Instructions for UT-KTH Mechanical Engineering Seminar II Fall 2025

Introduction
This seminar (or more properly project) is a task that requires searching for information beyond the course material, design of a study and perhaps a lot of engineering approximations. The work is performed in a group and at the end of the project you will hand in a jointly prepared account for each student's individual contribution to the work.

What do I need to do to pass?
In order to pass, the group must perform the project and report it with a poster. It is also required that the group prepares and present as specified below for each seminar. You must be present at the seminars (Nov 10, Nov 17, Nov 26, Dec 8) and at the poster presentation (Dec 17). Your contribution to the work, as presented in the joint account, must not be insignificant.

What will we do in more detail?
Together with a group consisting of students from UT and KTH you will:

1. Get acquainted with a flow problem from an earlier exam at UT or KTH and get an general understanding on what to do during the project. This is done before and during Seminar 1 (Nov 10).

2. Solve as much as possible of the examproblem and prepare a 8 minute (not more!) presentation describing the problem and its solution. The presentation is made at Seminar 2 (Nov 17).

3. Identify a phenomenon or construction/design where the flow case in the problem occurs. An image illustrating your chosen phenomenon or construction should be included in the presentation at seminar 2 (Nov 17).

4. Formulate a mathematical/physical model of the phenomenon or construction, where the dynamics of the fluid dynamical problem is included. Time dependent situations are encouraged (e.g. a heartbeat, emptying or filling, starting, pumping, etc)!

5. Solve the model analytically or numerically (or with a combination of methods). Points 4 and 5 are reported in a suitable manner during 8 minutes at Seminar 3 (Nov 26).

6. Make (at least) one parameter study and make conclusions regarding how the dynamics of the problem afect the phenomenon/construction. The accuracy of numerical solutions shall be investigated by varying the resolution.

7. Produce a poster reporting the project. The posters are discussed in digital form at Seminar 4 (Dec 8).

8. Present your poster at the poster presentation Dec 17.

Detailed instructions for seminar 1 & 2

Seminar 1

At this seminar, you will discuss the exam problem and the project together with other students working with the same problem. You shall have looked at the problem before the seminar. After the seminar everyone shall understand the problem and have an idea on how it can be solved.

You shall also get to know the other group members, have decided on how to communicate, when to meet and how to structure your work.

Seminar 2

At this seminar, your group shall present the solution of your problem. You will present the solution for course colleagues who has worked on other problems. You shall also present the phenomenon/construction you have chosen to study.

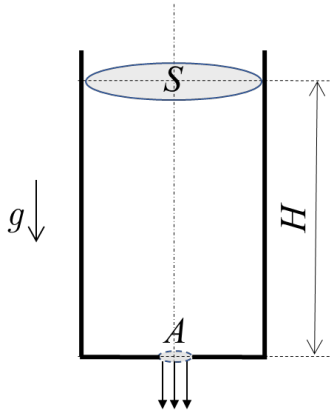
The solution is to be presented in a suitable manner during 8 minutes. Note that this is a fairly short time, why the presentation must be well prepared! The presentation shall finish with an image showing the phenomenon/construction you have chosen to model and study in the rest of the project.

Please chose either problem 1 or 2

Exam problem 1:

As shown in the figure, water flows out from a hole at the bottom of a cylindrical container. Let the area of the hole A, the depth of water H, the cross-sectional area of the container S, and gravitational acceleration g. Answer the following questions.

(1) Water is continuously added to the container so that the depth of water is kept constant at H. Find the volume flow rate Q of the water flowing out from the hole.
(2) Then, let us consider the case without adding water to the container. Assume that A is sufficiently small compared to S and find the time required to empty the container.



Exam problem 2:

As shown in the figure, two different kinds of liquid of density ρ_1 and ρ_2 flow into the mixer from inlet 1 and 2 respectively, and are mixed to create liquid of uniform density ρ_3 flowing out from outlet 3. A_1, A_2, A_3 and p_1, p_2, p_3 are the cross-sectional area and the gauge pressure at inlet 1, inlet 2, and outlet 3. Let Q_1, Q_2 be the volume flow rate at inlet 1 and inlet 2. Using the momentum conservation law, find the force, F_x and F_y, exerted to the mixer for both the x and y directions.