ME EN 7210 Optimal Controls **Spring 2026**
Assignment #3 **Due Thursday, Feb. 5 at the beginning of class**

This assignment MUST be typeset in either LaTex or MS Word. Any hand-written work will not be accepted and if submitted, the entire assignment will receive a zero grade!

Show all your work for full credit!

Problem 1
Let $f(t) = 2t^2 + 2t + 1$. Find the increment and the derivative of the function f(t).

Problem 2
Given the functional:

$$J\big(y(t)\big) = \int_{t_o}^{t_f} [3y^2(t) + 2y(t) + 8]dt$$

Find the first variational of the functional J(y(t)).

Problem 3
Let the cost functional be given by

$$J = \int_{-2}^{0} [12tx(t) + \dot{x}^2(t)]\, dt$$

with boundary conditions of x(-2) = 3 and x(0)=0. Find the optimum (i.e., extremal) of the functional J.

Problem 4

Let the cost functional be given by

$$J = \int_0^2 [2x^2(t) + \dot{x}^2(t)]\, dt$$

with boundary conditions of x(0) = 0 and x(2)=5. Find the optimum (i.e., extremal) of the functional J.

Problem 5

Let the cost functional be given by

$$J = \int_1^2 \frac{\dot{x}^2(t)}{2t^3}\, dt$$

with boundary conditions of x(1) = 1 and x(2)=10. Find the optimum (i.e., extremal) of the functional J.