MAE 478, Spring 2017

**Homework Assignment #2**

**Due Date: February 23, 2017**

1. (10) What is the ratio of the burning area to the nozzle area for a solid propellant motor with these characteristics?

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| Propellant Specific Gravity | 1.71 |
| Chamber Pressure | 14 MPa |
| Chamber Gas Temperature | 2220 K |
| Burning Rate | 38 mm/s |
| Temperature Sensitivity σp | 0.007 K-1 |
| Specific Heat Ratio | 1.27 |
| Molecular Mass | 23 kg/kg-mol |
| Burning Rate Exponent | 0.3 |

2. (10) Make a simple sketch and determine the mass or sea level weight of a rocket motor case that is made of alloy steel and is cylindrical with closed circular ends.

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| Chamber Pressure, maximum | 1520 psi |
| Outer case and vehicle diameters | 20.0 in |
| Length of cylinder portion of case | 19.30 in |
| Density of alloy steel | 0.289 lbm/in3 |
| Ultimate tensile strength | 172,000 psi |
| Safety factor on ultimate strength | 1.65 |

3. (20) Find Ab vs. d, p1 vs. t, and F vs. t plots for an end burner propellant grain. Some characteristics of the geometry and propellant are as follows: Rb=3in [propellant grain radius], Rt=0.3in [nozzle throat radius], R2=3in [nozzle exit radius], L=60 in, a=0.0563, n=0.33, T1=5500 R, ρb=0.064 lbm /in^3, k=1.2, R=66 (ft-lbf)/(lbm-R) [gas constant]. The length and duration of the plots should result in all the propellant being burned. Show your work and the MATLAB codes that were used to create the plots.