ANNOUNCED QUIZ #9 – ME 2030 –SECTION 001 – Fall 2024

NAME: SOLUTION

This is an open book quiz. You may use a four-function calculator. An unsigned honors pledge will result in a zero. Show all work.

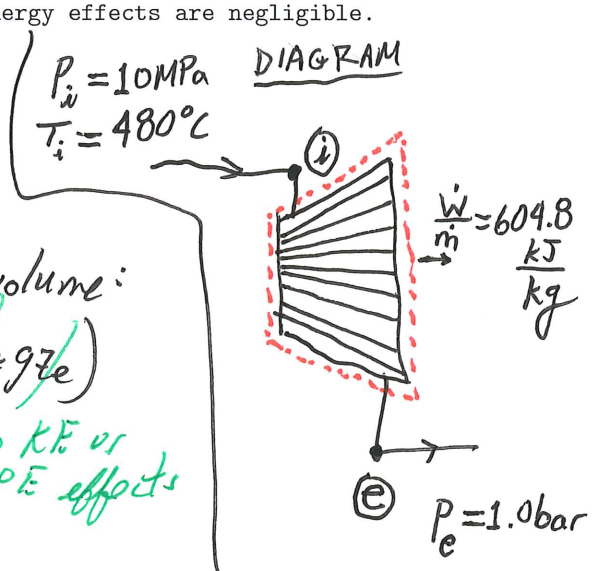
1. Consider a steam turbine where the inlet pressure and temperature are 10MPa and 480°C, respectively. If the exit pressure is 1.0 bar and the power output of the turbine is 604.8 kJ/kg of steam flowing, determine the exit temperature in °C. You may assume the turbine is adiabatic and that potential and kinetic energy effects are negligible.

GIVEN: $P_i, T_i, P_e, \dot{W}/\dot{m}; \dot{Q}=0$; No KE or PE effects.

FIND: $T_e = ?$ °C

ASSUME: Steady-state operation

DIAGRAM



ANALYSIS: Conservation of Energy for a control volume:

$$\frac{dE}{dt} = \dot{Q} - \dot{W} + \sum_i \dot{m}_i \left(h_i + \frac{V_i^2}{2} + g z_i\right) - \sum_e \dot{m}_e \left(h_e + \frac{V_e^2}{2} + g z_e\right)$$

S.S. Adiabatic No KE or PE effects

since S.S., $\dot{m}_i = \dot{m}_e = \dot{m}$

$$\dot{W} = \dot{m}(h_i - h_e)$$

$$\frac{\dot{W}}{\dot{m}} = h_i - h_e$$

From Table A-4 $h_i = 3321.4$ kJ/kg $\Rightarrow$ $604.8 \frac{kJ}{kg} = 3321.4 \frac{kJ}{kg} - h_e$

$$h_e = 2716.6 \frac{kJ}{kg}$$

From Table A-4 at $P_e = 1.0$bar and $h = 2716.6 \frac{kJ}{kg}$ $\rightarrow$ $T_e = 120$°C

$$T_e = 120°C \leftarrow \text{ANS.}$$

I HAVE NEITHER PROVIDED OR RECEIVED HELP DURING THIS QUIZ.

SIGNATURE