project guidelines

To pass the project, you have to submit:
1. your model (e.g. Ansys Workbench .wbpz file);
2. report (in English),
3. short presentation (in English, max. 20 minutes, submit slides).

The report and presentation should include the following:
1. Introduction: why the topic is important?
2. Mathematical model: equations, additional models, boundary conditions, material properties, etc.
3. Numerical model: discretization methods, convergence criteria, etc.
4. Results with discussion: what was calculated? What does it mean?
5. General conclusions: a summary of the project and what you learned during its preparation.

Generally, the presentation should be a summary of the report. In addition, the report should include an appendix with a detailed step-by-step tutorial on how to prepare geometry, mesh, set up, and analyze the case.

Topics of your work are presented below. If some material property, boundary, or operating condition is not included, it is up to you to decide its value.

The submission deadline is **19th Nov 2024**. The presentation session will be on **25th Nov 2024**.

The detailed grading rules are shown in the table.

topic 1 — Haber-Bosch

The aim of this topic is to simulate a Haber-Bosch process in a plug-flow reactor filled with fine-powdered iron catalyst. The task is to analyze influence of the catalyst's porosity on the conversion rate.

The reactor is a cylindrical 2 m tube, in which the diameter to length ratio equals 1:4. Prepare analyses for several operating temperatures (400 °C, 450 °C, 500 °C) and several flow rates (30 kg/s, 40 kg/s, 50 kg/s). The inlet H_2 to N_2 molar ratio is 2.5:1.

topic 2 — PEMFC

The aim of this topic is to simulate operation of a polymer electrolyte membrane fuel cell. The task is to analyze influence of the electrolyte thickness on the current-voltage characteristics of the cell.

The height of the components are as follows:
- anode (total): 1 mm,
- cathode (total): 1 mm,
- electrolyte: varied in range 0.05 mm–0.50 mm (choose 3 values),
- anode channel: 5 mm,
- cathode channel: 5 mm.

All of these components have the same shape and are sandwiched to form a cell. The cell active area is 50 cm^2. It is up to you to decide the cell shape and flow channels arrangement. Prepare analyses for the same flow rate (equals $1 \cdot 10^{-3}$ kg/s) of fuel (molar fractions: H_2 0.5, H_2O 0.1, N_2 0.4) and air (molar fractions: O_2 0.21, N_2 0.79). The operating temperature is 50 °C.

topic 3 — separation

The aim of this topic is to analyze separation of oil particles from air in a cylindrical cyclone separator. The task is to analyze influence of the inlet velocity and on collection efficiency.

The dimensions of the separator are as follows:

- $D = 0.2\,\mathrm{m}$,
- $D_\mathrm{e} = D/4$,
- $B = D/8$,
- $H = 5D$,
- $h = 2D$,
- $S = D/2$,
- $a = D/2$,
- $b = D/4$.

Symbols description is shown in Figure 1. The temperature is constant. Inlet velocity should vary in range 1 m/s–10 m/s (choose 3 values).

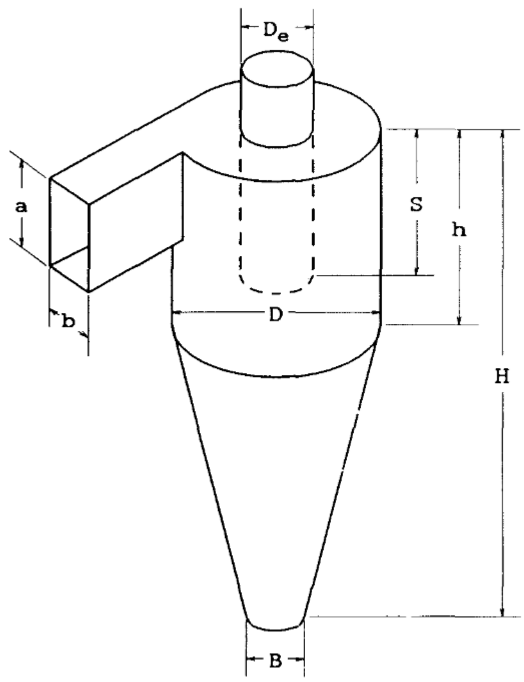

Figure 1: Scheme of cyclone separator (Aerosol Sci. Tech. 4:401–415 (1985))