Problem Set 3
Applied Mathematics I, MA 531
Due November 17, 2010

Do the following problems from the text, *Advanced Engineering Mathematics*, 2nd edition, by M. Greenberg.

Section 5.2: 5, 10d   Section 11.2: 3c,l, 6b
Section 5.3: 1a,b, 3c, 10c   Section 11.4: 2b,d
Section 5.4: 1e,g,m, 5a   Section 11.5: 1b,g, 2c
Section 5.5: 1b, 5c
Section 5.6: 1b

In addition, answer the following questions.

1. Let $\mathcal{L}$ denote the Laplace transform.
a) Prove that if $\mathcal{L}\{f(t)\} = F(s)$, then $\mathcal{L}\{tf(t)\} = -F'(s)$.
(Hint: Start with the definition of $F(s)$ and differentiate under the integral with respect to s.)
b) Use part (a) to obtain the Laplace transform of $t\sin kt$ and $t\cos kt$, $k \in \mathbb{R}$.

2. a) Show that $\mathcal{L}\{e^{kt}\} = \frac{1}{s-k}$ holds even if $k = a + bi$ is complex as long as $s > a$.
b) Use part (a) to find $\mathcal{L}\{e^{at}\cos bt\}$ without integrating by parts by considering $e^{at}\cos bt$ as the real part of $e^{(a+bi)t}$.