STUDENT SUCCESS CENTER
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

THERMODYNAMICS REVIEW

Energy Balance – Closed Systems	$E_2 - E_1 = Q - W$
Energy Rate Balance – Closed	$\frac{dE}{dt} = \dot{Q} - \dot{W}$
Energy Rate Balance – Steady State	$0 = \dot{Q}_{CV} - \dot{W}_{CV} + \sum_i \dot{m}_i \left(h_i + \frac{V_i^2}{2} + g z_i \right) - \sum_e \dot{m}_e \left(h_e + \frac{V_e^2}{2} + g z_e \right)$
Energy Balance – Power Cycle	$W_{cycle} = Q_{in} - Q_{out}$
Thermal Efficiency – Power Cycle	$\eta = \frac{W_{cycle}}{Q_{in}}$
Energy Balance – Refrigeration/Heat Pump Cycle	$W_{cycle} = Q_{out} - Q_{in}$
Coefficient of Performance – Refrigeration	$\beta = \frac{Q_{in}}{W_{cycle}}$
Coefficient of Performance – Heat Pump	$\gamma = \frac{Q_{out}}{W_{cycle}}$
Closed System Entropy Balance	$S_2 - S_1 = \int_1^2 \left(\frac{\delta Q}{T} \right)_b + \sigma$
Steady State Control Volume Entropy Rate Balance	$0 = \sum_j \frac{\dot{Q}_j}{T_j} + \sum_i \dot{m}_i s_i - \sum_e \dot{m}_e s_e + \dot{\sigma}_{CV}$
Ideal Gas Relations – Constant Specific Heat ratio, k, s1=s2	$\frac{T_2}{T_1} = \left(\frac{p_2}{p_1} \right)^{\frac{k-1}{k}}$ $\frac{T_2}{T_1} = \left(\frac{v_1}{v_2} \right)^{k-1}$ $\frac{p_2}{p_1} = \left(\frac{v_1}{v_2} \right)^{k}$
Ideal Gas Relation for Entropy – Constant Specific Heat	$s(T_2, p_2) - s(T_1, p_1) = c_p \ln \left(\frac{T_2}{T_1} \right) - R ln \left(\frac{p_2}{p_1} \right)$
Isentropic Efficiency Compressor & Pump	$\eta_c = \frac{\left(-\frac{\dot{W}_{CV}}{\dot{m}} \right)_s}{-\frac{\dot{W}_{CV}}{\dot{m}}} = \frac{h_{2s} - h_1}{h_2 - h_1}$
Isentropic Efficiency Turbine	$\eta_t = \frac{-\frac{\dot{W}_{CV}}{\dot{m}}}{\left(-\frac{\dot{W}_{CV}}{\dot{m}} \right)_s} = \frac{h_1 - h_2}{h_1 - h_{2s}}$
Saturation Table – Property Relationship (use for v, u, h, & s)	$u_1 = u_f + x_1 (u_g - u_f)$
Tds Relations	$Tds = du - pdv$ $Tds = dh - vdp$

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