

Old Dominion University
College of Engineering and Technology
Department of Engineering Technology

MET 350

Spring 2025

THERMAL APPLICATIONS

Lecture Hours: Tuesdays and Thursdays 3:00 pm - 4:15 pm

Location: CONSTANT HALL 2134

Dates: Jan 11, 2025 - Apr 28, 2025

1. Instructor Contact Information

Instructor: Dr. Orlando Ayala

Office Location: 111-A Kaufman Hall

Office Hours: Tuesdays and Thursdays from 9am to 11am or by appointment

Email Address: oayala@odu.edu

Telephone Number: (757) 683-4467

2. Course Textbook

Name: Thermodynamics, an Engineering Approach, 9th Edition (or earlier)

Author: Yunus Cengel & Michael Boles

Publisher: McGraw Hill

ISBN: 0073398179

3. Course Overview

Credits: 3

Pre- or Co-requisites: C or better in MET 300 Thermodynamics

Official Description: A study of basic applications of thermodynamics. Topics include the basic steam and gas turbine plants, introduction to internal combustion engines, introduction to refrigeration and air-conditioning systems, basic conduction and convection heat transfer including heat exchangers.

4. Course Objectives and Expectations

4.1. Course Objectives

After completing this course, the student should be able to:

- Develop an intuitive understanding of how to apply the first and the second law of thermodynamics to different thermal systems.
- Apply thermodynamics laws to gas turbines Engines using ideal cycles, reheating regeneration, and inter-cooling cycles.
- Analyze the ideal Internal Combustion Engines cycles using air as the working fluid.
- Apply thermodynamics laws to Jet Propulsion Engines using ideal cycles.
- Apply Rankine Cycle with superheating, re-heating, and regeneration to steam power plants.
- Develop a clear understanding the basic operation of combined gas turbines vapor cycles, co-generation and binary vapor cycles
- Define the thermal efficiency, second law efficiency, and energy availability.
- Demonstrate the knowledge of understanding of the basic vapor compression refrigeration and heat pumps cycles.
- Develop the knowledge to calculate moist air properties (Psychrometry).
- Define different air-conditioning processes using the Psychometric chart.

4.2. Course ABET student outcomes:

After completing this course, the student is expected to know and be able to do the following learned capabilities:

1. an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline;
2. an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;

4.3. Course Expectations

This 3-credit course requires 2.5 hours of classroom or direct faculty instruction and three hours of out-of-class student work each week per credit hour (this means approximately 9 additional hours, this means at least a full day of work!) for approximately 15 weeks.

Out-of-class work includes but is not limited to: required reading, library research, written assignments, and studying for exams.

By the way, no assignment will be accepted late so be sure to stay on schedule and ask for help if you begin to get stuck and fall behind.

4.4. Contact Policy

If you find that you have any trouble keeping up with assignments or other aspects of the course, make sure you let your instructor know as early as possible. Make sure that you are proactive in informing your instructor when difficulties arise during the semester so that he can help you find a solution.

5. Statement of Writing

In this class you will also learn to effectively communicate using technical writing. This is an important practice because after your graduation from ODU you will be forced to communicate in writing. I want to force you to do it right now what you will be anyway forced to do later in your professional life. The advantage of doing it right now is that I will guide you through the process and any issue you might have now with your written communication skills will not hurt your professional credibility and reputation. As a professional engineer, you will be involved in engineering design work, which, indeed, require calculations (what we like!) but it also requires oral and written communication. It does not matter how good your design is if you do not effectively communicate your results. Let us learn that art together. I am still learning, as it is a non-stop process. To that end, in this class I will ask you to give written details of the whole solving process you use in every single problem. We will follow the attached general rubric to grade this.

6. Grading Criteria

Individual grades for the course will be based on three (03) take-home tests and they will be equally weighted. They all are going to be based on 100 points. There will be homework assignments which will count as 10 points of the corresponding test (this is similar to say that HW assignments count as 10% of your final grade). Note that failure to turn them in ON TIME will affect the grade of the corresponding test (see schedule).

This class will require you to work many problems in order to fully grasp the material. I will assign several problems every week from each section of each chapter as homework assignments for you to work on. The solutions will be supplied after you turn them in. These problem assignments are to be turned in on the specified date and time (see schedule). You should work on them (and even more) because the lectures and examples done in class will not fully prepare you for the exams. Every week, you will have to solve ALL the assigned problems but the grade will be based on ONE randomly chosen problem.

As far as grading the 90 points of each test, 10 points will come following the attached rubric to measure whether you follow the basis of the technical writing structure when posting the solution of ALL the problems. The other 80 points will come from the actual procedure but I also take into consideration the final result. Let us take an example. One test might have 2 problems to solve; each problem is worth $80/2 (=40)$ points. Now, each problem is graded based on successfully achieved steps (procedure). I divide the problem into different steps you should accomplish to successfully solve the problem. A problem might be divided in 5 different steps and I include a "6th step" to include for correct numerical results. If you solve correctly the whole problem, you have a fraction of $6/6$ of the $80/2$ points of the problem. This is, 40 points, $(6/6) * (80/2) = 40$.

All HW assignments and tests MUST be submitted ONLY through CANVAS.

ADDITIONAL POINTS:

A. There will be an optional post-test activity, which consist of two short activities.

1. Soon after the test submission deadline, the solutions to the test will be available. This short post-test activity is to compare your test against the available solutions and to write a brief reflection statement containing:
 1. Statement on the mistakes you made and what you will do next time to avoid making same mistakes. Please point out exactly where you made the mistake, say why you made the mistake, and how you should have done it.
 2. Give yourself a grade based on the writing rubric provided in the test and the correctness of your solution.
 3. The answer to the following: if you had the opportunity to go back in time and take the test again, what advice would you give yourself to ensure that you had a better grade on the test?
 4. A short discussion of what you have learned and where you think engineers use those concepts (provide specific examples).

For more details on how to write the test reflection, read the ePortfolio assignment prompt.

2. Update an ePortfolio archive you will create. After every test you will upload your test and your test reflection to your ODU google drive. At the end of the semester, your ePortfolio archive will contain all tests and HW assignments you worked on during the class with their corresponding reflections. For instructions on how to create your ePortfolio archive, read the corresponding ePortfolio assignment prompt.

You should email me the link where you uploaded your test and reflection not later than 48 hours after the due date of the test. The whole post-test activity will account for up to 5 additional points towards the corresponding test. Please note that there will be no reminders about this post-test activity as the points are optional.

B. Final eP course reflection. By the end of the semester you will have the opportunity to get up to 3 points towards your final grade. Follow all the instructions in the ePortfolio assignment prompt. Please note that for those of you who worked towards the other additional points on the tests (test reflections), a lot of the work is already done.

Please note that if you work on both extra activities, you could get enough extra credit points towards your final grade that you could bump up your final letter grade!!

Finally, the following are the guidelines to assign the letter grades:

A 95-100

A- 90-95

B+ 87-90

B 84-87

B- 80-84

C+ 77-80

C 74-77

C- 70-74

D+ 67-70

D 64-67

D- 60-64

F < 60

7. Teaching and Learning Methods

7.1. Delivery Method

Some assignments require basic computing skills using standard software and browser applications (e-mail, CANVAS).

7.2. Instructional Approach

The course will be taught through direct and interactive instruction.

7.3. Course Interaction. Faculty-Student Communication System (FSCS)

Materials for the course will be available on canvas.odu.edu. Checking the course information is essential to ensure you have the most up to date information for the course (assignments, schedule changes, topic changes, instructor notes, etc.). It is the student's responsibility to check the site as part of preparation for the class period.

7.4. Electronic Devices Policy

All electronic devices, including laptop computers, cell phones, MP3 players, etc. must be turned off and put away during all classes.

7.5. Feedback

Course Final Evaluation

<http://www.odu.edu/academics/courses-registration/studentopinionsurvey>

You should really fill out the survey!

8. Schedule

See schedule in the “Schedule” Tab under MODULES

9. Student Responsibilities

9.1. Understanding the Syllabus Requirements

In this course, you are highly encouraged to:

1. Think and plan your individual learning process;
2. Clarify and set your own goals;
3. Monitor and assess your own progress;
4. Establish criteria for judging your own performance;
5. Work alone and collaborate with other students as appropriate.

9.2. Utilizing Online Components

Utilizing online components where applicable. Checking email and CANVAS

9.3. Statement on Learning

Learning is a shared responsibility. As the instructor and as a student in this class, it is our shared responsibility to develop and maintain a positive learning environment for everyone.

Students are asked to respect the learning needs of their classmates and assist the instructor in achieving this critical goal. It is the instructor’s responsibility to present learning opportunities through the course syllabus, lectures, discussions, activities, in-class and out-of-class assignments. It is the student’s responsibility to do the learning by completing the readings, by attending class (through face-to-face or through video streaming) and by participating in class discussions and assignments. A variety of assignments will be used to help the students to achieve the course goals (mastery of course content and skills) outlined in the syllabus.

9.4. Online Learning (Video streamers)

Online learning requires a significant amount of self-discipline and sometimes creative scheduling. All students are expected to participate actively, showing evidence of logging into the course at least twice each week (or contacting directly the instructor at least weekly) and actively engaging in Forum, Activity, and Assignment postings. However in the event that you are not able to participate during a week, please let your professor know with as much advance notice as possible.

10. Course Policies

10.1. Attendance

As per university policy, students are expected to attend Classes. For classes meeting twice a week, students missing more than 15% may be failed. Therefore, students who miss more than four class meetings are subject to automatic failure.

10.2. Participation

- I like you to share your experiences and knowledge with your peers in course discussions.
- I am looking for active participation and commitment to your learning experience.
- I expect you to communicate professionally with your professor about your progress in this course.
- I understand you expect prompt and qualitative feedback that will foster learning.
- I understand you expect to apply what you are learning in your personal and professional lives. Trust me, you will.

10.3. HW Assignments, Tests and Make-ups

I will allow you to make-up ONLY ONE TEST if you missed it. You will make-up the exam the week prior to finals week. I fully suggest you to avoid making-up test since you will be doing it in the busiest time of the semester. However, I understand that every now and then there are circumstances you cannot avoid. The only exception to this make-up policy is the last test; I will not allow make-ups for this one.

There will be no extension in the due date, neither make-ups for HW assignments. However, I will allow you to miss one per test. The grade for the one you miss will be the average of your other HW assignments for the corresponding test.

Please mark your calendars with the dates indicated in the schedule of activities.

10.4. Course Disclaimer

Every attempt is made to provide a syllabus that is complete and that provides an accurate overview of the course. However, circumstances and events may make it necessary for the instructor to modify the syllabus during the semester. This may depend, in part, on the progress, needs, and experiences of the students.

10.5. Accommodation

Students are encouraged to self-disclose disabilities that have been verified by the Office of Educational Accessibility by providing Accommodation Letters to their instructors early in the semester in order to start receiving accommodations as needed. Accommodations will not be made until the Accommodation Letters are provided to instructors each semester. However, I must point out that most of the assignments (HW, tests, etc.) are take-home. The amount of time assigned for each one is excessive. I do it to give the students freedom on when to actually work on the assignment in case the student work or have other commitments, or the student has any type of disability.

11. University Policies

11.1. College Classroom Conduct

The following standards are intended to define acceptable classroom behavior that preserves academic integrity and ensures that students have optimum environmental conditions for effective learning.

1. Students must turn off cell phones and pagers during class or have them set to vibrate mode. Instructors may require that cell phones and other electronic devices be left on their desks during tests or examinations.
2. Classes are expected to begin on time, and students will respect the time boundaries established by the professor. If classroom doors are locked, students may not knock or seek entrance in other ways.
3. Students should notify instructors in advance when a class will be missed. In the event of an emergency that causes a class to be missed, instructors must be notified as soon as possible.
4. Students must not engage in extraneous conversations during classes. Such acts are considered to be violations of the Code of Student Conduct.
5. Students will activate their Old Dominion email accounts and check them before each class. If the student chooses to have his/her messages forwarded to another account, it is the student's responsibility to take the necessary steps to have them forwarded.
6. Offensive language, gestures and the like are disrespectful and disruptive to the teaching-learning process. [http://studentservices.odu.edu/osja/ccs_pamphlet.pdf]

11.2. Honor Pledge

"I pledge to support the honor system of Old Dominion University. I will refrain from any form of academic dishonesty or deception, such as cheating or plagiarism. I am aware that as a member of the academic community, it is my responsibility to turn in all suspected violators of the honor system. I will report to Honor Council hearings if summoned."

(By attending Old Dominion University you have accepted the responsibility to abide by this code. This is an institutional policy approved by the Board of Visitors. For more information please visit [Honor Council](#)).

For your clarification, part of the Honor Code says:

IX. PROHIBITED CONDUCT

A. Academic Integrity violations, including:

1. Cheating: Using unauthorized assistance, materials, study aids, or other information in any academic exercise (Examples of cheating include, but are not limited to, the following: using unapproved resources or assistance to complete an assignment, paper, project, quiz or exam; collaborating in violation of a faculty member's instructions; and submitting the same, or substantially the same, paper to more than one course for academic credit without first obtaining the approval of faculty).

IMPORTANT NOTE: You will NOT be allowed to use ANY Internet source while taking the tests, except by ODU related.

11.3 Special Needs

Old Dominion University is committed to achieving equal educational opportunity and full participation for persons with disabilities. It is the university's policy that no qualified person be excluded from participation in any university program or activity, be denied the benefits of any university program or activity, or otherwise be subjected to discrimination with regard to any university program or activity. This policy derives from the university's commitment to non-discrimination for all persons in employment, access to facilities, student programs, activities and services. You may view the policy online: [Old Dominion University Policies and Procedures 4500 - Accommodation of Students with Disabilities \(pdf\)](#). For additional information visit the [Office of Educational Accessibility online](#) or at 1525 Webb Center.

11.4 University Email Policy

The Old Dominion University e-mail system is the official electronic mail system for distributing course-related Communications, policies, Announcements and other information. In addition, the University e-mail user ID and password are necessary for authentication and access to numerous electronic resources (online courses, faculty Web pages, etc.) For more information about the policy, please visit: [Electronic Messaging Policy for Official University Community Policy 3506 \(pdf\)](#). For more information about student email, please visit <http://occs.odu.edu/accounts/studemail/>

11.5 Withdrawal

A syllabus constitutes an agreement between the student and the course instructor about course requirements. Participation in this course indicates your acceptance of its teaching focus, requirements, and policies. Please review the syllabus and the course requirements as soon as possible. If you believe that the nature of this course does not meet your interests, needs or expectations, if you are not prepared for the amount of work involved - or if you anticipate that the class meetings, assignment deadlines or abiding by the course policies will constitute an unacceptable hardship for you - you should drop the class by the drop/add deadline, which is located in the ODU Schedule of Classes. For more information, please visit the Office of the [University Registrar](#).

12. Student Help Resources

12.1 Online Student Orientation: <http://www.clt.odu.edu/oso>

12.2 Technical Support Center: <http://occs.odu.edu/>, occs-help@odu.edu, 757-683-3192

12.3 Study Guides Strategies: <http://www.studygs.net/>

12.4 Papers Citation Styles: MLA, APA, Chicago & CBE:

<http://www.dianahacker.com/resdoc>