MEGR3112

for mixtures of ideal gases:

mole fraction, $y_i = n_i/n_{mix} = p_i/p_{mix} = V_i/V_{mix} = (x_i/M_i)/(1/M_{mix})$ mass fraction, $x_i = m_i/m_{mix} = y_i M_i/M_{mix}$

$C_{p\,mix} = \sum x_i C_{P_i}$ $R_{mix} = \sum x_i R_i$ $M_{mix} = \sum y_i M_i$ $k_{mix} \neq \sum x_i k_i$

for air-standard cycles: $r_v = v_1/v_2$ $r_c = v_3/v_2 = T_3/T_2$ $r_p = p_2/p_1$ air standard Diesel: $r_c/r_v = v_3/v_4$

for mixtures of air and water vapor:

relative humidity, $\Phi = \frac{y}{y_{sat}} = \frac{mole\ fraction\ of\ vpor\ at\ T,P}{mole\ fraction\ of\ vapor\ at\ T,Psat} = \frac{P_v}{P_g} = \frac{partial\ pressure\ of\ vapor\ at\ T,P}{partial\ pressure\ of\ vapor\ at\ T,Psat}$

specific humidity (humidity ratio), $\omega = \frac{m_v}{m_a} = \frac{mass\ of\ vapor}{mass\ of\ air} = \frac{M_v}{M_a}\frac{P_v}{P_a} = 0.622\frac{P_v}{P_a}$

for mixture of air and water vapor with evaporation or condensation:

$$\frac{Q}{m_a} = C_p(T_2 - T_1) + \omega_2 h_{v2} - \omega_1 h_{v1} + (\omega_1 - \omega_2) h_{liq}$$

for reacting mixtures of ideal gases: $\bar{q} + \sum_i n_i [\bar{h}_f^0 + \Delta\bar{h}]_i = \bar{w} + \sum_e n_e [\bar{h}_f^0 + \Delta\bar{h}]_e$
reactants products

$\bar{h}_{RP}^0 = \sum_e n_e [\bar{h}_f^0]_e - \sum_i n_i [\bar{h}_f^0]_i$ = enthalpy of combustion = enthalpy of reaction = heating value

mean effective pressure, mep $= \frac{w_{net}}{v_2 - v_1}$ compression ratio, $r_v = \frac{v_1}{v_2}$

pressure ratio, $r_p = \frac{p_2}{p_1}$ Air std Diesel: cutoff ratio, $r_c = \frac{v_3}{v_2} = \frac{T_3}{T_2}$ $\frac{v_3}{v_4} = \frac{r_c}{r_v}$

$\eta_{th} = \frac{w_{net}}{q_H} = 1 - \frac{q_L}{q_H}$ Heat engine; $\beta = \frac{q_L}{w_{net}}$ Heat pump (cooler); $\gamma = \frac{q_H}{w_{net}}$ Heat pump (heater)

$w = -\int v\, dP - ½(\vec{V}_2^{\,2} - \vec{V}_1^{\,2}) - g(Z_2 - Z_1)$ Reversible, steady flow

$q = \int T ds$ Reversible process

$\frac{P_{R2}}{P_{R1}} = \frac{P_2}{P_1}$; $\frac{v_{R2}}{v_{R1}} = \frac{v_2}{v_1}$ Isentropic, ideal gas, non-constant specific heats

$\eta_{turbine} = w_a/w_s$ $\eta_{compressor} = w_s/w_a$ $\eta_{pump} = w_s/w_a$ $\eta_{nozzle} = \frac{\vec{V}_a^{\,2}}{\vec{V}_s^{\,2}}$