Example 1

In a turbine expander, the inlet stagnation conditions are 500K and $8*10^5$ Pa. The mass flow rate is 2 kg/s and the isentropic total-to-total efficiency is 0.95. The turbine stagnation entropy drop is twice the mean blade speed squared ($\Delta h_0=2u_m^2$) and the mean blade speed is 500 m/s. The flow (absolute) velocity at the rotor exit is axial and is 0.728 of the mean blade speed. Calculate the isentropic total-to-static efficiency, the polytropic total-to-total and total-to-static efficiencies. Also calculate the power delivered by the blading.

Sketch the h-s diagram at station N (nozzle inlet) and 2 (rotor outlet). Treat the air as a semi-perfect gas (Cp depending on T).