CIEG-306 Fluid Mechanics Laboratory

Spring 2012

Lecture: Monday 11:15am~12:05pm. 006 Kirkbride Lecture Hall.

Labs: Start from February 27 after experiment 1~3 are taught in Monday’s lecture. Experiments will be carried out in Ocean Engineering Lab according to the section you selected.

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Office Hours*: Prof. Hsu: Tue 1-2pm, or by appointment
Jia-Lin Chen: Tuesday, 11am~12pm
Jill Pietropaolo: Monday, 12~1pm
Christine Gralher: Wednesday 12~1pm

*office hour will start from the week of Feb 27 at Ocean Engineering Lab.

Textbook: Lecture handouts and your Fluid Mechanics textbook used in CIEG-305.


Course Description: This course is an independent one-credit course which is intended to be taken after CIEG-305 Fluid Mechanics. The course consists of seven experiments. Each experiment is carried out in groups after they are explained in the Monday lecture. Each group consisting of 9~10 students will measure a common set of data for a particular experiment. However, a lab report is required for each team consisting of 3 students (or less). Because more than one experiment will be performed at a time, it is necessary that the groups stay together for the entire semester. It is also important that before arriving at the lab the groups are prepared to perform the assigned experiment for that week.

Objective:
1. To illustrate the physical concepts of fluid mechanics developed in CIEG-305.
2. To serve as an introduction to experimental techniques in fluid dynamics.
3. To demonstrate the applicability and limitation of the theory and the uncertainties involved in measurements.
4. To develop the student’s ability to communicate technical information.

List of Laboratory Experiments:

1. Hydrostatic pressure on submerged surface.
2. Stability of a floating body.
3. Flow from a hole.
4. Impact of a jet.
5. Hydraulic jump.
6. Flow measurement.
7. Reynolds experiment – the nature of turbulence.

Organization of Labs

The experiment will be carried out in the Ocean Engineering Laboratory, behind Penny Hall. Aside from the last experiment, the lab will be set up so that three different experiments are being carried out side by side. On each lab day, your group perform one of the experiments (1~7). This procedure is intended to enable you to learn how to approach the experiments on your own and give you more opportunity for hands-on interaction with the apparatus. It is emphasized here that the teaching assistant’s job is NOT to perform the experiment for you. The teaching assistant’s job is to help keep the experiment apparatus running appropriately and to assist in interpretations, and to answer your questions. The teaching assistant is there to help but he/she will try to leave the group to proceed on their own.

For many students, it takes some adjustment to get accustomed to working in a group. For your own benefit, make sure you fully understand all steps of each experiment and try to operate the apparatus. Also, help others to achieve the same. If there is a disagreement in the group, try to resolve the issue by yourselves first. But if you really cannot, do not hesitate to seek help from the TA. Movies for experiment 1~6 are available on course website. Please watch it before you come to the lab session.

Lab Reports

The purpose of the lab report is to help you develop your technical communication skills. Hence, please take the writing of the report seriously and don’t postpone it to the last minute. The best result is often achieved if team member discuss the main points in the report before writing a draft. Then, each lab member can further iterate the writing before finalizing it.

For each experiment, every student is responsible for a lab report written by a team of 3 students or less. Students within a lab-group (i.e., students performing the experiment together on the same day and time) are encouraged to discuss their measured data.
It is highly recommended that the lab report be typed. A good lab report shall have the following format:

1. Title page with the title of the experiment, names of the students in the tram, the group and the date of the experiment.
2. Objectives.
3. Theoretical background.
4. Equipments
5. Procedures.
6. Results.
7. Error analysis.
8. Discussion and conclusion.
9. Appendices.

A report should be always concise, yet complete. Please use your own words; verbatim copying of the lab handout should be avoided, and point will be subtracted from your grade if you do.

Section 2 (Objectives) in your report summarizes in a few lines what is the nature of the experiment and what you want to achieve in this laboratory exercise.

Section 3 (Theoretical background) in the report gives the theoretical background for the experiment, including the derivations discussed during the lecture. Choose one of your textbooks as reference and try to present your derivation in the report based on your own words and writing styles. Write enough steps such that a reader does not need a piece of paper on the side to fulfill your derivation. Also remember that you may be able to help explaining some intermediate steps you omit by explaining them in words between the equations. Always number all equations and refer to the equation numbers in ().

Section 4 (Equipments) describes the equipment used for the experiment. It is important to include a drawing of the experiment that show all relevant details, including a definition of symbols used in the report. If you decide to use a drawing produced by students other than your team member, you need to cite it in your report. Each team shall also add an appropriate description of the equipment shown on the drawing.

Section 5 (Procedures) describes how the experiment is performed. This can be conveniently done as a numbered list of steps. You are also encouraged to include special comments (such as difficulties, cautionary notes) for certain step based on your own experience learned during the experiment.

Section 6, 7 and 8 are the most essential part of the report. In section 6 (Results), the raw data should be arranged in a tabular form. Also remember to use metric (S.I.) unit. If the data is extensive, you can present them in the Appendices. The analysis of the data can be documented in two ways: A completely worked out example for one set of the numbers is required. For repetitive calculations, the result of the results can simply be tabulated. Again, try to present the results and analyses in a systematic way and refer to the equation number that
you defined in the previous section. Use computer generated graphic for all graphics (you can use for example, Matlab or Excel).

In Section 7 (Error analysis), you should discuss the major sources of error in your data, and their effects on the results you presented, and try to comment on way to perform a more accurate experiment. It is likely that there are discrepancies between the theory and lab measurements. You should discuss how errors in your measurement can cause such discrepancies. Additionally, some assumptions used in deriving the theory may be too idealized and causing such discrepancies. These points shall be discussed carefully. In general, for the experiments considered in this course, the measured data should not deviate from the theoretical predictions by more than 10~20%. If you have error that is larger than expected, there may be something wrong in your measurement, your data analysis or your theoretical calculations. You need to find the error before submitting the report.

In section 8 (discussion and conclusion), answer the questions as required in the lab handout and added with your own observations and finding.

The Appendices shall include copies of the original notes taken in the laboratory. This record of your data collection should include the following (1) name of data recorder, (2) names of all group member present, (3) data.

Grading:

The lab reports are graded on a scale of 100 for each experiment. Positive points are distributed on the basis of merit, such as

- Are the overall thoughts in the report organized?
- Are important details carefully explained?
- Are the discussion and error analysis complete and reasonable?
- Is the report provides insights to the fluid mechanics problem and demonstrate your good understanding?

Lab reports are due two weeks after the experiments are carried out. Late reports will be penalized (three points each day) unless you get special written consent from the TA. As a reminder, you shall always keep your report in your computer, just in case of loss of your report.

Lab attendance is absolutely necessary. 50 points are deducted from each lab report if you miss the session without permission. 10 points are also deducted if one arrives the lab session more than 10 minutes after the group members have started the experiment. Grading standards will be set by the teaching assistant. Grading concerns are questions shall be first directed to the TA. If no agreement is reached, students should meet with Prof. Hsu.