MECH 225 Engineering Science 2

Data sheet

Unless told otherwise in a question, you may assume the following:

Density of water = 1000 kgm^{-3}

Atmospheric pressure = 101.3 kPa

Acceleration due to gravity = 9.81 ms^{-2}

The universal gas constant, R_0 = 8314. J $kmol^{-1}$ K^{-1}

Formulae list

All the symbols have their usual meanings.

Reaction turbines and pumps:

$$u_r = \frac{\dot{V}}{2\pi r B}$$

$$u_w = \frac{u_r}{\tan\alpha}$$

$$\tan\beta = \frac{u_r}{u_w - U}$$

where U is the tangential speed of the impeller

$$T = \dot{m}(u_{w1}r_1 - u_{w2}r_2)$$

For an ideal gas:

$c_p - c_v = R$

For a reversible adiabatic process:

$p_1V_1^{\gamma} = p_2V_2^{\gamma}$ also $\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1} = \left(\frac{p_2}{p_1}\right)^{(\gamma-1)/\gamma}$

$$W = \frac{p_2V_2 - p_1V_1}{\gamma - 1} = mc_v(T_2 - T_1)$$

For a reversible constant pressure process:

$W = p(V_1 - V_2) = mR(T_1 - T_2)$ $Q = mc_p(T_2 - T_1)$

For a reversible constant temperature (isothermal) process:

$W = mRT\ln\left(\frac{V_1}{V_2}\right) = p_1V_1\ln\left(\frac{V_1}{V_2}\right)$ $Q = -W$

For a reversible constant volume process:

$W = 0$

$Q = mc_v(T_2 - T_1)$

For a reversible polytropic process:

$p_1V_1^n = p_2V_2^n$

n is the polytropic index

$$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{n-1} = \left(\frac{p_2}{p_1}\right)^{(n-1)/n}$$

$$W = \frac{p_2V_2 - p_1V_1}{n-1}$$

$Q = mc_v(T_2 - T_1) - W$