

INTRODUCTION TO CONTINUOUS CONTROL SYSTEMS
COLUMBIA UNIVERSITY MECHANICAL AND ELECTRICAL ENGINEERING
DEPARTMENTS: E3601

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Homework 4

Problem 1 (Laplace Transform – Differentiation). *Show that the Laplace transform of the n_{th} derivative of a function $f(t)$ is given by the following identity:*

$$\begin{aligned}\mathcal{L}\left\{\frac{d^n f(t)}{dt^n}\right\} &= s^n F(s) \\ &- \lim_{t \rightarrow 0} \left[s^{n-1} f(t) + s^{n-2} \frac{df(t)}{dt} + \dots \right. \\ &\quad \left. + \frac{d^{n-1} f(t)}{dt^{n-1}} \right] \\ &= s^n F(s) - s^{n-1} f(0) - s^{n-2} f^{(1)}(0) - \dots - f^{(n-1)}(0)\end{aligned}\tag{1}$$

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