

ME 18b, HW 1

Due Tuesday April 7, 2008 (by 4 pm)

Please indicate the number of classes attended and the number of hours spent on homework.

1.1 Thermal efficiency for an Ideal Rankine cycle.

Suppose you wish to design a solar powered Rankine cycle plant using water as a working fluid. If the solar collector exit has saturated water vapor at a pressure of 900 kPa and the condenser operates at 10 kPa determine the following: (a) the operating temperatures of the evaporator and the condenser. (b) The thermal efficiency of this ideal power plant. (c) Compare this to the thermal efficiency of a Carnot Cycle plant. Draw a diagram of the cycle and draw the process on a T-s diagram.

1.2 Rankine cycle for power.

A steam power plant has a high pressure of 3 MPa and it maintains 60°C in the condenser. The turbine exhaust quality must remain above 90%. Find the specific work and heat transfer in all components and the cycle efficiency. How do the specific work and heat transfer and efficiency change if the boiler pressure was raised to 3.5 MPa? Draw a diagram of the cycle and draw the process on a T-s diagram

1.3 Ocean Powered Rankine Plant

The ammonia based Rankine-cycle power plant shown below was designed to operate in an ocean environment that is 25°C at the surface and 5°C at depth. If the ammonia mass flow rate is 1000 kg/s determine the following:

- The turbine power output and the pump power input.
- The mass flow rate of seawater through each heat exchanger
- The thermal efficiency of the power plant.
- Draw the process on a T-s diagram.

