# ME 433 Week 8 Homework Spring 2024

## Part I. Virtual Data for your Vehicle

Choose a virtual vehicle for which you are going to install your virtual engine (from past assignments) a transmission, and a differential (or final drive reduction in the case of a motorcycle) For this vehicle and geartrain you should find the following information:

* Frontal area
* Coefficient of drag
* Coefficient of rolling resistance
* Mass (of the vehicle, including your engine, and including a driver – if equipped)
* If equipped, the primary gear reduction [ratio] before the transmission.
* Gear ratio of each speed in the transmission (reverse ratio not necessary).
* Gear ratio of the final drive (usually the chain drive of a motorcycle, or the differential ratio on a 4-wheeled vehicle)
* The tire diameter of the driven axle.

1. With the above information, make a plot of Road Load Power [hp] vs. Vehicle speed [mph].

## Part II. Top Speed Prediction

Decide on a drivetrain loss for your system (typically 10-15%). Using the engine you selected from previous assignments and accounting for drivetrain loss, calculate a theoretical top speed [mph] of your vehicle.

## Part III. Net Acceleration Force

For the vehicle, engine, transmission, and tire size of your virtual vehicle – use your favorite modeling software to create data and a plots (using English units of [lbf and mph]):

1. Road Load Force [lbf] as a function of vehicle speed [mph] (this should be the similar to Part I)
2. Propulsion force [lbf] as a function of vehicle speed [mph] for each gear ratio in the transmission. i.e. for a 5-speed transmission you will have five different curves. Note that the propulsion force also needs to include the drivetrain loss (from Part II), and the tire radius. Put all the transmission ratios on the same plot.
3. On a separate plot, graph the net acceleration force (Fpropulsion – Froadload) as a function of vehicle speed.

## Part IV. Acceleration Model

Using your data from Part III c), use an Euler’s Method to simulate the 0-60 mph acceleration of your virtual vehicle. For a timestep you might start by cutting your predicted (before calculation) 0-60 time into 100 pieces. i.e. if you think it will take 5 seconds to go 0-60, make your timestep 0.05 seconds. Remember from Dynamics that the linear EOM looks like:

* You know F­net­, mass, and dt, so you can calculate a change in velocity.
* At the new velocity you can look up your Fnet. Use that to calculate the next change in velocity over your time step.
* Repeat this process until your vehicle reaches 60 mph
* If you want to get fancy, add in a time delay (no propulsive force) between shifts. This is usually around 0.5 seconds for a car, and as quick as 0.1 seconds for a dual-clutch or sequential transmission.