

## **ME 301: Fundamentals of Thermodynamics**

*This is a cooperative course taught jointly by WSU and the University of Idaho.*

- Course description:* Thermodynamic properties of matter, ideal and real gases, work and heat, first and second laws and their application to engineering systems.
- Number of credits:* 3. This course is required.
- Course Coordinator:* D. McLarty
- Prerequisites by course:* Physics 201 with a grade of C or better, or PHYS 201 and 211, both with a C or better
- Prerequisites by topic:*
1. Differentiation
  2. Integration
  3. Conservation of mass
  4. Conservation of energy
- Postrequisites:* ME 405; ME 303 (recommended)
- Textbooks/other required materials:*
1. Cengel, Y. *Property Tables Booklet/Thermodynamics*. McGraw-Hill, 2010, 7/e.
  2. Cengel, Y.A. and Boles, M.A. *Thermodynamics: An Engineering Approach*. McGraw-Hill, 2014, 8/e.
- Course objectives:*
1. Determine the properties of pure substances using thermodynamic tables.
  2. Use the ideal gas law.
  3. Calculate changes in internal energy and enthalpy using specific heats.
  4. Calculate the work done by a closed system via integration.
  5. Apply the first law of thermodynamics to a closed system.
  6. Apply the first law of thermodynamics to an open system.
  7. Analyze the Carnot, Otto, and Rankine thermodynamic cycles.
  8. Apply the second law of thermodynamics.
  9. Calculate changes in entropy using thermodynamic tables.
  10. Calculate changes in entropy for ideal gases.
- Topics covered:*
1. Basic concepts of Properties in pure substance.
  2. First law of thermodynamics for closed systems.
  3. First law of thermodynamics for control volumes.
  4. Second law of thermodynamics; Carnot Cycle; thermodynamic temperature scale.
  5. Concept and calculation of entropy.
  6. Gas power cycles; Vapor cycles.
  7. Refrigeration cycles.

*Expected learning outcomes:*

1. An understanding of how an automobile engine runs, how a utility plant generates electricity, and how a refrigerator keeps the icebox cold.
2. Ability to analyze the performance of an engine, a power plant, or a refrigerator by applying the first law of thermodynamics.
3. Ability to determine the fundamental limits on the operation of these devices using the second law of thermodynamics.

*Class schedule:*

Three 50-minute lecture sessions per week, for one semester.

*Laboratory schedule:*

None.

*Contribution to meeting the professional component:*

Engineering Topics

*Relationship of course to student outcomes:*

Meets:

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

*Prepared by:* Amy Johnson and D. McLarty

*Date:* May 6, 2021

#### **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.