1. Please derive equations for the kinetic energy of the mean flow and that of the turbulence.

2. Using the Navier-Stokes equations, develop an exact Reynolds stress transport equation applicable to an incompressible turbulent flow.

3. Using the vorticity equation, develop transport equations for mean vorticity and vorticity fluctuation. In addition, please also derive equations for the square of the mean vorticity and the mean-square vorticity fluctuation.