Code No: 52120/MT

M.Tech. I-Semester Examinations, February-2007.

MODERN CONTROL THEORY
(Common to Power Electronics, Electrical Power Engineering and Power Engineering and Energy Systems)

Time: 3 hours **Max. Marks: 60**

Answer any FIVE questions
All questions carry equal marks
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1.a) Clearly explain the limitations of the classical control method. Define state, state variables and state space.
b) Develop the state model of Linear system and draw the block diagram of state model.

2.a) Derive the solution of homogeneous state equations.
b) Obtain the state model of the electrical network shown in figure below by choosing minimum number of state variables
fig.

3.a) State the duality between controllability and observability.
b) A Linear dynamical time invariant system represented by $\dot{x}$=Ax+Bu

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

Find if the system is completely controllable.

4.a) Discuss about the Jump resonance and subharmonic oscillations in non Linear systems.
b) Explain describing function of saturation non-Linearity.

5.a) Explain the stability analysis of non Linear systems using phase trajectories.
b) Draw the phase trajectory of the system described by the equation $\ddot{x} + \dot{x} + x^2 = 0$. Comment on the stability of the system.

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6.a) State and explain the Liapunov stability problem.

b) Consider the second order system described by

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

The equilibrium state is the origin. Determine the stability of the system using Liapunov's method.

7.a) What is the effects of Pole Placement by state feed back?

b) Consider the system defined by

$\dot{x}$ = Ax, y = Cx

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

Design a full order state observer. The desired eigen values for the observer matrix are μ_1=-5, μ_2=-5

8.a) What is the procedure followed for solving optimal control problem using Hamiton – Jacobi method?

b) Consider a system described by the equations

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

$x_1(0) = x_2(0) = 1$

Choose the feed back 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

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