Unified Engineering Fall 2007
Thermodynamics & Propulsion Z. S. Spakovszky

(Add a short summary of the concepts you are using to solve the problem)

Problem T15

The turbine section of a GE Power Systems' F Class land based gas turbine receives hot compressed air at 17 bar, 1500 K, expands it to 1 bar and develops a gross power output of 470 MW. Air enters the compressor section at 1 bar, 280 K. All events are ideal and kinetic and potential energy effects can be neglected. The fuel mass flow can be assumed negligible compared to the air mass flow.

a) Sketch the cycle and all its components; introduce station labels.

b) Find the air mass flow required.

c) Determine the compressor power required.

d) What is the net power output?

e) What is the cycle efficiency?

f) For maximum cycle power output, what should be the compressor pressure ratio?

Consider that for the compressor R = 287 J/kg-K and $\gamma = 1.4$, and for the turbine R=287 J/kg-K and $\gamma=1.3$.

(Add a short summary of the concepts you are using to solve the problem)

Problem T16

At the Boston Garden ice rink, the heat transfer from the air above the ice to the ice surface is at a rate of 400 kW. The ice surface temperature is maintained by a refrigerator that uses the air outside the building as the high temperature heat reservoir, and the lowest layer of ice as the low temperature heat reservoir.

b) When the lowest layer of ice is at a temperature of –9 C and air outside the building is at a temperature of 15 C, estimate the minimum cost of maintaining the ice at this fixed temperature for 24 hours. For this level of power consumption, electric power costs $0.02/kWh.

c) Would you expect the operating costs of the refrigerator to increase or decrease as the temperature of the outside environment decreases? Assume everything else remains unchanged.