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Roll No ....

MEIC - 202

M.E./M.Tech., II Semester

Examination, June 2016

Optimal And Adaptive Control

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt any five questions.
ii) All questions carry equal marks.

1. a) State and explain the term Convexity with suitable example.
   b) Derive expression for the Euler - lagrange equation. Discuss the significance and applications of this equation.

2. a) What is an adaptive control system? Discuss the gain scheduling approach of designing a controller in adaptive control system.
   b) What is MRAC adaptive control system? And how is the MIT rule useful in designing adaptive system.

3. a) Find optimal control law $u^x(t)$ for the system

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -10 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 10 \end{bmatrix} u$$

   Which minimize the performance index:

$$J = \frac{1}{2}\int_0^2 u^2\, dt$$

   b) Find the extremal of the functional

$$J(x) = \int_0^{\pi/4} \left\{ \dot{x}_1^2(t) + \dot{x}_2^2(t) + \dot{x}_1(t)\dot{x}_2(t) \right\} dt$$

   Subject to the boundary conditions

   $x_1(0) = 1,\ x_1(\pi/4) = 2$

   $x_2(0) = 3/2,\ x_2(\pi/4)$ is free

4. The first order linear system

   $\dot{x}(t) = -10x(t) + u(t)$

   Is to be controlled to minimize the performance index

$$J = \frac{1}{2}x^2(t) + \int_0^{0.04} \left\{ \frac{1}{4}x^2(t) + \frac{1}{2}u^2(t) \right\} dt$$

   The admissible state and control values are not constrained by any boundaries. Find the optimal control law by using Hamilton Jacobi approach.

5. a) Explain the principle of optimality, imbedding principle and principle of causality of Dynamic Programming.
   b) What do you mean by full-state feedback control law? How does it help in pole placement design of control system.

6. a) State and explain the Bellman's principle of optimality.
   b) Explain the characteristics of dynamic programming solution.

7. a) How does pole placement help in stabilizing a system?
   b) Write down Necessary and sufficient condition for Arbitrary Pole Placement.

8. a) Give formulation of continuous linear regulator problem using state variable approach.
   b) Explain the pontryagin's minimum principle and state inequality constraints.

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