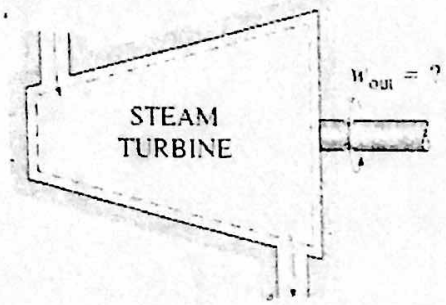
Cankaya University
Faculty of Engineering
Mechanical Engineering Department
Me 211 Thermodynamics I
Quiz # 7 Fall 2017

Steam (water vapor) enters an **adiabatic** turbine at 6 MPa, 440 °C and leaves at a pressure of 500 kPa. Determine the work output of the turbine per kg of steam if the process is **reversible.** Also draw the T-s diagram with respect to saturation lines

P_1=6 MPa
T_1=440 C



P_2=500 kPa

$\dot{m}_1 = \dot{m}_2 = \dot{m}$

State 1

$P_1 = 6\,MPa$
$T_1 = 440°C$
$\Rightarrow h_1 = 3277,3\ kJ/kg$
$s_1 = 6,6853\ kJ/kgK$

State 2 $\quad s_1 = s_2 = 6,6853\ kJ/kgK$

$P_2 = 500\ kPa$
$s_f = 1,8607\ kJ/kgK$
$s_g = 6,8212\ kJ/kgK$

$s_f < s_2 < s_g \Rightarrow$ saturated mixture

$s_2 = s_f + x_2 \cdot (s_g - s_f) \Rightarrow 6,6853 = 1,8607 + x_2(6,8212 - 1,8607)$

$\Rightarrow x_2 = 0,973$

$h_f = 640,2\ kJ/kg$, $h_{fg} = 2108,5\ kJ/kg$

$h_2 = h_f + x_2 \cdot h_{fg} = 640 + 0,973 \cdot 2108,5 = \underline{2690,73\ kJ/kg}$

1st law:

$\cancel{\dot{Q}}^{\,0} - \dot{W}_T = \dot{m}(h_2 - h_1) \Rightarrow \dot{W} = \dot{m}(h_1 - h_2)$

$\frac{\dot{W}}{\dot{m}} = w = (h_1 - h_2) = \underline{586,6\ kJ/kg}$