


FACULTY OF ENGINEERING

B.E. 4/4 (EE / Inst.) II – Semester (Main) Examination, May / June 2012

Subject : **Advanced Control Systems (Elective – II)**

Time : 3 hours

Max. Marks : 75

Note: Answer all questions from Part–A and answer any **FIVE** questions from Part–B.**PART – A (25 Marks)**

1. Define 'state'. How to choose state variables for a given system. 2
2. Write the state equation and the output equation of the following difference equation. 3

$$C(K=3) + 5 C(K+2) + 3 C(K+1) + 2 C(K) = u(K).$$
3. Define observability. 2
4. $\frac{C(S)}{R(S)} = \frac{S+4}{(S^2 3S+2)}$, Determine controllable canonical state model. 3
5. Define saddle point. 2
6. How to determine stability of a Non linear system? 3
7. Define stability in the sense of Liapunov. 2
8. Find the sign definiteness of the following functions. 3
 - i) $V(x) = -(x_1 + x_2)^2 - x_3^2$
 - ii) $V(x) = x_1^2 + x_2 x_3$
 - iii) $V(x) = (x_1 + x_2 - x_3)^2 + x_4^2$
9. Write different types of performance measures used in optimal control. 3
10. Define functions. 2

PART – B (50 Marks)

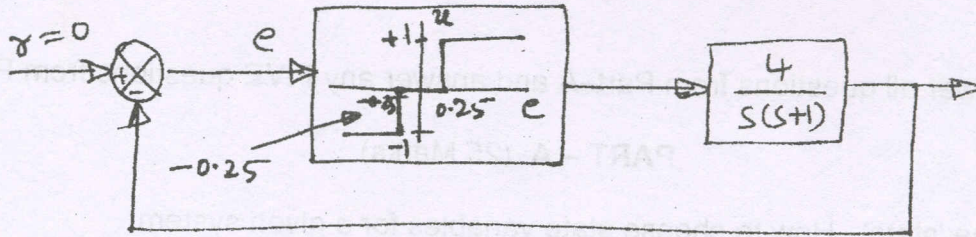
11. A linear time invariant system is characteristics by the non homogeneous state equation. 10

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

initial conditions $x_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$, determine the solution of the equation for step input.

- 12.a) State and prove necessary condition for poteplacement. 5

13. Draw the phase trajectories for the following system with initial conditions $c(0) = 2$, $\dot{c}(0) = 5$ using isocline method.



- 14.a) A non linear system is governed by the equations

5

$$\dot{x}_1 = x_2$$

$$\dot{x}_2 = -x_1 - x_2$$

Determine the stability of the system using Liapunov method.

- 15.a) State and prove fundamental theorem of calculus of variations.

5

- b) Determine the variation of the functional $J(x) = \int_0^1 x^2 dt$.

5

16. $\frac{C(s)}{R(s)} = \frac{S+3}{(S+1)(S+2)^2}$, obtain observable canonical form and Jordan

canonical forms state models.

10

17. Write short notes on :

- a) Common physical non linearities

5

- b) Formulation of optimal control problem.

5