MECH 4420
Homework #1
(Due Wed 1/25/2012 in class)

1. Download the data from the class website. Write a Matlab *FUNCTION* that takes in time, vehicle yaw rate, and vehicle velocity and returns vehicle heading angle (between 0 and 360 deg) and the vehicle acceleration. Write a Matlab *SCRIPT* that loads the data, uses the above function, and plots vehicle heading, yaw rate, and vehicle speed and longitudinal acceleration versus time on one page. Use trapezoidal integration. What is the vehicle doing?

2. A car starts from rest and rolls down a hill with a road grade of 20 degrees. The car weighs 3500 pounds and reaches a final velocity of 10 mph. Write the equations of motion for the system. Analytically solve for *v(t)* and *x(t)* assuming the air drag is proportional to velocity. Write software to simulate the system (numerically integrate the dynamic equations of motion). Provide plots of position and velocity of your simulations compared against the analytical solution. (use "subplot" to get multiple figures on one page and "hold on" to get multiple figures on one plot). Simulate the system assuming the air drag is proportional to velocity squared. Compare the response to the linear simulation (by providing plots of velocity on the same plot).

3. A vehicle is traveling 20 m/s (in the longitudinal direction) and has a lateral velocity of 1 m/s (at the CG) during a ***steady state*** cornering maneuver. The front wheels are turned 5 degrees and yaw rate of the vehicle during the turn is 50 deg/sec. The wheel base width of the car is 1 meter and the wheel base length is 2 meters. Assume the CG of the car is located at the center of the vehicle. (*I recommend writing the equations in Matlab)*
    a) calculate the longitudinal and lateral velocity at each of the tires.
    b) What is the velocity of the car in E-N fixed coordinates in terms of the vehicle heading angle (ψ) measured clockwise from North
    c) What is the radius of curve traced by the vehicle
    d) What would a 3-axis accelerometer placed at the CG of the car measure