

## 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:* K. Matveev
- Prerequisites by course:* ME 301; ME 303; STAT 370 or concurrent enrollment; admitted to the 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, 3<sup>rd</sup> 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:*

Meets:

1. School of MME ME educational objectives: 1, 2, 3
2. School of MME ME program outcomes: 1, 3, 6, 7
3. ABET EC2019, Criterion 3 program outcomes: 1, 3, 6, 7

*Prepared by:* Amy Johnson and K. Matveev

*Date:* September 1, 2020

#### **POLICIES**

**A. Reasonable Accommodation** (the nature of the particular course determines which one applies):

- **Pullman Campus.** Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center.
- **WSU Online Course.** Reasonable accommodations are available in online classes for students with a documented disability. All accommodations must be approved through your WSU Disability Services office. If you have a disability and need accommodations, we recommend you begin the process as soon as possible. For more information contact a Disability Specialist on your home campus: Pullman or WSU Online (<http://accesscenter.wsu.edu>), Spokane (<http://spokane.wsu.edu/students/current/studentaffairs/disability/>), Tri-Cities (<http://www.tricity.wsu.edu/disability>), Vancouver (<http://studentaffairs.vancouver.wsu.edu/student-resource-center/disability-services>).

#### **B. Academic Integrity**

WSU expects all students to behave in a manner consistent with its high standards of scholarship and conduct. Students are expected to uphold these

standards both on and off campus and acknowledge the university's authority to take disciplinary action. The Standards of Conduct for Students can be found at <http://conduct.wsu.edu>.

**C. WSU Safety**

WSU is committed to maintaining a safe environment for its faculty, staff, and students. Safety is the responsibility of every member of the campus community and individuals should know the appropriate actions to take when an emergency arises. In support of our commitment to the safety of the campus community the University has developed a Campus Safety Plan, <http://safetyplan.wsu.edu>. It is highly recommended that you visit this web site as well as the University emergency management web site at <http://oem.wsu.edu/> to become familiar with the information provided.