Math 3413.001: Physical Mathematics I

Homework 5, due February 27 (Thursday)

Lecture 10 (Feb 13) Due date 02/27/2020 : Section 7.1

1. Use the definition of Laplace transform to find the Laplace transform of the following functions
   (a) $f(t) = 2t + 3$
   (b)
   $$f(t) = \begin{cases} \cos(t) & \text{if } 0 < t < 2\pi; \\ 0 & \text{if } t \geq 2\pi. \end{cases}$$
2. Use the formulas for Laplace transforms for $t^a, e^{at}, \sin(kt)$ and $\cos(kt)$ done in class to find the Laplace transform of the following functions
   (a) $f(t) = t^{3/2} - e^{\pi t}$
   (b) $f(t) = \sin(2t)\cos(2t)$
3. Use the formulas for Laplace transforms for $t^a, e^{at}, \sin(kt)$ and $\cos(kt)$ to find the Inverse Laplace transform of the following functions
   (a)
   $$F(s) = \frac{2}{s} + \frac{3}{s^{5/3}} - \frac{1}{s-1}.$$
   (b)
   $$F(s) = \frac{2s-3}{s^2+9}.$$

Suggested problems from the book (DO NOT SUBMIT): Pg 445-446, $\#1, 4, 7, 13, 17, 25, 30$.

Lecture 12 (Feb 20) Due date 02/27/2020 : Section 7.2

1. Solve the following initial value problem using Laplace transforms
   $$x' - ax = 0, \qquad x(0) = b \text{ where } a, b \text{ are real numbers.}$$
2. Solve the following initial value problem using Laplace transforms
   $$x'' - 3x' + 2x = 4e^{2t}, \qquad x(0) = -3, x'(0) = 5.$$
3. If $\mathcal{L}\{f(t)\} = F(s)$, then we have $\mathcal{L}^{-1}\{F(s)/s\} = \int_0^t f(\tau)d\tau$. Use this formula to calculate the inverse Laplace transform of the following funcitons.
   (a)
   $$F(s) = \frac{4}{s(s-1)(s+2)}$$
   (b)
   $$F(s) = \frac{2}{s^2(s^2+4)}$$

Suggested problems from the book (DO NOT SUBMIT): Pg 464-465, $\#3, 7, 10, 19, 22$