Advanced Thermodynamics: Homework (5% - Due Date 19/9/2011)

1. A 2200cc four-stroke-four-cylinder, petrol engine with a compression ratio of 10 operates on the Otto cycle. The air is at 100kPa and 30°C at the beginning of the compression process, and the maximum pressure in the cycle is 7.5MPa. Assume the compression and expansion processes are polytropic (with a polytropic constant of 1.3). Using constant specific heats at 800 K, determine:

(a) the temperature at the end of the expansion process

(b) the net work output and the thermal efficiency

(c) the mean effective pressure

(d) the engine speed for a net power output of 70 kW

(e) the specific fuel consumption in g/kWh defined as the ratio of the mass of the fuel consumed 10 the net work produced

The air-fuel ratio is 16, defined as the amount of air divided by the amount of fuel intake.

2. Consider a solar-pond power plant that operates on a simple ideal Rankine cycle with refrigerant-134a as the working fluid. The refrigerant enters the turbine as a saturated vapour at 1.5MPa and leaves at 0.7MPa. The mass flow rate of the refrigerant is 5 kg/s.

Show the cycle on a T-s diagram with respect to saturation lines, and determine:

(a) the thermal efficiency of the cycle

(b) the power output of this plant.