UBC - Department of Mechanical Engineering
MECH 489/582 – Experimental Thermofluids
4 Credits / [3,2,0]

INSTRUCTOR: Dr. N. Atabaki, P. Eng.

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OFFICE HOURS: Wed 11:00 to 12:00 RH 104
or by appointment (e-mail)

LECTURES: MECH 489 101 & MECH 582 101 — Mon/Wed/Fri 10:00 to 11:00
MacMillan 256

LAB: Tue 17:00 to 19:00
Location: TBA

TA: Soheyl Vakili — **Office:** Room X221 ICICS (phone: 604-822-0939)
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PREREQUISITES:

MECH 327 and MECH 380 (You need a good background in Fluid Mechanics and Heat Transfer)

COURSE DESCRIPTION

This course is designed to introduce students to the basics of designing thermofluid experiments. The following topics will be discussed: Introduction to measurement systems; Experimental uncertainties, and error analysis; Data acquisition systems; Pressure measurement; Temperature measurement; Flow measurement; Flow visualization techniques; Design of experiments; and Case studies of industrial and research experimental practice.

COURSE MATERIALS

Instructor's handouts will be distributed in class.

TEXTBOOK

The following Textbook is a good reference for this course (buying is **optional**):

Experimental Methods for Engineers
J.P. Holman, 7th Edition, McGraw-Hill, 2001.

REFERENCE TEXTBOOKS

The following textbooks are additional references for this course:

1. **Theory and Design for Mechanical Measurements**
   R.S. Figliola, and D.E., Beasley, 4th Edition, Wiley, 2006.

2. **Measurement and Data Analysis for Engineering and Science**,
   P.F. Dunn, McGraw-Hill, 2005.

3. **Thermal and Flow Measurements**
   T.W. Lee, CRC Press, 2008.

4. **An Introduction to Error Analysis**
   J. Taylor, 2nd Edition, University Science Book, 1982.

5. **Fluid Mechanics**
   F.M. White, 6th Edition, McGraw-Hill, 2008.

6. **Principles of Engineering Thermodynamics**
   M.J., Moran, and H.N., Shapiro, 5th Edition, Wiley, 2004.

7. **Principles of Heat Transfer**
   F., Kreith, and M.S., Bohn, 6th Edition, Brooks/Cole, Pacific Grove, California, 2001.

8. **Fundamentals of Heat and Mass Transfer**
   F.P., Incropera, and D.P., DeWitt, 5th Edition, Wiley, 2001.

REFERENCE JOURNALS

The following Journals are additional references for this course:

1. **Journal of Applied Mechanics**
2. **Journal of Heat Transfer,** *trans. ASME*
3. **International Journal of Heat and Mass Transfer**
4. **Journal of Fluids Engineering**
5. **International Journal of Heat and Fluid Flow**
6. **AIAA Journal of Thermophysics and Heat Transfer**
7. **Experimental Thermal and Fluid Science**
8. **Journal of Fluid Mechanics**

GRADING POLICY

Suggested Homeworks (**0%**)
3-4 Problem Sets will be distributed in class; these are **recommended**; **NOT** to be turned in for grading.

Laboratory Activities (25%)
1- Wind tunnel experiment (**12.5%**)
2- Heat transfer experiment (**12.5%**)
These experiments will be done in groups of two class members *(except for graduate students that should work individually)*. A lab report should be turned in for grading within two weeks of the experimentation date for each group. You need to register with the TA for the Lab schedule.

Mini Project (25%)
A mini project will be assigned. Projects involve designing an experiment in Thermofluids (Subjects will be defined by the Instructor). Each project should be done in groups of two class members *(except for graduate students that should work individually)*.The outcomes of the projects are a complete report and an in-class presentation.

Mini project Report - (**15%**) **Subject Title Given:** Monday, October 26; **Due:** Friday, November 13.

In-Class presentation - (**10%**) Each group has a class presentation of 15 min followed by a 10 min question period starting in the week of Monday, November 16, 2009.

Midterm (20%)
A 50 min midterm exam is designed to be held on **Friday, October 23,** 2009, starting at 10:00 in MacMillan 256.

Final Exam (30%)
Date and location of the final exam will be determined later.

LIST OF TOPICS AND COURSE OUTLINE

		Estimated Length
1)	Introduction	2 weeks
2)	Probability and Statistics	1½ weeks
3)	Uncertainty Analysis	1 week
4)	Data Acquisition System	1 week
5)	Pressure Measurement	1 week
6)	Temperature Measurement	1 week
7)	Flow Measurement/Flow Visualization	1½ week
8)	Experimental Case Studies (Guest Speakers)	1 week
9)	Student In-Class Presentations	2½ weeks

LEARNING OBJECTIVES

A) General Objectives:

- Familiarize students with different aspects of designing an experiment;
- Make understand the importance of quantifying and presenting experimental errors and uncertainties
- Introduce common measurement devices, techniques, and instrumentations used in thermofluid experiments;
- Make students ready to conceive a thermofluid experiment

B) Specific Objectives

At the end of this course, it is expected that students will able to:

- Apply the concept of planning experiments;
- Understand the importance of dimensional analysis and calibration;
- Communicate and report clearly your results
- Identify random and systematic errors
- Apply the statistical approaches in determining random errors;
- Apply data reduction techniques
- Perform uncertainty analysis
- Use available techniques for propagation of uncertainties;
- Understand the general concept of data acquisition
- Select pressure, temperature and flow measurement systems