Chapter # 9

Problem # 9-1

Take the following data to estimate the difference between the fluid thermodynamic pressure and turbulent effective pressure; for the air flow through the wind tunnel，the pressure of the air is 1 bar, the average velocity is $u = 50$ m/s，the temperature of air is 20 $^{\circ}C$ ， and turbulence intensity $\sqrt{u'^2}/u = 5\%$ ， (which is a quite large value). Assumed that the turbulence is isotropic, i.e. various statistical values regardless of the direction of turbulence, here is $\overline{u'^2} = \overline{v'^2} = \overline{w'^2}$

Problem # 9-2

Try to write k equation in three dimension Cartesian coordinates (see 9-21)

Problem # 9-4

In a two-dimensional boundary layer flow, if the generation of turbulent kinetic energy and dissipation balanced each other, try this

$\sqrt{\tau_w/\rho} = C_\mu^{1/4} k^{1/2}$.

Problem # 9-5

The definition of turbulent kinetic energy dissipation rate is $\varepsilon = \nu[\overline{(\frac{\partial u_i'}{\partial x})^2}$. Try to write the expression of ε in three dimension Cartesian coordinates, and identify its dimension and unit (*SI*). Then to analyze c_μ, c_1, c_2 are dimensionless numbers or not.