 Roll No

MEIC-202

M.E./M.Tech. II Semester

Examination, May 2018

Optimal and Adaptive Control

Time : Three Hours

Maximum Marks : 70

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

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

2. a) Explain how to be formulate the optimal control problem.
b) Determine an optimal control law for transferring the system

$\dot{x}_1 = x_2$

$\dot{x}_2 = U$ form an arbitrary initial state to the point (2, 2) in minimum time with $|u(t)| \le 1.0$

3. a) The system equation are given as

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} X + \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} U$$

optimize the PI given below using matrix Riccati equation.

$$PI = \int_0^\infty \left\{ X^T \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} X + U^T \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \right\} dt$$

b) Explain the optimal state estimation with suitable description.

4. a) Derive the Riccati equation of continuous time linear state Regulator.
b) The plant equation of a system are given by:

$\dot{x} = -x + u$

It is required to minimize the

$PI = \int_0^1 (x^2 + u^2) dt$

Obtain an open loop control law using:
i) Calculus of variations and
ii) Pontryagin's maximum principle.

5. a) Explain the Pontryagin's minimum principle and state inequality constraints.
b) How does pole placement help in stabilizing a system.

6. a) What is the Sub-optimal control? Define of sub-optimal control for discrete time system.
b) Write a short note on parameter optimization.

7. a) State the Two-point boundary value problems and explain how it can be solved though variation of extremals. Also summarize the algorithm of variation of extremals.
b) Find extremals for

i) $\int_{t_0}^{t_f} \frac{\dot{x}^2}{t^3} dt$

ii) $\int_{t_0}^{t_f} (\dot{x}^2 + x^2 + 2xe^t) dt$

8. a) What do you mean by full - state feedback control law? How does it help in pole placement design of control system?
b) Write down Necessary and Sufficient Condition for Arbitrary Pole Placement.

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