

ME 201: Introduction to Thermal Science

Summer 2021, Online University Park

May 17 to August 13, 2021

This is an online course offered during the Summer 2021 semester for non-Mechanical Engineering majors. The course is in a remote asynchronous format. This means you will participate in the course with no formal lecture times. You will be responsible to read course material, watch the video lectures, complete course assignments, and take two course exams proctored online. Pre-recorded on-demand video lectures will be available for watching online via CANVAS. A schedule of important deadlines is given on the last page.

Instructor: Dr. Laura L. Pauley, llp1@psu.edu

Office Hours: In most weeks office hours will be by Zoom on Friday at 11AM– 1 PM EDT. Before the midtem exam I will have office hours on Tuesday and before the final exam I will have office hours on Thursday. Zoom Office Hours will be at <https://psu.zoom.us/j/2440712508>.

Live Class: On weeks when there is an exam, I will have a live (optional) review session to answer any questions that you have before the exam. The live Zoom class will be at 11 AM EDT at <https://psu.zoom.us/j/93822957772>. You will need to log into psu.zoom.us before entering the Zoom session. I will record and post these review sessions for students who are not able to attend.

Text: Fundamentals of Thermal-Fluid Sciences, 6th Edition, in digital format on McGraw Hill Connect. You must purchase the digital materials since questions on the reading and homework problems are in Connect. To purchase the Connect materials, use the link from the Canvas course site to receive a discounted price. See instructions on the next page for purchasing the text.

Prerequisites: CHEM 110 or equivalent

| | | |
|-----------------|---------------------|-----|
| Grading: | Reading Questions** | 20% |
| | Homework** | 25% |
| | Midterm Exam | 25% |
| | Final | 30% |

** The lowest score will be dropped before the average is determined.

The final course grade will be assigned using the following approximate cutoffs:

| | |
|-----------------|-------------------|
| A 92.0 - 100 | C+ 77.0 – 79.99 |
| A- 90.0 - 91.99 | C 70.0 – 76.99 |
| B+ 87.0 - 89.99 | D 60.0 – 69.99 |
| B 83.0 – 86.99 | F 59.99 and below |
| B- 80.0 – 82.99 | |

Canvas: This course has a Canvas site. Included on the site are the pre-recorded lesson videos for each module. Lesson may be paused, restarted, rewound, and watched multiple times. I recommend that you watch each lesson in two or more sessions with short pauses between the sessions in order to stay focused while watching. Exams will be given in Canvas. In the Canvas course site you will find a link to “McGraw Hill Campus” from the left menu. You should purchase your course digital materials using this tab to get the discounted price.

Reading Assignments with Questions: In each Topic Module there are one or two reading assignments in McGraw Hill Connect. You should read the assignments given in the course schedule from the electronic text. Each reading assignment has conceptual questions that need to be submitted by Friday at 11:50 PM EDT. You will only get a grade for the assignment after you complete the related questions. If you do not complete the questions before the due date, you will be given a score based on the amount completed at the due date. For each concept in the reading, you will be asked questions until you show a good understanding of that concept. For each question there is a link “Read About the Concept” that will guide you to the related section of the reading. Exams will include conceptual questions similar to these reading questions.

Homework: Homework is completed in McGraw Hill Connect. Homework will be due for every module by Sunday 11:50 PM EDT. The homework assignment can be reopened in multiple visits and is only recorded as an “attempt” when you “submit” your work. You will be given two “attempts” for each assignment. After submitting the first attempt, you will be told which problems were correct and you will find an explanation of each problem calculation. If you choose to use a second attempt for the homework, you will be given different numbers to solve in each problem and your score for the second attempt will be penalized by 10%. Late homework is penalized by 15% per day. Your highest score for each homework will be used in calculating your homework average. The lowest recorded homework grade for the semester will be dropped before the average is determined.

Exams: The midterm exam is on Wednesday June 30 and the final exam is on Friday August 13. Each exam will be one hour long and will be available during an 11 hour window from noon to 11 PM EDT. The exam will be available in Canvas and proctored by Examity. You will need to schedule a proctoring time with Examity before taking each exam. The exam questions will be viewed as a Canvas “Quiz”. After writing out your solutions to each problem you will scan your work and upload it to a Canvas dropbox for partial credit grading. Details about the Examity proctoring can be found below.

Exam Proctoring: Exams will be proctored using Examity at no additional expense to the student. Each exam will be open during an 11 hour period and you must schedule a time for your exam to be proctored by Examity. You will need a computer with web cam and microphone to take the exams. You will also need to scan your work and generate one pdf file to upload to the Canvas dropbox. You can use a computer scanner or CamScanner on your cell phone. Photos of your work are not accepted.

*“This course will require you to take exams using certain proctoring software that uses your computer’s webcam or other technology to monitor and/or record your activity during exams. The proctoring software will be listening to you, monitoring your computer screen, viewing you and your surroundings, recording and storing any and all activity (including visual and audio recordings) during the proctoring process. By enrolling in this course, you consent to the use of the proctoring software selected by your instructor, including but not limited to any audio and/or visual monitoring which may be recorded. **Please contact your instructor with any questions.**”*

Computer Requirements: At this time, review Examiity System Requirements < <https://examiity.psu.edu/support-technical-help/>> to make sure your computer meets the minimum standards. In addition, be sure to access the Examiity Computer Readiness Check < <https://prod.examiity.com/systemcheck/check.aspx>>

In addition to the Examiity requirements, this online course will require ready access to a document scanner that allows for the creation of PDF files, which will enable students to submit handwritten homework and exams. You must have access to the scanner during your proctored exam session. Students can use a computer scanner or CamScanner on their cell phone. Submitted scanned work must be in one pdf file. Photos of your work are not accepted.

Grade Appeal: For two weeks after an exam is returned, the grade may be appealed by returning it with a short note to Dr. Pauley. After two weeks have passed, no grade will be changed.

Digital Textbook and Materials: The work for the readings and homeworks must be completed on the electronic text (eText) site **Connect**. Therefore, access to the eText on Connect is absolutely required and must be purchased. It is available at a significantly discounted price compared to the hard copy of the text, and there is a two-week complimentary access pass available. The hard text copy is neither required nor sufficient for course work.

To purchase the Connect materials at a discounted price, log into the Canvas course site and click on the “McGraw Hill Campus” tab on the left course menu under the Home tab. When registering on CONNECT, use your Penn State email ID, such as abc1234@psu.edu; however, do not use your Penn State password. Do NOT use any other email address (like gmail, hotmail, etc.).

In case you are considering dropping the class, you will be offered free access to CONNECT and the electronic text for an initial trial period (two weeks). However, you must complete the CONNECT access purchase immediately after the complimentary period if you plan to continue in the class. The following is a useful link to a YouTube video on how to use the eText and the CONNECT software, and we strongly recommend that you watch it before starting assignments:

<https://www.youtube.com/watch?v=auaHNO9A2Es>
<https://www.youtube.com/watch?v=E85ZXgBw6yQ&t=234s>

You may also purchase the loose leaf paper edition or the hardcover edition of the textbook. However, it is not required and only having a paper or hardcover edition is not sufficient.

Objectives and Scope: This introductory course in *Thermal Sciences* will introduce you to three traditional fields:

- (1) Thermodynamics (Greek *thermes* - heat), which is about the fundamentals of energy, properties of matter, and their relationship. Scope is limited to the classical (as opposed to statistical) viewpoint;
- (2) Fluid Mechanics, where you will learn about principles governing flow of gases and liquids; and,
- (3) Heat Transfer, involving the fundamentals of transport of energy caused by the difference in the temperatures of two or more bodies. We will examine different modes of heat transfer - conduction, convection and radiation.

Furthermore, we will study engineering systems and their interactions with surroundings as they pertain to energy and fluid exchange, approached from a basic as well as an applied (problem solving) point of view. We will also discuss some of the current issues related to course topics.

Course Delivery and Contact Information: Primary communication will be via two portals- (i) the CANVAS portal on the Penn State site and (ii) the McGraw-Hill Connect site. For more information on:

- **Course content and topics** – Contact the instructor Dr. Pauley at llp1@psu.edu.
- **Homework, Exams, and Reading Assignments** – Contact the instructor Dr. Pauley at llp1@psu.edu.
- **Online delivery, course access difficulties, CANVAS issues, etc.** – Contact e-Learning Specialist, Richelle Weiger, at rbw11@psu.edu
- **Connect or eBook issues** – Call or contact tech support at <http://mpss.mhhe.com/> (see details below)

Additional information/instructions will be updated on CANVAS occasionally as needed. This is a tentative outline and changes may be announced later.

Connect Help: Students can visit the following link for online assistance/chat or other help from the Connect tech team or call the phone numbers provided below:

<https://mhedu.force.com/CXG/s/ContactUs>

USA and Canada 1-800-331-5094 (toll-free)

Sunday: 12 PM - 12 AM

Monday –Thursday: 24 Hours

Friday: 12 AM - 9 PM

Saturday :10 AM - 8 PM

(USA Eastern Time)

The instructor may adjust the above scale in the final analysis, but in no case will scores higher than those listed above be required to achieve the stated letter grades.

Make-up Work: There may be a week during the summer when you are not able to turn in an assignment in a timely manner because there are unavoidable circumstances, such as illness, athletic event-related or work-related travel, family vacation with no Internet access, late registration, computer problems, family emergency, etc. It is for these reasons I have adopted the policy that one lowest grade in the homeworks and reading assignments will be dropped -

(see “Grading Policy” above). The first HW assignment and/or first Reading Assignment missed for any reason will be automatically treated as a dropped score(s) – **therefore, please do not request a make-up for any first missed assignment**. Any additional make-up assignments will be allowed only under extremely unusual circumstances, with proper documentation for the first as well as the subsequent missed instances. Anticipated absences should be reported well before the due date of assignment.

Students with Disabilities: Penn State welcomes students with disabilities into the University’s educational programs. Every Penn State campus has an office for students with disabilities. The Student Disability Resources (SDR) website provides contact information for every Penn State campus (<http://equity.psu.edu/sdr/disability-coordinator>). For further information, please visit the Student Disability Resources website (<http://equity.psu.edu/sdr>).

In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an on-site interview, and provide documentation: See documentation guidelines (<http://equity.psu.edu/sdr/guidelines>). If the documentation supports your request for reasonable accommodations, your campus disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early as possible. You must follow this process for every semester that you request accommodations.

Counseling and Psychological Services: Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional well-being. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients’ cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity, and sexual orientation.

-Counseling and Psychological Services at University Park (CAPS)

<http://studentaffairs.psu.edu/counseling/> ; 814-863-0395

-Counseling and Psychological Services at Commonwealth Campuses

<http://senate.psu.edu/faculty/counseling-services-at-commonwealth-campuses>

-Penn State Crisis Phone Line (24 hours/7 days): 877-229-6400

-Crisis Text Line (24 hours/7 days): Text LIONS to 741741

Educational Equity/Report Bias: Consistent with University Policy AD29, students who believe they have experienced or observed a hate crime, an act of intolerance, discrimination, or harassment that occurs at Penn State are urged to report these incidents as outlined on the University’s Report Bias webpage <http://equity.psu.edu/reportbias/>.

* Submit a report via the Report Bias webpage (<http://equity.psu.edu/reportbias/>)

* Contact one of the following offices:

-University Police Services, University Park: 814-863-1111

-Multicultural Resource Center, Diversity Advocate for Students: 814-865-1773

-Office of the Vice Provost for Educational Equity: 814-865-5906

-Office of the Vice President for Student Affairs: 814-865-0909

-Affirmative Action Office: 814-863-0471

Disclaimer: This is a tentative outline; changes may be made and announced as necessary.

Academic Integrity Policy

Academic integrity is the pursuit of scholarly activity free from falsification, misrepresentation, and deception and is an educational objective of this institution. All University policies regarding academic integrity apply to this course. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights, and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

All submitted work for this class (homeworks and exams) must be your individual effort. Evidence to the contrary will result in failure of the course. This same policy applies to any other deliberately dishonest action.

The University and the College of Engineering consider academic dishonesty, including cheating and plagiarism, to be a serious offense. The University Policy 49-20 describes the general university policy on academic dishonesty. For Engineering, the academic integrity web site is at <https://advising.engr.psu.edu/student-resources/academic-integrity.aspx> . Dishonest incidents should be reported to the course instructor or to the Department Head who will refer it to the College Committee on Academic Dishonesty.

Academic dishonesty includes, but is not limited to,

- cheating, including using solutions posted online
- plagiarizing
- fabricating of information or citations
- facilitating acts of academic dishonesty by others, including uploading solutions to an online site or sharing your work with others.
- having unauthorized possession of examinations
- submitting the work of another person or work previously used without informing the instructor
- tampering with or modifying the academic work of other students

Examples: Any sharing of assignment solutions or answer keys via personal communication or websites other than those communications or web-based applications used as part of the course is not allowed. Copying from other students, copying from answer keys or solution sets, or having tutors complete assignments for students is unacceptable. All of these are examples of academic dishonesty. Instructors regularly monitor the web for inappropriate posting of instructional materials.

It is expected that any work submitted is your own. Students in this class are expected to work on their assignments individually. All exam answers must be your own, and you must not provide any assistance to other students, nor accept assistance from others during exams.

Consequences: Students who present other people's work as their own, post their own work for others to copy, or post answer keys will receive, at minimum, a 0 on the assignment. They may also receive an F or XF in the course and be recommended for academic or disciplinary sanctions.

Summer 2021 ME 201 Course Topics Outline

Updated 6/14/2021

Required Text: **Electronic text (eText)** *Fundamentals of Thermal-Fluid Sciences* by Y.A. Cengel, J.M. Cimbala, and R.H. Turner, 6th Ed. by McGraw-Hill.

| Week | Lecture Notes | Reading Assignments | Topics |
|--|----------------|---------------------------|---|
| 1 May 17 | Lesson A1 | Ch. 1 | Introduction to Thermal-Fluids, Units Energy Concepts, Temperature Pressure, U-Tube manometer |
| | Lesson A2 | Ch. 2-1 to 2-6 | |
| | Lesson A3 | Ch. 2-7 to 2-8 | |
| Reading Questions due Friday May 21. Homework 1 due Sunday May 23. | | | |
| 2 | Lesson B1 | Ch. 3 | Concepts and Definitions Accounting Principle, State Principle Properties of Ideal Gas |
| | Lesson B2 | Ch. 4-6 | |
| | Lesson B3 | | |
| Reading Questions due Friday May 28. Homework 2 due Sunday May 30. | | | |
| 3 | Lesson C1 | Ch. 4-1 to 4-5 | Thermodynamics Properties of Pure Substances Phase Change, Steam Tables Liquid Properties, NIST Tables |
| | Lesson C2 | | |
| | Lesson C3 | | |
| Reading Questions due Friday June 4. Homework 3 due Sunday June 6. | | | |
| 4 | Lesson D1 | Ch. 5 | First Law of Thermodynamics for Closed Systems Conservation of Mass |
| | Lesson D2 | Ch. 6-1 | |
| | Lesson D3 | | |
| Reading Questions due Friday June 11. Homework 4 due Sunday June 13. | | | |
| 5 | Lesson E1 | Ch. 6-2 to 6-4 | First Law for Control Volumes (Open Systems) |
| | Lesson E2 | | |
| | Lesson E3 | | |
| Reading Questions due Friday June 18. Homework 5 due Sunday June 20. | | | |
| 6 | Lesson F1 | Ch. 12-1 | Bernoulli Equation |
| | Lesson F2 | Ch. 12-2 | Energy Analysis of Internal Flows |
| Lesson F3 | | | |
| Reading Questions due Friday June 25. Homework 6 due Sunday June 27. | | | |
| 7 | LiveZoom | Monday, June 28 | Review at 11 AM EDT |
| | Midterm | Wednesday, June 30 | Exam proctored online |
| | Lesson G1 | Ch. 16 | Heat Transfer Modes |
| 8 | Lesson G2 | Ch. 17-1 to 17-3 | Conduction in Planar Geometries |
| | Lesson G3 | Ch. 17-4 to 17-5 | Conduction in Round Tubes |
| | Lesson G4 | Ch. 17-6 | Heat Transfer from Finned Surfaces |
| Reading Questions due Friday July 9. Homework 7 due Sunday July 11. | | | |
| 9 | Lesson H1 | Ch. 19-6 | Heat Transfer in Pipes |
| | Lesson H2 | Ch. 22-1 to 22-3 | Analysis of Heat Exchangers |
| | Lesson H3 | Ch. 22-4 | Log Mean Temperature Difference |
| Reading Questions due Friday July 16. Homework 8 due Sunday July 18. | | | |

| Week | Lecture Notes | Reading Assignments | Class Topic |
|---|-------------------|--------------------------|---|
| 10 | Lesson I1 | Ch. 8-1 to 8-4 | Entropy and Isentropic Processes Property Diagrams and Entropy Change of Ideal Gases |
| | Lesson I2 | Ch. 8-5 to 8-8 | |
| | Lesson I3 | Ch. 8-9 | |
| Reading Questions due Friday July 23. Homework 9 due Sunday July 25. | | | |
| 11 | Lesson J1 | Ch. 7-1 to 7-2, 7-5 | Second Law of Thermodynamics, Irreversibilities Heat Engines, Refrigerators and Heat Pumps Carnot Cycle |
| | Lesson J2 | Ch. 7-3 to 7-4 | |
| | Lesson J3 | Ch. 7-6 to 7-10 | |
| Reading Questions due Friday July 30. Homework 10 due Sunday August 1. | | | |
| 12 | Lesson K1 | Ch. 8-11 | Isentropic Efficiencies Air Cycles Steam Power Cycles |
| | Lesson K2 | Ch. 9-1 to 9-7 | |
| | Lesson K3 | Ch. 9-9 to 9-13 | |
| Reading Questions due Friday August 6. Homework 11 due Sunday August 8. | | | |
| 13 | Lesson K4 | Ch. 9-14 to 9-18 | Refrigeration Cycles Review at 11 AM EDT |
| | Live Zoom | Wednesday, August 11 | |
| | Final Exam | Friday, August 13 | Exam proctored online |