EML 4421 IC Engines and Propulsion Systems Homework 2 Spring 2006
Due Jan. 26, 2006

1. Show that the temperature at the end of the intake stroke (T_1) is a function of the pressure ratio between intake pressure and the exhaust pressure (P_i/P_e), the residual gas fraction (f), the exhaust temperature (T_e), and the specific heat ratio (γ):

$$T_1 = (1-f)T_i + fT_e\left[1-\left(1-\frac{P_i}{P_e}\right)\left(\frac{\gamma-1}{\gamma}\right)\right]$$

2. Determine the net thermal efficiency (η), residual gas fraction (f), and the temperature after the intake stroke (T_1) of the following engine operating under an ideal four-stroke Otto cycle. The engine is throttled with an intake pressure of P_i=50 kPa and an inlet temperature T_i=300 K. The exhaust pressure is P_e=100 kPa and the compression ratio r=10. The heat addition q_{in}=2500 kJ/kg and γ=1.3. (Hint: the solution can be found by iteration and trials and errors. Assume values for f and T_e in order to determine all relevant parameters. Check with the assumed values and make sure that improvements be made to reach converged solutions. Since there are two guessed values, numerical optimization schemes are usually needed. In the present case, use T_e=1300 K as your initial guesses value for faster convergence. Also note that f is usually very smaller ($0.1 > f > 0$). Show steps how you reach the final converging solution.