ENSC 461

Assignment #4 (Gas-turbine)

Assignment date: Tuesday Feb. 08, 2011

Due date: Tuesday Feb. 15, 2011

Problem 1:

An ideal gas-turbine cycle with ideal regeneration and with *n*-stage of compression (with intercooling) and expansion (with reheating), equal increment at each stage of compression and expansion, has an overall pressure ratio of *r*. Air enters each stage of the compressor at T_1 and each stage of the turbine at T_3.

a) Derive relationships for exit temperature at each stage of compression and expansion. Compare the results when *n = 1* with the single-stage ideal Brayton cycle which operates at the same pressure ratio and works between the same min and max temperatures T_1 and T_3.

b) Determine the thermal efficiency for the *n*-stage system. Plot a *T-s* diagram for the system. Compare the thermal efficiency of the n-stage cycle, when *n* → ∞ with the thermal efficiency of a Carnot engine working between the same temperatures T_1 and T_3. Elaborate on your answer.

Problem 2:

Show that the work input to a two-stage compressor is minimized when equal pressure ratios are maintained across each stage. That is:

$$P_{int} = \sqrt{P_1 P_2}$$
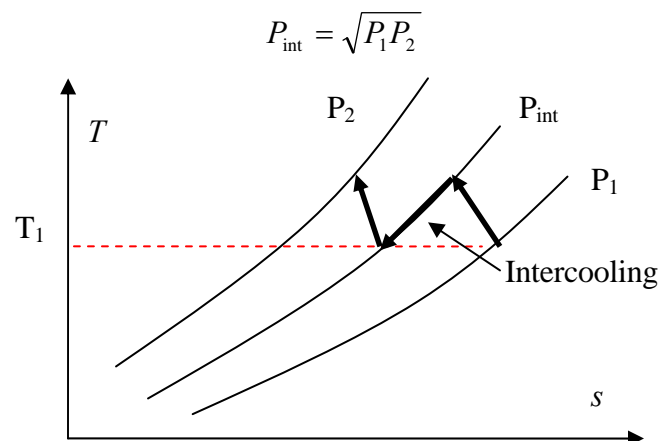
Note: assume polytropic (more general than isentropic) compression.