ME 18b, HW 2

Due April 14, 2008 (accepted until 4 pm)

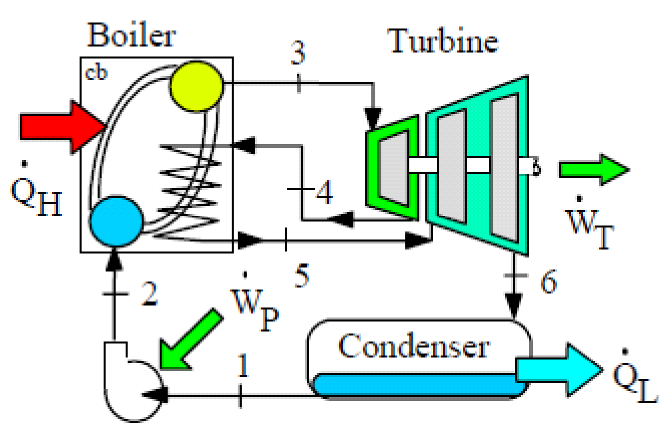
STUDENTS NOTE: We will be taking a tour of Caltech's cogeneration plant on Wilson Avenue on Tuesday April 7 from 1:15-2:15 pm. You will receive homework credit for attending this tour. Please plan accordingly.

TAs for HW #2: Xaobai Li, TOM 212E, Mon & Fri 3-4 pm; Julianne Gould, SFL 318, Sun 4-6 pm.

1. Please describe 3 things that surprised or impressed you about the Caltech co-generation plant. These 3 things should be about power generation, cooling resources, pollution control, or some other engineering related topic. If you *did not attend* the tour, you will not be able to answer the question.

2. This question is a bit open ended so answer it however you wish. I'm expecting about a paragraph or two of information for your response. Do some background research on the Rankine cycle and write a summary of what you found out about it. Describe the person it was named after. When and where did he live, what did he do, when did he develop the cycle etc? Remember to cite your sources of information.

3. Rankine Cycle with Reheat: For the ideal steam cycle shown below calculate the net work and heat input to the cycle, the overall thermal efficiency and the moisture content of the steam leaving the low-pressure turbine. The conditions at state 3 are: 3 MPa and 400°C; state 5 is at 0.8 MPa and 400°C; state 1 pressure is at 10 kPa. Draw the process on a labeled T-s diagram. What would the moisture content of the steam exiting the low pressure turbine be if there was no reheat process? How much does the thermal efficiency change by having a reheat process in the Rankine cycle? Comment on whether it seems worth the trouble of adding piping and heat exchangers to the basic cycle for this change in thermal efficiency.



4. Rankine Cycle with Closed Feedwater Heater: A Rankine cycle with ammonia as a working fluid has a mass flow rate of 5 kg/s. The turbine inlet conditions are 2 MPa and 140°C. Ammonia is extracted from the turbine at 800 kPa for the closed ammonia feed heater. The condenser operates at -20°C and the closed ammonia feed heater has an exit state (3) at the temperature of the condensing extraction flow and a drip pump. Find the extraction flow rate and the state 4 Temperature and Enthalpy into the boiler. Find the heat transfer rate to the ammonia in the boiler and the total work output of the turbine. Draw a sketch of the process.