ME 306: Thermal and Fluids Laboratory

Course description: Instrumentation, data acquisition, and theory verification in the thermal and fluid sciences.

Number of credits: 2 (1-3). This course is required.

Course Coordinator: C.D. Richards

Prerequisites by course: ME 301; ME 303; STAT 370 or concurrent enrollment; certified major in Mechanical Engineering

Prerequisites by topic:

1. Thermodynamics, including properties, first law, and second law.
2. Fluid mechanics.
3. Experience using spreadsheets for calculations and plotting.
4. Statistics including probability and confidence intervals.

Postrequisites: ME 406

Textbooks/other required materials: Wheeler, A.J. and Ganji, A.R, *Introduction to Engineering Experimentation*, Prentice Hall, 2010, 3rd edition.

Course objectives:

1. Learn the operating principles of some of the instruments used by mechanical engineers.
2. Learn how computers can be used for data acquisition and processing.
3. Learn how to use some basic electronic instruments.
4. Develop a better understanding of some of the concepts of thermodynamics and fluid mechanics through theory verification experiments.

Topics covered:

1. Data processing and plotting
   a. Plotting and fitting thermocouple and pressure transducer data
   b. Using Excel to compute FFT and transfer function
   c. Using Excel to find the response time.
2. Electronic instruments
   a. Digital multimeter
   b. Oscilloscope
   c. Function generator
   d. Digital thermometer
   e. Amplifiers
3. Digital data acquisition
   a. Successive approximation A/D converters
   b. Nyquist frequency and frequency folding
   c. Sampling to determine amplitude and frequency information
   d. Quantization of error of an A/D converter

e. Components of a digital data acquisition system
4. Instrumentation and uncertainty, including bias and precision error for a single sample experiment and measuring devices: temperature, pressure, velocity, flow, and force
5. Theory verification (rotated each semester)
   a. Measurement of conduction
   b. Calibration of a venturi
   c. Pressure loss in pipes, bends, and valves
   d. Tank filling and discharge
   e. Transition between laminar and turbulent flow

Expected learning outcomes:

1. Understand how to estimate the uncertainty of an instrument.
2. Know how to present data in a spreadsheet.
3. Know how to use a spreadsheet for data reduction including how to calculate a Fourier transform and a transfer function.
4. Know how to plot experimental data using a spreadsheet.
5. Know how to use some of the fundamental electronic instruments.
6. Know how to specify a simple digital data acquisition system.
7. Know the operating principles of the instruments used by mechanical engineers.
8. Know how to specify an instrument for a particular application.
9. Increase understanding of some principles of thermodynamics.
10. Increase understanding of some concepts of fluid dynamics.

Class schedule: One 50-minute lecture session per week.

Laboratory schedule: One 3-hour laboratory session per week.

Relationship of course to program objectives: Engineering Topics

Relationship of course to student outcomes:
3 strongly supported; 2 supported; 1 minimally supported

Student Outcomes Pre-Fall 2018 (ABET EC2000)

a	b	c	d	e	f	g	h	i	j	k
	3			1		2		1		2

Student Outcomes Fall 2018 forward (ABET EC2019)

1	2	3	4	5	6	7
1		2			3	2

Prepared by: Andrea Butcherite and C.D. Richards *Date:* May 30, 2018