Code: R7420202

R7

B.Tech IV Year II Semester (R07) Supplementary Examinations, March/April 2013

ADVANCED CONTROL SYSTEMS

(Electrical and Electronics Engineering)

Time: 3 hours Max Marks: 80

Answer any FIVE questions

All questions carry equal marks

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1 (a) Obtain the solution of state equations with input.

(b) Obtain state transition matrix for $\begin{bmatrix} -2 & 1 & 0 \\ 0 & -2 & 1 \\ 0 & 0 & -2 \end{bmatrix}$.

2 (a) Explain the concept of controllability and observability and explain how controllability and observability are evaluated by Kalman's test.

(b) Obtain observability canonical form for the state model.

$\dot{X} = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 3 \\ 1 & 1 & 1 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} U, Y = [1 \quad 1 \quad 0]X.$

3 Explain in detail behavior of non-linear systems and also explain various common physical non-linearities.

4 Consider a system with an ideal relays shown in figure (1). Determine the singular point. Construct phase trajectories, corresponding to initial conditions.
(i) $C(0) = 2, \dot{C}(0) = 1 \; and$ (ii) $C(0) = 2, \dot{C}(0) = 1.5$.
Take, r = 2 volts and M = 1.2 volts.

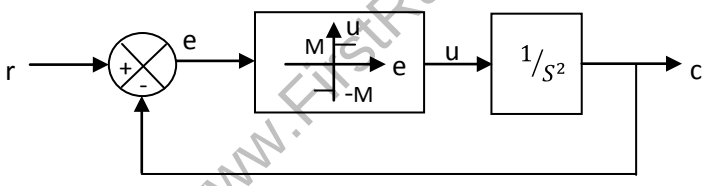

Figure: (1)

5 (a) State and prove Lyapunov's instability theorem.

(b) For the dynamics $\dot{x}_1 = x_2, \; \dot{x}_2 = -x_1^3 - x_2$, prove that the system is globally asymptotically stable using Lyapunov's function of the form, $v(x) = \alpha x_1^4 + \beta x_1^2 + x_1 x_2 + x_2^2$. What values of '$\alpha$' and '$\beta$' are appropriate?

6 Consider a linear system described by 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 ± j1.

7 (a) State and derive 'Euler Lagrangine equation'.

(b) Explain constraints of state variable inequality.

8 State and explain linear quadratic regulator (LQR) problem.

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