Thermodynamics II **Quiz 1** **MECH 351**
Fall, 2006

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CONCORDIA UNIVERSITY
FACULTY OF ENGINEERING AND COMPUTER SCIENCE
DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING

Students Name: [redacted]

ID No. [redacted]

Notes:
Quiz time is 50 minutes.

Question 1.
Consider a simple ideal Rankine cycle with fixed turbine inlet temperature and condenser pressure. What is the effect of increasing the boiler pressure on:
A- Pump work input. B- Turbine work output. C- Heat supplied. D- Heat rejected. E- Cycle efficiency. G- Moisture content at turbine exit.

Question 2.
Consider a 210-MW steam power plant that operates on a simple ideal Rankine cycle. Steam enters the turbine at 10 MPa and 500 °C and is cooled in the condenser at a pressure of 10 KPa. Assuming an isentropic efficiency of 85%for both the turbine and the pump, show the cycle on T-s diagram with respect to saturation lines, and determine (a) the quality of the steam at the turbine exit, (b) the thermal efficiency of the cycle, and (c) the mass flow rate of the steam.

Good Luck

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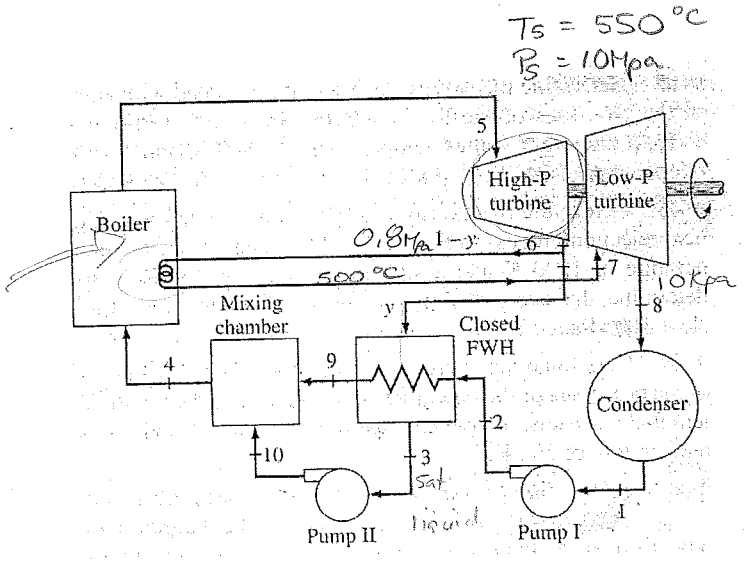
I. [50 points] A steam power plant operates on an ideal rehear-regenerative Rankine cycle and has a net power output of 80 MW. Steam enters the high pressure turbine at 10 MPa and 550°C and leaves at 0.8 MPa. Some steam is extracted at this pressure to heat the feedwater in a closed feedwater heater. The extracted steam leaves the feedwater heater as a saturated liquid. The rest of the steam is reheated to 500°C and is expanded in the low pressure turbine to 10 kPa. Thermodynamic properties are given in the table below in order to save time.

1- Draw the cycle on a T-s diagram with respect to saturation lines
2- Determine the mass flow rate of steam through the boiler $\dot{m}$
3- Determine the thermal efficiency of the cycle.

h_1	191.83
h_2	201.92
h_3	721.11
h_4	731.37
h_5	3500.9
h_6	2811.9
h_7	3480.6
h_8	2494.4
h_9	731.37
h_{10}	731.37

All in kJ/kg



$h_2 = h_1 + W_{p1}$

$h_2 - h_1 = W_p$

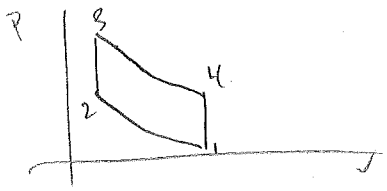
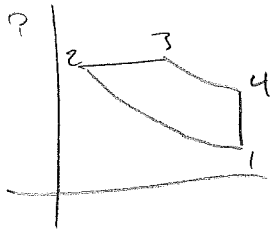
II.1. A Diesel cycle, with a compression ratio of 18, operates on air with a low pressure of 200 kPa and a low temperature of 200°C. Assume constant heat capacities. If the heat supplied is 1800 kJ/kg, determine:

1- The pressure, the temperature and the specific volume at each point.
2- The cutoff ratio.
3- The thermal efficiency of the cycle.

For air at room temperature: k=1.4; C_p=1.0035 kJ/kg K; C_v=0.718 kJ/kg K and R=0.287 kJ/ kg K

II.2: Put the following sentences under the right cycle:

1. Uses a spark plug.
2. Heat is supplied at constant pressure.
3. Has a higher compression ratio.
4. Compresses fuel only.
5. Heat is supplied at constant specific volume.
6. Compresses air only.
7. Has a higher efficiency than a Carnot cycle operating under the same conditions.
8. Compresses air+fuel.

Otto cycle	Diesel cycle
	
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