Code No. 3187

FACULTY OF ENGINEERING

B.E. 4/4 (EE / Inst.) II-Semester **(Main)** Examination, May 2011

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

Time : 3 Hours Max. Marks: 75

Note: Answer **all** questions of Part - A and answer any **five** questions from Part-B.

PART – A (25 Marks)

1. $A = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$, determine e^{At}. (3)

2. Define State (2)

3. Define Observability (2)

4. $\frac{Y(s)}{U(s)} = \frac{1}{S^3 + 2S^2 + 2s + 1}$, determine controllable companion form. (3)

5. Define Subharmonics (2)

6. Define singular point (3)

7. Determine sign definiteness of the following scalar functions. (3)

   (a) $V(x) = x_1^2 + x_2^2 - x_3^4$

   (b) $V(x) = (x_1 + x_2)^2 + x_3^2$

   (c) $V(x) = x_1^2 + x_2^4 + x_3^6$

8. Define stability in the sense of Liapunov (2)

9. Define "admissible control" (2)

10. Define Variation (3)

PART – B (5x10=50 Marks)

11. Given the state equations of a linear system as (10)

$$\frac{dx(t)}{dt} = Ax(t) + Bu(t)$$

with u(t) = u(KT) = constant for $KT \le t < (K+1)T$.

The system is discrete resulting in the following discrete data state equation.
Determine data state equation

$$x[(K+1)T] = \phi(T)\, x(KT) + \theta(T) u(KT)$$

Determine $\phi(T)$ & $\theta(T)$

for $A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$.

12.(a) State and prove necessary condition for pole placement. (5)

(b) A discrete data control system is described by the following equation (5)

$$x(K+1) = A\,x(K) + B\,u(K)$$
$$(K) = D\,x(K)$$

$$A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix} \qquad B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

Determine its controllability

13.(a) Explain the common physical non linearities. (5)

(b) Explain delta method for construction of phase trajections. (5)

14. Explain variable gradient method and write steps to find out stability. (10)

15.(a) Determine the variation of the functional

$$T(x) = \int_{t_0}^{t_f} [x^2(t) + 2x(t)]dt \qquad (5)$$

(b) State and prove fundamental theorem of calculus of variations. (5)

16. A feed back system has closed loop transfer function, construct three different state models. (10)

$$\frac{C(s)}{U(s)} = \frac{10(s+4)}{s(s+1)(s+3)}$$

17. Write short notes on the following :

(a) Hamiltonian method (5)

(b) Isocline method (5)