ENME 712: Measurement and Instrumentation Techniques for Thermal and Fluid Processes

Spring Semester 2020

M, W 11:00-12:15 pm, MATH 0106

Instructors:	K. Kiger, with guest lectures from C. Cadou, S. Stoliarov, P Sunderland, and J. Wright and A. Johnson (NIST)
Offices:	Dr. Kiger EGR 1131U (301) 405-5245 (see CANVAS for contact information for guest lecturers)
Office Hours:	Monday 12:15 – 2:00 pm, and by appointment
Text Book:	No formal textbook is assigned for the course. Class notes and reference books will serve as the "text."
Reference Books:	See list at end of syllabus.

Course Description

This course is designed to offer systematic coverage of the methodologies for measurement and data analysis of thermal and fluid processes at the graduate level. The course content is divided into two main segments: one which is composed of a guided independent survey of contemporary and current developments in instrumentation, and the second which is a more traditional review of established and commonly used instrumentation in thermo-fluid processes.

In the first component (about 20% of the course), students will be introduced to and invited to investigate the frontiers of research in novel instrumentation methods and technologies and the challenges they present in measurement and instrumentation. Our focus will be on the measurements methods for fluid flow, the transport of heat, mass, and momentum in a diverse range of flow situations. The format will be structured through several group homework assignments, culminating with a lecture to the class detailing your findings.

In the second component (about 80%), we will cover the state of the art in measurement and instrumentation techniques as related to thermal and fluid processes. Specifically three main modules will be covered: (1) Traditional measurement techniques for pressure, temperature and flow rate; (2) more contemporary specialized instrumentation for velocimetry, heat flux, species characterization and multiphase flow and (3) Experimental design and planning, sources of errors in measurements, and uncertainty analysis. Your understanding will be reinforced with several individual homework sets and a second group project designed to reinforce the process of experimental design and assessment of uncertainties inherent to the measurement process.

The course should be a must for researchers with either a computational or experimental research background interested in acquiring a systematic understanding of commonly used thermofluid instrumentation as well as state-of-the-art and emerging technologies in measurement science.

Grading

Tentative grade weight distributions are as follows:

Homework	25%
Projects and Presentations	40%
Exams/Quizzes	35%

For additional details feel free to send an email to Dr. Kiger (kkiger@eng.umd.edu)

-

COURSE OUTLINE – Detailed, but approximate. Timing may change to suit needs of guest lecturers and material coverage.

Monday,	January 27, 2020	Introduction, Survey Project Assignment	KK
Wednesday,	January 29, 2020	Experimental Design I	KK
Monday,	February 3, 2020	Experimental Design II	KK
Wednesday,	February 5, 2020	Uncertainty Analysis	KK
Monday,	February 10, 2020	Volumetric Flowrate I	JW+AJ
Wednesday,	February 12, 2020	Volumetric Flowrate II	JW+AJ
Monday,	February 17, 2020	Pressure Measurement - Gages	KK
Wednesday,	February 19, 2020	Pressure Measurement - Probes	KK
Monday,	February 24, 2020	Temperature – Thermocouple I	KK
Wednesday,	February 26, 2020	Temperature – Thermocouple II	KK
Monday,	March 2, 2020	Temperature - RTD, Thermistors	KK
Wednesday,	March 4, 2020	Exam 1	KK
Monday,	March 9, 2020	Survey Project Presentations	class
Wednesday,	March 11, 2020	Survey Project Presentations	class
Monday,	March 16, 2020	Spring Break	KK
Wednesday,	March 18, 2020	Spring Break	KK
Monday,	March 23, 2020	Velocity Measurement – light propagation	KK
Wednesday,	March 25, 2020	Velocity Measurement – LDA	KK
Monday,	March 30, 2020	Velocity Measurement - PIV	KK
Wednesday,	April 1, 2020	Velocity Measurement - PIV	KK
Monday,	April 6, 2020	Species measurement	SS
Wednesday,	April 8, 2020	Exam 2	KK
Monday,	April 13, 2020	Spectroscopic methods (PLIF+IR)	CC
Wednesday,	April 15, 2020	Combustion: soot characterization	PS
Monday,	April 20, 2020	Thermal Anemometry	KK
Wednesday,	April 22, 2020	Heat Flux Measurement	KK
Monday,	April 27, 2020	Challenges In Measuring Multiphase Flow	KK
Wednesday,	April 29, 2020	Multiphase Flow Measurement	KK
Monday,	May 4, 2020	Multiphase Flow Measurement	KK
Wednesday,	May 6, 2020	Final Project Discussion	KK
Monday,	May 11, 2020	Final Project Discussion	KK

KK: Ken Kiger
JW: John Wright
AJ: Aaron Johnson

PS: Peter Sunderland
SS: Stanislav Stoliarov
CC: Chris Cadou

General References:

Goldstein, R.J., *Fluid Mechanics Measurement, 2nd ed.*, Taylor & Francis, Washington DC, 1996.

Holman, J.P., *Experimental Methods for Engineers, 7th ed.*, McGraw-Hill, New York, 2000.

Tropea, C., Yarin, A. & J. Foss (editors), *Springer Handbook of Experimental Fluid Mechanics*, Springer-Verlag, Berlin, 2007.

Topical References

Hinds, W.C., *Aerosol Technology: Properties, Behavior and Measurement of Airborne Particles, 2nd ed.*, John Wiley & Sons, Inc., New York, 1999.

Eckbreth, A.C., *Laser Diagnostics for Combustion Temperature and Species, 2nd ed.*, Gordon and Breach Publishers, Amsterdam, 1996.

Kohse-Höinghaus, K. and J.B. Jeffries, *Applied Combustion Diagnostics*, Taylor & Francis, New York, 2002.