

Thermal Systems Design

Homework #3

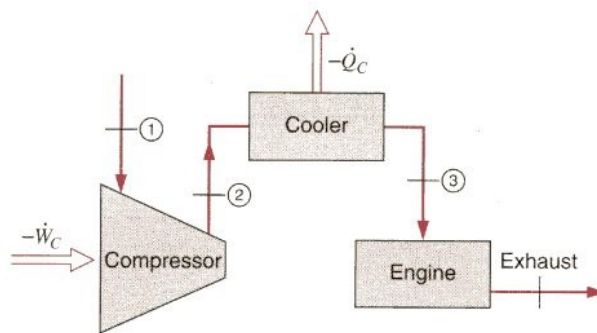
Due Thursday February 16, 2006

Work Problems 3.3 and 3.9 from the *Thermal Design and Optimization* book. Also work problems 10.16, 10.37, and 10.45 from the *Fundamentals of Thermodynamics*, 5th edition by Sonntag, Borgnakke, and Van Wylen.

Copies of the latter problems were handed out in class. They are presented here to ensure access to the problems.

10.16

Air enters the turbocharger compressor (see figure) of an automotive engine at 100 kPa, 30°C, and exits at 170 kPa. The air is cooled by 50°C in an intercooler before entering the engine. The isentropic efficiency of the compressor is 75%. Determine the temperature of the air entering the engine and the irreversibility of the compression-cooling process.



10.37

Air enters a compressor at ambient conditions, 100 kPa, 300 K, and exits at 800 kPa. If the isentropic compressor efficiency is 85%, what is the second law efficiency of the compressor process?

10.45

The condenser in a refrigerator receives R-134a at 700 kPa, 50°C, and it exits as saturated liquid at 25°C. The flowrate is 0.1 kg/s, and the condenser has air flowing in at ambient 15°C and leaving at 35°C. Find the minimum flow-rate of air and the heat exchanger second-law efficiency.