

AE 3450 Thermodynamics and Compressible Flow
Assignment # 4

Note: Please show your work.

5.33 For the same change of state, the entropy change of a substance during an irreversible process is (greater than, equal to, less than) the entropy change of the same substance during a reversible process. Explain.

5.40 Air proceeds along a constant-pressure path at 100 kPa from 20 to 100°C. Determine the entropy change during the process assuming the following:

(a) Air is an ideal gas with constant specific heats.

(b) Air is an ideal gas with variable specific heats.

5.46 Five lb_m of air is initially at a temperature of 60°F and a pressure of 14.7 psia. The state of the air is changed until the pressure and temperature are 100 psia and 520°F, respectively. Calculate the entropy change during the process, assuming ideal-gas behavior and

(a) constant specific heats and

(b) variable specific heats.

5.83 Air enters a steady-flow, internally reversible, adiabatic turbine at 877°C, 500 kPa, and leaves at 100 kPa. The mass flow rate of air entering the turbine is 6 kg/s. Determine the exit-air temperature and the power output of the turbine.

5.115 A steady-flow centrifugal compressor is supplied with saturated water vapor at 15 kPa and 500 kg of the water is compressed per hour to 250 kPa, 400°C. During the process there is heat transfer to the surroundings ($T_0 = 30^\circ\text{C}$) at a rate of 0.8 kW. Determine the power required to compress the water, the rate of change of entropy of the water, and the rate of change of entropy of the surroundings.

5.117 A turbine salesman makes the following claim for one of his products: Steam enters a steady-flow, adiabatic turbine at

4 MPa, 600°C with negligible velocity and exhausts at 200 kPa with a velocity of 180 m/s. The flow rate is 2.2 kg/s, and the turbine power output is 2 MW.

(a) What would be the temperature of the exhaust steam for the turbine as described by the salesman?

(b) Could the salesman's claim be valid? Explain and justify your response.