1. Show, for an axial flow turbine stage, that the relative stagnation enthalpy across the rotor row does not change.

2. An axial flow turbine operating with an overall stagnation pressure of 8 to 1 has a polytropic efficiency of 0.85. The exhaust Mach number of the turbine is 0.3. The exhaust velocity of the turbine is 160m/s. Assume for the gas that $C_p = 1.175\text{kJ/(kgK)}$ and $R = 0.287\text{kJ/(kgK)}$.

   (a) Determine the total-to-total efficiency of the turbine.

   (b) Determine the total-to-static efficiency.

   (c) Determine the inlet total temperature (stagnation temperature).

3. In a reaction axial flow turbine, $\alpha_2 = \beta_3 = 70°$, the exit velocity of steam from the stator blades is 160m/s, the blade speed is 152.5m/s and the axial velocity is constant. The total-to-total efficiency, η_{tt}, is 0.80 and the turbine consist ten stages. The stagnation pressure and temprature at turbine inlet is 1.5MPa and 300°C. Assume for the gas that $C_p = 1.838\text{kJ/(kgK)}$ and $\gamma = 1.33$.

   (a) Determine the specific work done by the steam per stage.

   (b) Determine the load factor.

   (c) Determine the reaction factor.

   (d) Is this an industrial turbine or an aerospace one?

   (e) Find the stagnation pressure and temperature at turbine outlet.

4. The mean blade radius of the rotor of a mixed flow turbine are 0.3m at inlet and 0.1m at outlet. The rotor rotates at 20000rpm and the power of the turbine is 430kW. The flow velocity at stator exit is 700m/s and $\alpha_2 = 70°$. Determine the absolute and relative flow angles and the absolute exit velocity for the rotor. The mass flow rate is 1 kg/s and the axial velocity of the through-flow (V_a) is constant through the rotor.

5. In a zero-reaction gas turbine stage, $T_{o2} = 1100°\text{K}$, $P_{o1} = 414\text{KPa}$, $P_{o2} = 400\text{KPa}$, $p_2 = 207\text{KPa}$, $p_{o3} = 200\text{KPa}$, $U = 291\text{m/s}$, $\alpha_2 = 70°$, and $V_1 = V_3$. Assume a perfect gas with$C_p = 1.148\text{kJ/(kgK)}$ and $\gamma = 1.333$. Determine the total-to-total efficiency of the stage.