

Problem 1:

Consider the turbine-exhaust nozzle combination of a jet engine shown schematically on the board. You are given the following system specifications:

Turbine power output= 40 MW

Mass flow= 75 kg/s

P_{ta} = 25 bar

T_{ta} = 1200 K

P_c = 1bar

Turbine adiabatic efficiency= 0.8

Nozzle adiabatic efficiency= 0.95

You may assume air is the working fluid, and c_p = 1kJ/kgK. Neglect the velocities at the turbine inlet and outlet.

- a) Sketch the processes on a T-s diagram.
- b) Find the nozzle exit velocity.
- c) Find the specific entropy change across each component.

Problem 2:

Air enters a two-stage compressor at 100 kPa and 300 K and is compressed to 900 kPa. The pressure ratio across each stage is the same, and the air is cooled by removing 80 kW of heat from the flow between the two stages. Assuming each compressor has an adiabatic efficiency of 0.85, determine the power input to the compressors for a mass flow rate of 1 kg/s. What would your answer be if only one stage of compression were used between the same inlet and exit pressures? Neglect the velocities at both compressor inlets and outlets.