8+8]
- Explain the following nonlinearities i) Saturation and ii) Dead-zone.
 - Discuss the describing function analysis of non linear systems. [8+8]
- What are singular points and how are they classified. Sketch them and explain
 - Construct phase trajectory for the system described by the equation.

$$\frac{dx_2}{dx_1} = \frac{4x_1 + 3x_2}{x_1 + x_2}$$
 Comment on the stability of the system. [8+8]

Contd....2

::2::

6. a) Explain method of constructing Lyapunov functions by Krasooviski's method for non linear systems.
 b) Consider a non-linear system described by the equations:

$$\begin{aligned}\dot{x}_1 &= -3x_1 + x_2 \\ \dot{x}_2 &= -x_1 - x_2 - x_2^3\end{aligned}$$

By using the Krasoviskii method, investigate the stability of the system. [8+8]

7. a) Explain the method of control system design by pole placement.

- b) For the following system, the transfer function is given by $\frac{10}{s^3 + 3s^2 + 2s}$
 Design a state feedback controller, so that the poles of the above system placed at $-2, -1 \pm j1.2$. [8+8]

8. a) State and explain the principle of optimality.

- b) Obtain the Hamilton Jacobi equation for the system described by $\dot{x} = u(t)$, subjected to the initial condition $x(0) = x^0$ Find the control law that minimizes $J = \frac{1}{2}x^2(t_1) + \int_0^{t_1} (x^2 + u^2)dt$, t_1 specified. [8+8]
