2020

Applied Thermodynamics

North Carolina Agricultural and Technical State University

NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

COURSE SYLLABUS

College Name: College of Engineering
Department Name: Mechanical Engineering
Course Name: Applied Thermodynamics

COURSE INFORMATION

- Course Number/Section: MEEN 341
- Term:
- Semester Credit Hours: 3
- Times and Days:
- Class Location:

INSTRUCTOR CONTACT INFORMATION

- Instructor:
- Office Location:
- Office Phone:
- Email Address:

Faculty must notify students of the approximate time and method they can expect to receive an answer to all communications (e.g., email, phone, course messages). Excluding holidays, the response should be provided within 48 hours.

If there's a graduate teaching assistant assigned to work with this course, please include their names also.

STUDENT HOURS

These are times students may visit the professor without an appointment to request the assistance they need.

NOTE: Students are responsible for reading, understanding, and following the syllabus.

: AM ☐ / PM ☐ – : AM ☐ / PM ☐

Monday ☐ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday ☐

COURSE PREREQUISITES

MEEN 241 and MATH 231

COURSE DESCRIPTION

This course involves applications of basic thermodynamic principles to real systems. The topics covered include: review of concepts from fundamentals of thermodynamics, vapor power cycles, gas power cycles, refrigeration and heat pump, mixtures of ideal gases, psychrometrics, combustion, and 1D Compressible Flow.

STUDENT LEARNING OBJECTIVES/OUTCOMES (SLO)

Learning outcomes should be specific, measurable, and focused on the content knowledge the students are expected to master and not what the faculty will teach.

If the course is a General Education Course, the SLO should be listed and labeled as "General Education."

SLO 1: Demonstrate use of First, Second Law of Thermodynamics, and conservation of mass principles to simple engineering systems.
SLO 2: Design a simple vapor cycle and gas power systems.
SLO 3: Select or design a simple vapor compression and gas refrigeration systems.
SLO 4: Predict the P-V-T behavior of gas mixtures.
SLO 5: Evaluate the state of atmospheric air in a simple HVAC system and Design a simple HVAC system.
SLO 6: Determine flow parameters in HVAC systems using psychrometric chart
SLO 7: Analyze typical combustion processes to perform energy balances and determine heat release from chemical reactions
SLO 8: Evaluate simple 1D compressible flows using 1D conservation equations

REQUIRED TEXTBOOKS AND MATERIALS

Any course-level subscriptions and tools linked in Blackboard Learn learning management system (LMS) should be listed here. The Blackboard LMS must have links to their student data privacy statement.

REQUIRED TEXTS:

Çengel, Y. A., Boles, M. A., & Kanoglu, M. (2018). *Thermodynamics: An engineering approach*.

REQUIRED MATERIALS:

SUGGESTED COURSE MATERIALS

SUGGESTED READINGS/TEXTS:

FE SUPPLIED-REFERENCE HANDBOOK,9.4 edition, NCEES, 2013, 978-1-932613-67-4

SUGGESTED MATERIALS:

GRADING POLICY

ASSIGNMENTS AND GRADING POLICY

94% and above	A		76% - 74%	C
93% - 90%	A-		73% - 70%	C-
89% - 87%	B+		69% - 67%	D+
86% - 84%	B		66% - 64%	D
83% - 80%	B-		63% - 0%	F
79% - 77%	C+			

For GRADUATE COURSES: See 2019-2020 Graduate Catalog p.38 for graduate grading scale and Non-Graded Courses

GRADING ALLOCATION

Course grades are based on a weighted grading scale of 100%. The breakdown for the course is as follows: *[Faculty, please adjust according to your course.]*

Category	# of Activities	Percentage Grade Weight
Homework Assignments	5	25%
Quizzes	5	25%
Midterm Exam	1	25%
Final Exam	1	25%
Total	**16**	**100%**

COURSE POLICIES

USE OF BLACKBOARD AS THE LEARNING MANAGEMENT SYSTEM

Blackboard is the primary online instructional and course communications platform. Students can access the course syllabus, assignments, grades, and learner support resources. Students are encouraged to protect their login credentials, complete a Blackboard orientation, and log in daily to the course.

Note: Uploading assignments through Blackboard presents a challenge for Chromebook users in locating the files for submission. If you use a Chromebook, please be sure you also have access to a Mac computer or Windows computer so you can fully participate in your Blackboard class. For more information about student computer recommendations, please visit https://hub.ncat.edu/administration/its/computer-recommendations.php.

MAKE-UP EXAMS

See << Update Academic Year >>*Undergraduate Bulletin:*

https://www.ncat.edu/provost/academic-affairs/bulletins/index.php

For GRADUATE STUDENTS: See 2019-20 Graduate Catalog p. 54

EXTRA CREDIT

LATE WORK

SPECIAL ASSIGNMENTS

For GRADUATE STUDENTS: FAILING TO MEET COURSE REQUIREMENTS (Graduate Catalog p.40)

For GRADUATE STUDENTS: CLASS ATTENDANCE (see 2019-20 Graduate Catalog p. 53-54)

Students are expected to attend class and participate on a regular basis in order to successfully achieve course learning outcomes and meet federal financial aid requirements (34 CFR 668.22). Class attendance in online courses is defined as active participation in academically-related course activities. Active participation may consist of course interactions with the content, classmates, and/or the instructor. Examples of academically-related course activities include, but are not limited to:

- Completing and submitting assignments, quizzes, exams, and other activities within Blackboard or through Blackboard (3rd-party products).
- Participating in course-related synchronous online chats, discussions, or meeting platforms such as Blackboard Collaborate in which participation is tracked.

CLASSROOM CITIZENSHIP

Courtesy, civility, and respect must be the hallmark of your interactions.

COMPLIANCE WITH THE AMERICANS WITH DISABILITIES ACT

North Carolina A&T State University is committed to following the requirements of the Americans with Disabilities Act Amendments Act (ADAAA) and Section 504 of the Rehabilitation Act.
If you need an academic accommodation based on the impact of a disability, you must initiate the request with the Office of Accessibility Resources (OARS) and provide documentation in accordance with the Documentation Guidelines at N.C. A&T. Once documentation is received, it will be reviewed. Once approved, you must attend a comprehensive meeting to receive appropriate and reasonable accommodations. If you are a student registered with OARS, you must complete the Accommodation Request Form to have accommodations sent to faculty.

OARS is located in Murphy Hall, Suite 01 and can be reached at 336-334-7765, or by email at accessibilityresources@ncat.edu. Additional information and forms can be found on the internet at https://www.ncat.edu/provost/academic-affairs/accessibility-resources/index.php.

Please note: Accommodations are not retroactive and begin once the Disability Verification Form is provided to faculty.

TITLE IX

North Carolina A&T State University is committed to providing a safe learning environment for all students—free of all forms of discrimination and harassment. Sexual misconduct and relationship violence in any form are inconsistent with the university's mission and core values, violates university policies, and may also violate federal and state law. Faculty members are considered "Responsible Employees" and are required to report incidents of sexual misconduct and relationship violence to the Title IX Coordinator. If you or someone you know has been impacted by sexual harassment, sexual assault, dating or domestic violence, or stalking, please visit the Title IX website to access information about university support and resources. If you would like to speak with someone confidentially, please contact Counseling Services at 336-334-7727 or the Student Health Center at 336-334-7880.

TECHNICAL SUPPORT

If you experience any problems with your A&T account, you may call Client Technology Services (formerly Aggie Tech Support and Help Desk) at 336-334-7195, or visit https://hub.ncat.edu/administration/its/dept/ats/index.php.

FIELD TRIP POLICIES / OFF-CAMPUS INSTRUCTION AND COURSE ACTIVITIES

If applicable:

Off-campus, out-of-state, foreign instruction, and activities are subject to state law and university policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at https://www.ncat.edu/campus-life/student-affairs/index.php.

STUDENT HANDBOOK

https://www.ncat.edu/campus-life/student-affairs/departments/dean-of-students/student-handbook.php

STUDENT TRAVEL PROCEDURES AND STUDENT TRAVEL ACTIVITY WAIVER

https://hub.ncat.edu/administration/student-affairs/staff-resources/studen_activity_travel_waiver.pdf

OTHER POLICIES *(e.g., Copyright Guidelines, Confidentiality, etc.)*

STUDENT HANDBOOK

https://www.ncat.edu/campus-life/student-affairs/departments/dean-of-students/student-handbook.php

Graduate Catalog

SEXUAL MISCONDUCT POLICY

https://www.ncat.edu/legal/title-ix/sexual-harassment-and-misconduct-policies/index.php

FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT (FERPA)

https://www.ncat.edu/registrar/ferpa.php

STUDENT COMPLAINT PROCEDURES

https://www.ncat.edu/current-students/student-complaint-form.php

STUDENT CONDUCT AND DISCIPLINE

North Carolina A&T State University has rules and regulations that govern student conduct and discipline meant to ensure the orderly and efficient conduct of the educational enterprise. It is the responsibility of each student to be knowledgeable about these rules and regulations.

Please consult the following about specific policies such as academic dishonesty, cell phones, change of grade, disability services, disruptive behavior, general class attendance, grade appeal, incomplete grades, make-up work, student grievance procedures, withdrawal, etc.:

- Undergraduate Bulletin
  https://www.ncat.edu/provost/academic-affairs/bulletins/index.php

- Graduate Catalog
  https://www.ncat.edu/tgc/graduate-catalog/index.php

- Student Handbook
  https://www.ncat.edu/campus-life/student-affairs/departments/dean-of-students/student-handbook.php

ACADEMIC DISHONESTY POLICY

Academic dishonesty includes but is not limited to the following:

1. Cheating or knowingly assisting another student in committing an act of cheating or other academic dishonesty;
2. Plagiarism (unauthorized use of another's words or ideas as one's own), which includes but is not limited to submitting exams, theses, reports, drawings, laboratory notes or other materials as one's own work when such work has been prepared by or copied from another person;
3. Unauthorized possession of exams or reserved library materials; destroying or hiding source, library or laboratory materials or experiments or any other similar actions;
4. Unauthorized changing of grades, or marking on an exam or in an instructor's grade book or such change of any grade record;
5. Aiding or abetting in the infraction of any of the provisions anticipated under the general standards of student conduct;
6. Hacking into a computer and gaining access to a test or answer key prior to the test being given. N.C. A&T reserves the right to search the emails and computers of any student suspected of such computer hacking (if a police report of the suspected hacking was submitted prior to the search); and
7. Assisting another student in violating any of the above rules.

A student who has committed an act of academic dishonesty has failed to meet a basic requirement of satisfactory academic performance. Thus, academic dishonesty is not only a basis for disciplinary action, but may also affect the evaluation of a student's level of performance. Any student who commits an act of academic dishonesty is subject to disciplinary action.

In instances where a student has clearly been identified as having committed an act of academic dishonesty, an instructor may take appropriate disciplinary action, including loss of credit for an assignment, exam, or project; or awarding a grade of "F" for the course, **subject to review and endorsement by the chairperson and dean**.

For GRADUATE STUDENTS: Reference for academic dishonesty – 2010-2020 Graduate Catalog, p.58-59

For GRADUATE STUDENTS: STUDENT RELIGIOUS OBSERVANCE (see Graduate Catalog, p.55)

ASSIGNMENTS AND ACADEMIC CALENDAR

Include topics, reading assignments, due dates, exam dates, withdrawal dates, pre-registration and registration dates, all holidays, and convocations.*

THE WEEK OF MM/DD/YY	SUBJECT	UNIT LEARNING OUTCOMES (ULO)	READING IN TEXT, ACTIVITY, HOMEWORK, EXAM
	Module 1: Vapor and Gas Power Cycles	ULO 1: Describe the Carnot and the modifications made to it to obtain the ideal Rankine Power Cycle. (SLO 1-2) ULO 2: Analyze an actual vapor power cycle using the energy and mass conservation equations. (SLO 1-2) ULO 3: Describe the various modifications to the ideal Rankine power cycle to increase efficiency and power. (SLO 1-2) ULO 4: Apply the energy and mass conservation equations to ideal Reheat (SLO 1-2) ULO 5: Regeneration cycles.Describe the Carnot Gas Power Cycle and explain its value in engineering. (SLO 1-2) ULO 6: Apply the Air Standard assumptions to the Ideal Otto, Diesel, and Brayton Cycles. Apply the is entropic efficiency to the actual Brayton Cycle. Apply the energy and mass conservation equation to the Otto, Diesel, and	1. **Read Textbook:** Çengel, Y. A., Boles, M. A., & Kanoglu, M. (2018). *Thermodynamics: An engineering approach.* a. Chapter 9 b. Chapter 10 **2. Complete:** Discussion Board #1 : Self-Introduction (N/A) **3. Complete:** Discussion Board #2 (ULO 2-3) **4. Complete:** Quiz #1 (ULO 1,4,5) **5. Complete:** Homework #1 (ULO 1,2,5)

		Brayton Cycles. (SLO 1-2)	
	Module 2: Vapor Compression and Gas Refrigeration Systems	ULO 1: Recognize the differences between refrigerators and heat pumps (reversed heat engines). (SLO 1,3) ULO 2: Discuss the modifications made to the reversed Carnot cycle to obtain the ideal vapor refrigeration cycle. (SLO 1,3) ULO 3: Apply the energy and mass conservation equations to advanced vapor compression refrigeration cycles. (SLO 1,3) ULO 4: Apply the Air-Standard Assumptions to the ideal gas refrigeration cycle. (SLO 1,3) ULO 5: Apply the energy equation to the ideal gas refrigeration cycle. Compare the performances of the ideal and actual gas refrigeration cycles. (SLO 1,3)	1. **Read Textbook:** Çengel, Y. A., Boles, M. A., & Kanoglu, M. (2018). *Thermodynamics: An engineering approach.* a. Chapter 11 **2. Complete:** Discussion Board #3 (ULO 1-2) **3. Complete:** Quiz #2 (ULO 3-5) **4. Complete:** Homework #2 (ULO 3-5)
	Module 3: Composition of Gas Mixtures and Air-Conditioning Processes	ULO 1: Develop rules for determining nonreacting gas mixture properties from knowledge of mixture composition and the properties of the individual components. (SLO 4) ULO 2: Define the quantities used to describe the composition of a mixture, such as mass fraction, mole fraction, and volume fraction. (SLO 4)	1. **Read Textbook:** Çengel, Y. A., Boles, M. A., & Kanoglu, M. (2018). *Thermodynamics: An engineering approach.* a. Chapter 13 b. Chapter 14 **2. Complete:** Discussion Board #4 (ULO 1-10) **3. Complete:** Quiz #3 (ULO 3-5) **4. Complete:** Homework #3 (ULO 1-5) **5. Complete:** Midterm Exam (All ULOs Module 1-2)

		ULO 3: Apply the rules for determining mixture properties of ideal-gas mixtures. (SLO 4-5) ULO 4: Predict the P-v-T behavior of gas mixtures based on Dalton's law of additive pressures and Amagat's law of additive volumes. (SLO 4-6) ULO 5: Differentiate between dry air and atmospheric air. (SLO 1,4-6) ULO 6: Define and calculate the specific and relative humidity of atmospheric air. (SLO 1,4-6) ULO 7: Calculate the dew-point temperature of atmospheric air. (SLO 1,4-6) ULO 8: Relate the adiabatic saturation temperature and wet-bulb temperatures of atmospheric air. (SLO 1,4-6) ULO 9: Use the psychrometric chart and EES as tools to determine the properties of atmospheric air. (SLO 1,4-6) ULO 10: Apply the principles of the conservation of mass and energy to various air-conditioning processes. (SLO 1,4-6)	
	Module 4: Combustion-Chemical	ULO 1: Apply the conservation of mass to reacting systems to	1. **Read Textbook:** Çengel, Y. A., Boles, M. A., & Kanoglu, M. (2018). *Thermodynamics: An*

	Reactions	determine balanced reaction equations. (SLO 7) ULO 2: Define the parameters used in combustion analysis, such as air–fuel ratio, percent theoretical air, and dew-point temperature. (SLO 7) ULO 3: Calculate the enthalpy of reaction, the enthalpy of combustion, and the heating values of fuels. (SLO 1,7) ULO 4: Apply energy balances to reacting systems for both steady-flow control volumes and fixed-mass systems. (SLO 1,7) ULO 5: Determine the adiabatic flame temperature for reacting mixtures. (SLO 1,7) ULO 6: Evaluate the entropy change of reacting systems. (SLO 1,7)	*engineering approach.* a. Chapter 13 b. Chapter 14 **2. Complete:** Discussion Board #5 (ULO 1,2,3,5) **3. Complete:** Quiz #4 (ULO 3-5) **4. Complete:** Homework #4 (ULO 3-5)
	Module 5: 1D Compressible Flow Analysis	ULO 1: Develop the general relations for compressible flows encountered when gases flow at high speeds. (SLO 8) ULO 2: Introduce the concepts of stagnation state, speed of sound, and Mach number for a compressible fluid. (SLO 8) ULO 3: Develop the relationships between the static and stagnation fluid properties for isentropic	1. **Read Textbook:** Çengel, Y. A., Boles, M. A., & Kanoglu, M. (2018). *Thermodynamics: An engineering approach.* a. Chapter 17 **2. Complete:** Discussion Board #6 (ULO 1-5) **3. Complete:** Quiz #5 (ULO 3-5) **4. Complete:** Homework #5 (ULO 3-5) **5. Complete:** Final Exam (All ULOs Module 1-5)

		flows of ideal gases. (SLO 8) ULO 4: Derive the relationships between the static and stagnation fluid properties as functions of specific-heat ratios and Mach number. (SLO 1,8) ULO 5: Derive the effects of area changes for one-dimensional isentropic subsonic and supersonic flows. (SLO 1,8)	

** These descriptions and timelines are subject to change at the discretion of the instructor.*