NR/R09

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

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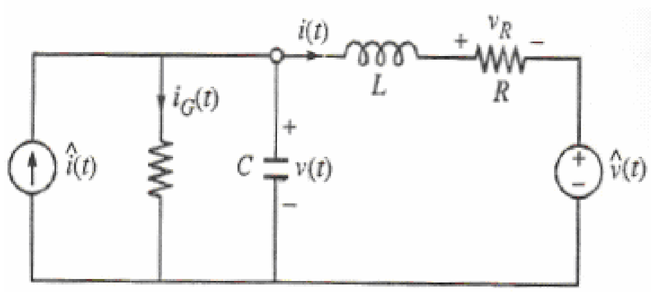
1. a) Explain the concepts of state, state variables, state model and state diagram with suitable examples.
   b) What are the advantages and disadvantages of state space analysis. [8+8]

2. a) Derive the solution of Non-homogeneous state equations.
   b) Obtain the state model of the electrical network shown in figure by choosing minimum number of state variables [8+8]



Figure

3. a) Define controllability and observability. Give the Kalman Test for both of them.
   b) 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]

4. a) Explain the following nonlinearties i) Saturation and ii) Dead-zone.
   b) Discuss the describing function analysis of non linear systems. [8+8]

5. a) What are singular paints and how are they classified. Sketch them and explain
   b) 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

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:

$$\dot{x}_1 = -3x_1 + x_2$$
$$\dot{x}_2 = -x_1 - x_2 - x_2^3$$

   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 $\dfrac{10}{s^3 + 3s^2 + 2s}$

   Design a state feedback controller, so that the poles of the above system placed at -2, -1 ± 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 $J = \dfrac{1}{2}x^2(t_1) + \int_0^{t_1}(x^2 + u^2)dt,\ t_1$ specified. [8+8]

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