EEL 3657 Homework # 1 - Due Th May 30

Covers LDEs, modeling of simple physical systems, Laplace transforms. Assume/discover any constants, parameters, or initial conditions that you feel might help toward a good grade. Your notes and the textbook should be ample material to solve these problems.

1. A rocket is shot straight up. During initial stages of flight, it has an acceleration of 7t ms^{-2}. The engine cuts off at t = 10s. How high will the rocket go?

2. A copper ball is heated to 100 degrees Centigrade. Then at time t = 0, it is placed in water which is maintained at 30 degrees Centigrade. At the end of 3 minutes, the temperature of the ball is reduced to 70 degrees Centigrade. Find the time at which the temperature of the ball is reduced to 31 degrees Centigrade.
   Hint: Newton's law of cooling: The time rate of change of temperature T of the ball is proportional to the difference between T and the temperature of the surrounding medium.

3. Find Laplace transform of (a) $t\sin(\omega t)$ (b) $\sin^2(\omega t)$

4. Prove the final value theorem.

5. Find $f(0^+)$ and $\dot{f}(0^+)$ when $F(s)=\dfrac{5}{(s+3)^2}$ with and without using the initial value theorem.

6. Use MATLAB to find the partial-fraction expansion of the function
   $$F(s)=\frac{5(s+4)}{(s+3)^2(s+1)(s+2)}$$