# ME 433 Week 5 Homework Spring 2024

## Part I. Selecting an Engine to Model

Throughout the semester there will be various homework assignments where you will be simulating some aspect of engine performance. For this part of the homework assignment you should select an engine you plan to do simulations of over the semester. This could be an engine from a vehicle you have, or maybe just one you happen to like. For this assignment you need to provide the following:

1. Manufacturer and model of the engine (and possibly some examples of what vehicles it was installed in)
2. Type of engine (SI, CI, Forced Induction or Naturally Aspirated, etc.)
3. Number of cylinders and their configuration/layout
4. Swept Volume of the engine [L and in3]
5. Compression Ratio
6. Values for peak torque [N-m and ft-lbf], and engine speed where that occurs [RPM]
7. Values for peak power [kW and hp], and engine speed where that occurs [RPM]
8. Bore and Stroke [mm and in]
9. Maximum speed, or redline [RPM]
10. If possible, find either/both a peak Torque vs. RPM and/or Power vs. RPM plot for this engine.

## Part II. Basic Calculations for Your Engine

For the engine you chose in Part I, calculate the following for just one of the cylinders:

1. Volume at Bottom Dead Center (BDC) [L and in3]
2. Volume at Top Dead Center (TDC) [L and in3]
3. Average clearance height at TDC [mm and in]
4. Use either the Otto or Dual Cycle to approximate:
   * Power [hp]
   * Efficiency [%]
   * MEP [kPa and psia]

## Part III. Time and Velocity

Several velocity, time, and length scales are useful in understanding what goes on inside engines. Make estimates of the following quantities for a 1.6 liter four-cylinder spark-ignition engine with a bore of 100 mm, operating at wide-open throttle at 2500 RPM. Clearly document your assumptions and your solution process. You can use the “Four-Stroke SI Engine” plot (slide 4 from LECT 3) to approximate crankangles as necessary.

1. The time [seconds, or milliseconds] that takes for: one complete engine cycle, the intake process, the compression process, the combustion process, the expansion process, and the exhaust process.
2. The average velocity [m/s] in the intake port during the induction process (assuming that the port area is about 20% of the piston area).
3. The average velocity [m/s] of the flame traveling across the combustion chamber.
4. If the intake port area is 20% of the piston area, what would the length [mm and in] of the runner be for the runner to have the same volume as the displaced volume of the cylinder? Assume an average intake temperature of 80 °C.
5. If the exhaust port area is 12% of the piston area, what length [mm and in] of exhaust is filled by one cylinder charge after it exits the cylinder? Assume an average exhaust gas temperature of 425 °C.