Chapter 2

Calculus of Variations and Optimal Control

Solution to Problem 2.1

The performance index is

$$J = \int_{0}^{2} [2x^{2}(t) + \dot{x}^{2}(t)]dt,$$

=
$$\int_{t_{0}}^{t_{f}} V(x(t), \dot{x}(t))dt$$

where

$$V = 2x^2(t) + \dot{x}^2(t), \quad t_0 = 0, \quad t_f = 2.$$

Using the Euler-Lagrange equation (2.3.15)

$$\left(\frac{\partial V}{\partial x}\right)_{\bullet} - \frac{d}{dt}\left(\frac{\partial V}{\partial \dot{x}}\right)_{\bullet} = 0 \longrightarrow$$

$$4x^{\bullet}(t) - \frac{d}{dt}\left(2\dot{x}^{\bullet}(t)\right) = 0 \longrightarrow$$

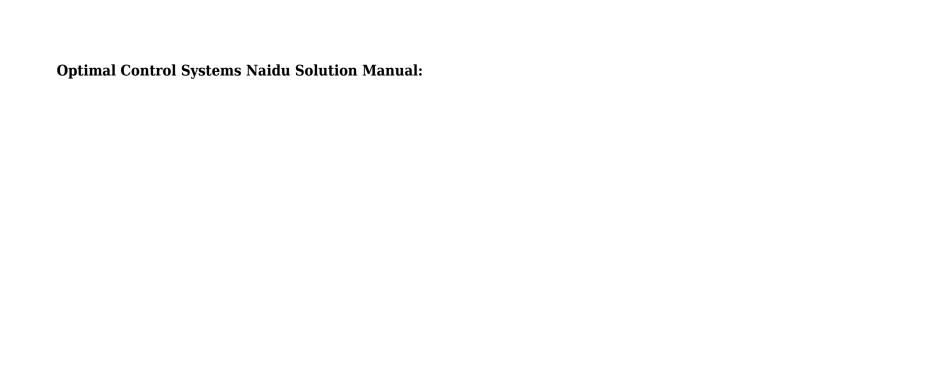
$$\dot{x}^{\bullet}(t) - 2x^{\bullet}(t) = 0.$$

Solving the previous equation

$$x^{\bullet}(t) = C_1e^{\sqrt{2}t} + C_2e^{-\sqrt{2}t}$$

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