Applied Thermodynamics

The University of Toledo
Mechanical Engineering Technology /College of Engineering
MET 3100 – 001, 002, 003 – Spring 2019

Instructor: ***Dr. Carmen Cioc***
Email: *Carmen.Cioc2@utoledo.edu*
Office Hours: M&W / 3:00 ÷ 5:00pm
T / 4:00pm ÷ 5:00pm
or by appointment
Office Location: NE 1609
Office Phone: 419-530-3017

Class Location: PL 3110
Class Day/Time: M&W / 11:10am ÷ 12:30pm
Lab Location: NE 1430
Lab Day/Time: M&W / 12:40pm ÷ 2:30pm
Lab instructor: ***William Mugge***
Credit Hours: 4
Course Website: Blackboard Learn

COURSE/CATALOG DESCRIPTION

Basic principles and laws of classical thermodynamics, equations of state, reversibility and entropy applied to processes and cycles for ideal and non-ideal substances.

COURSE OVERVIEW

The class is building on the introductory course, presenting the basic principles and laws of classical thermodynamics, equations of state, reversibility and entropy applied to processes, and cycles for ideal and non-ideal substances. The laboratory studies the relationship between the thermodynamic characteristics of engineering systems, as well as provides students with hands on experience and understanding of the real world engineering applications. Special attention will be given to:

- *Gas power cycles: Otto, Diesel, Brayton, etc.*
- *Vapor and combined power cycles: Rankine cycles*
- *Refrigeration cycles: reversed Carnot, ideal and actual vapor-compression refrigeration cycle*
- *Air conditioning processes*
- *Heat transfer*

STUDENT LEARNING OUTCOMES (ABET Student Learning Outcomes)

At the end of the course students are expected to be able to:

- *Use appropriate tables and diagrams to determine the state of the working fluid (a)*
- *Calculate thermal efficiencies, heat transfer in & out, work in & out, etc. for ideal thermodynamic cycles, as Otto, Diesel, Brayton, Rankine, and refrigeration cycles (a, j)*
- *Calculate / investigate actual engine cycles and compare them with the idealized ones as well as identifying viable ways to improve the thermal efficiencies of the engine cycles as Otto and Diesel (a, j)*
- *Calculate actual power & actual refrigeration cycles and compare them from a thermodynamic point of view with the idealized ones (a, c)*
- *Conduct laboratory experiments, analyze and interpret experimental data (c, e, j)*
- *Produce written technical and laboratory reports (g)*

TEACHING STRATEGIES

This course is designed to stimulate student learning through engagement and participation. I will assign homework each class. I will assign homework each class. I will give you a short quiz every week. I expect that you will be actively engaged in class discussions.

Recommendations for success:

- *Before each class: read the pages from the textbook on the material to be presented – it will help you a lot to focus on the lecture and to understand the concepts.*
- *Come to the lecture and focus on what is being presented; take notes; ask questions if needed.*
- *After the class:*
  - *Read the relevant pages from the textbook.*
  - *Read your notes and handouts; redo on your own the problems solved in class.*
  - *Solve (on your own) the examples from the textbook; compare with the provided solutions.*
  - *Try to do the assigned homework (alone); If you do not know how to do the homework, ask for help.*
- *Before each quiz: download the homework solution; compare with your solution (not just the final results). Redo the problems you found to be difficult; do the same with the problems solved in class and with the textbook examples. Ask for help (instructor and TA) if you find something confusing.*
- *Before a test: make sure you go again through all quizzes, homework problems, class problems, and examples from the textbook; ask for help if needed.*

PREREQUISITES AND COREQUISITES

MET 2210 for level UG with min. grade of D- and *MATH 2460 for level UG with min. grade of D-*

REQUIRED TEXTS AND ANCILLARY MATERIALS

*Thermodynamics, by Cengel. – **required**; 8th Edition, ISBN: 9780073398174*

TECHNOLOGY REQUIREMENTS

Web assist - Blackboard https://blackboard.utdl.edu/ - to post solutions, announcements, etc.

UNIVERSITY POLICIES

The University is an equal opportunity educational institution. Please read The University's Policy Statement on Nondiscrimination on the Basis of Disability Americans with Disability Act Compliance.

Academic Accommodations

The University of Toledo is committed to providing equal access to education for all students. If you have a documented disability or you believe you have a disability and would like information regarding academic accommodations/adjustments in this course please contact the Student Disability Services Office.

ACADEMIC POLICIES

As a student in my course and enrolled at the University of Toledo you should be familiar with the policies that govern the institution's academic process. Please read the ***Undergraduate Academic Policies.***

Students are expected to attend every class. Please read the ***Missed Class Policy.*** *(http://www.utoledo.edu/policies/academic/undergraduate/index.html)*

Academic dishonesty will not be tolerated. Examples of academic dishonesty include, but are not limited to:

- *Plagiarizing or representing the words, ideas or information of another person as one's own and not offering proper documentation;*
- *Giving or receiving, prior to an examination, any unauthorized information concerning the content of that examination;*
- *Referring to or displaying any unauthorized materials inside or outside of the examination room during the course of an examination;*
- *Communicating during an examination in any manner with any unauthorized person concerning the examination or any part of it;*
- *Giving or receiving substantive aid during the course of an examination;*
- *Commencing an examination before the stipulated time or continuing to work on an examination after the announced conclusion of the examination period;*
- *Taking, converting, concealing, defacing, damaging or destroying any property related to the preparation or completion of assignments, research or examination;*
- *Submitting the same written work to fulfill the requirements for more than one course.*

As a reminder, "MISCONDUCT: Students may work together on homework problems or assigned papers, but must submit their own work. Students are not allowed to work together on quizzes and exams". Any occurrence of academic misconduct will result in a grade of ***F*** *in the course. Students that receive a reduced course grade as a result of academic misconduct will not be allowed to withdraw from the course and may not petition for a GPA recalculation after retaking the course. Please refer to the Academic Dishonesty and Academic Grievance policies for more details.* *http://www.utoledo.edu/policies/academic/undergraduate/*

Attendance and classroom behavior:

- *Attendance will not be taken for lectures, but you are fully responsible for being present at all examinations, as well as for all materials, announcements, or changes in the schedule discussed in class.*
- *The University of Toledo and the College of Engineering academic dishonesty and missed class policies will be applied.*
- *Please note that in case of excused absence, any missed work must be done and written documentation of the circumstance (such as a doctor's note) must be provided to be kept on file.*
- *I will not allow any behavior that negatively impacts the learning of other students, such as conversation that can be heard from three rows away, or cell phone ringing. Cell phones and other similar devices must be turned off (not just in silent mode) during lectures and during examinations.*
- *No personal laptop / tablet / phone / smart watch are allowed during any examination (quiz or test). If you are found using any such device, you will automatically get zero on that quiz/test, and considered for academic dishonesty regulations, mentioned above.*

- *If you do not understand something, there is a good chance that others have the same problem. Never be embarrassed to ask for help if you find something confusing. However, when doing so, please talk only one person at a time. A professional attitude is expected at all times.*

COURSE EXPECTATIONS

- ***Homework**: I will assign homework problems in most lectures to help you better understand the material covered and as preparation for examinations. Homework is due every* **Monday** *at the beginning of the class. Homework will be graded* **selectively***; problems will count 5 points each, unless otherwise stated. Please prepare the homework neatly, showing all necessary steps leading to the results. Homework turned in after the solution is posted online will not be accepted.*
- ***Quiz**: As a general rule, I will give you a short, 15 minute, quiz every* ***Wednesday*** *with some exceptions; the lowest quiz grade will be dropped when calculating the average. As a reminder, no smart phone/ table / smartwatch / laptop, Bluetooth connectivity, etc. will be allowed during the quiz.*
- ***Labs**: Lab reports cannot be turned in unless the student physically attended the lab – Attendance will be taken. All lab reports turned- in after the due date will be deducted 10% per day. You need to attend all the laboratories and to get an average of a least* ***50%*** *for the laboratory work to be considered for a final passing grade.*
- ***Test**: I will give you three in class tests. One of these three tests will be retaken in the final examination. You must get at least 50% for each of the three tests to be considered for a final passing grade. If any of the tests has less than 50%, you will not get a passing grade for the course. As a reminder, no smart phone/ table / smartwatch / laptop, Bluetooth connectivity etc. will be allowed during test. The final examination date and time will be announced at a later date and time may be found at: http://www.utoledo.edu/offices/registrar/exam_schedules.html*

Note: Most tests and quizzes are open book, except otherwise noted in class.

GRADING

The following parts will be considered when calculating the final grade:

- *Homework: 5% of the final grade*
- *Quizzes: 16% of the final grade*
- *Labs: 25% of the final grade*
- *Tests: 3 x 17% of the final grade*
- *Class participation: 3% of the final grade*

Midterm Grading

Midterm grades are used to assist you with determining where you stand academically in the course. Attendance is also recorded during Midterm grading to meet the state and federal laws regarding financial aid disbursement.

Usually you will get only one of the three tests before the midterm grades are posted and therefore, the following weighting will be considered when calculating the midterm grade:

- *Homework:* *5% of the midterm grade*
- *Quizzes:* *33% of the midterm grade*
- *Labs:* *25% of the midterm grade*
- *Test:* *1 x 34% of the midterm grade*
- *Class participation:* *3% of the midterm grade*

Final Grading

The final grade will be determined using a straight scale as follows.

Numerical Average	Grade
≥ 93.00	A
89.33 – 92.99	A–
85.67 – 89.32	B+
82.00 – 85.66	B
78.33 – 81.99	B–
74.67 – 78.32	C+
71.00 – 74.66	C
67.33 – 70.99	C–
63.67 – 67.32	D+
60.00 – 63.66	D
≤ 60.00	F

COMMUNICATION GUIDELINES

Please use your UT student email address for any email communications.

STUDENT SUPPORT SERVICES

The university offers additional support, like free tutoring.

- *Engineering Technology Department - NE 1604 & NE 1606*
- *University of Toledo – Learning Enhancement Center - http://www.utoledo.edu/success/lec/ or http://www.utoledo.edu/studentaffairs/support.html*

COURSE SCHEDULE (TENTATIVE):

Week	Date	Topics	Chapter	Laboratory	Quiz
1	14-Jan	Review : Properties of pure substances	3	The Perfect Gas Law (Excel)	
	16-Jan	Review : Energy analysis of closed systems and Mass and energy analysis of control volume	4, 5		
2	21-Jan	**No classes – MLK Holiday**			
	23-Jan	Heat transfer	class notes		√
3	28-Jan	Heat transfer	class notes	Energy Balance of a Heat Exchanger	
	30-Jan	Second Law of Thermodynamics & Carnot Cycle & Entropy	6, 7		√
4	04-Feb	Gas Power Cycles: Overview & Otto Cycle	9-1 ÷ 9-4	Otto Cycle (Excel)	
	06-Feb	Gas Power Cycles: Diesel Cycle	9-6		√
5	11-Feb	Gas Power Cycles: Dual Cycle	9-6		
	13-Feb	Review			√
6	18-Feb	**Test 1**		Stirling Engine	
	20-Feb	Gas Power Cycles: Brayton Cycle	9-8		
7	25-Feb	Gas Power Cycles: Brayton Cycle with Regeneration	9-9	Compressor Inherent Characteristics	
	27-Feb	Gas Power Cycles: Brayton Cycle with Regeneration, Intercooling, and Reheat	9-10		√
8	04-Mar	**Spring Break – No Classes**			
	06-Mar				
9	11-Mar	Gas Power Cycles: Ideal Jet – Propulsion Cycle	9-11		
	13-Mar	Vapor Power Cycle: Rankine Cycle	10-2 ÷ 10-4	Rankine Cycle (#1)	√
10	18-Mar	Vapor Power Cycle: Reheat Rankine Cycle	10-5		
	20-Mar	Vapor Power Cycle: Regenerative Rankine Cycle	10-6	Rankine Cycle (#2)	√
11	25-Mar	Review			
	27-Mar	**Test 2**			
12	01-Apr	Refrigeration Cycles	11-1 ÷ 11-4	Refrigeration Cycle	
	03-Apr	Innovative Vapor-Compression Refrigeration Systems	11-8		√
13	08-Apr	Gas-vapor mixtures and Air-Conditioning	14	HVAC & Psychrometric Chart	
	10-Apr	Gas-vapor mixtures and Air-Conditioning	14		√
14	15-Apr	Gas-vapor mixtures and Air-Conditioning	14		
	17-Apr	Review			
15	22-Apr	**Test 3**			
	24-Apr	Review for finals			