Department of Energy and Process Engineering
TEP4170 Heat and combustion technology

Exercise 3:

1) Conduct the development of the equation for turbulence energy (Eq. 3.4 in the textbook). Assume constant density.

2) In Exercise 2 you developed the mean momentum equation, Eq. 2.8 in the textbook. Formulate this equation on (2-dimensional) boundary layer form and explain which assumptions/approximations you have to do.

3) At several instances, helicopter crews reports abnormal engine operation at in-flight to a certain offshore oil platform. The power of the engine, a gas turbine, is reduced for a short moment.
   The instances are not critical incidents. However, as long as the reason is unknown, there is some unrest.
   After an initial discussion on the reason for the anomalities, you are consulted. In the first place, the discussion will be regarding what to investigate.
   One of the ideas put forth is that turbulence in the air might affect the air-inlet of the (gas-turbine) compressor.
   – Do an estimate to figure out whether this can be a reason.
   – Any other (potential) reasons?
   (Hint 1: have a look at Sect. 9.5 in the textbook. Hint 2: dynamic and static pressures.)

4) Figure 1.3 in the textbook (Ertesvåg) shows one of the classical experiments in turbulent combustion (Hottel and Hawthorne, 1947), which you will partly repeat in Lab. Exercise I:
   For a non-premixed flame it is observed that when the velocity (that is, the mass flow rate) increases, the length of a laminar increases correspondingly, while after a transition stage, the length of a turbulent flame is approximately constant.
   – Try to explain (write text!) these two observations.