Code No: I5614/R16

M. Tech. I Semester Regular Examinations, January-2017

MODERN CONTROL THEORY

Common to Power Systems(56),PSC &A(53),PSE(30),PS & C(31),ADV PS(50),EPE(60) Power Electronic (43),PI&D(42),PE & ED(54),PE & D (52),PE & S(12),EM & D(44), And Power Electronics & Power Systems (99)

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

Answer any FIVE Questions
All Questions Carry Equal Marks

1. a Derive the expressions for the general solution of non homogenous state space model. 6
   b Obtain the unit step response of the following system 6

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u(t)$$
$$X^T = [0 \quad 1]$$

2. a Derive the transfer function of armature controlled DC motor and draw its state block diagram. 6
   b derive the state space representation using phase variable for n number of state variables and draw its state diagram 6

3. Check the controllability and observability of the following system, and Convert the state model into the Jordan canonical form. 12

$$\dot{X} = \begin{bmatrix} -1 & 0 & 1 \\ 1 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix} X + \begin{pmatrix} 1 & 0 \\ 0 & 1 \\ -1 & 1 \end{pmatrix} U(t) \quad y(t)$$
$$= \begin{bmatrix} 0 & 1 & -1 \\ 1 & 2 & 1 \end{bmatrix} x(t)$$

4. a Derive the Ackerman's formula for 'Pole placement'. 4
   b Given the transfer function $\frac{Y(s)}{U(s)} = \frac{10}{S(S+1)(S+2)}$, design a feedback controller with a state feedback so that the closed loop poles are placed at -2, -1+ j. 8

5. a Explain the commonly occurred nonlinearities in the control system 5
   b Derive the describing function for the nonlinearity with dead-zone and saturation. 7

6. Draw the phase trajectory of the system described by the equation 12
   $\ddot{X} + \dot{X} + X^2 = 0$ Comment on the stability of the system.

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7. a Determine the stability of the following system using Lyapunov method. 8

$\dot{x}_1 = -x_1 + 2x_1^2 x_2$

$\dot{x}_2 = -x_2$

b Discuss the phenomena of Jump response. 4

8. Consider a nonlinear system described by the equations $\dot{x}_1 = -3x_1 + x_2$ $\dot{x}_2 = -x_1 - x_2 - x_2^3$ and investigate the stability of equilibrium state using Krasovskii's method. 12

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