



NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

Course Syllabus

Course Information

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| <i>Course Number/Section</i> | ASME 231 |
| <i>Course Title</i> | Atmospheric Thermodynamics |
| <i>Term</i> | Spring 2019 |
| <i>Days & Times</i> | 12:30 – 1:45 TR, 302 Gibbs Hall |

Professor Contact Information

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| <i>Professor</i> | Dr. Yuh-Lang Lin |
| <i>Office Phone</i> | (336) 285-2127 |
| <i>Email Address</i> | ylin@ncat.edu (or yuhlang2009@gmail.com) |
| <i>Office Location</i> | 302H Gibbs Hall |
| <i>Office Hours</i> | (a) 1:00-3:00 MWF or stop by anytime for short discussions; (b) by appointment for longer discussions |
| <i>Teaching Assistant:</i> | Shak Karim: skarim@aggies.ncat.edu |
| <i>Other Information</i> | MesoLab website: http://mesolab.org |

Course Pre-requisites, Co-requisites, and/or Other Restrictions

- (1) PHYS 241 or equivalent to General Physics I

Course Description

This course covers the general aspects of thermodynamic physical processes occurring within the atmosphere. Topics included are thermodynamics systems, equation of state for ideal gases, Charles' law, Boyle's law, mixture of gases, first law of thermodynamics, internal energy, specific heats and enthalpy, adiabatic processes, potential temperature, Carnot's cycle, second law of thermodynamics, entropy, moisture variables, phase transitions, Clausius-Clapeyron equation, moist air adiabats, thermodynamic diagrams, hydrostatic equation, geopotential, scale height and the hypsometric equation, thickness and heights of constant pressure surfaces, Reduction of pressure to sea level, dry and moist adiabatic lapse rates, parcel method, potential or convective instability, slice method of stability analysis, entrainment into cumulus clouds, bubble and plume theories, introduction to numerical cloud modeling

Student Learning Objectives/Outcomes

- Objective:** Understand the thermodynamic physical processes occurring within the atmosphere and governing laws
Outcome: Students will demonstrate the ability to answer conceptual questions as well as apply the approximation techniques to problems on examinations.
- Objective:** Effectively relate basic ideas and concepts to more sophisticated atmospheric thermodynamic systems and processes
Outcome: Students will demonstrate the ability to employ critical thinking in answering short questions as well as solving problems on examinations.
- Objective:** Apply the thermodynamic diagrams to real atmospheric soundings
Outcome: Student will be able to use skew-T log-p diagram to determine cloud base, cloud top, lifting condensation level, level of free convection for conditionally unstable atmosphere.

Required Textbooks and Materials

Required Texts

None

Required Materials

- (1) Lecture notes will be posted on Dr. Lin's MesoLab website: <http://mesolab.org>

Suggested Course Materials

Suggested Readings/Texts

- (1) A First Course in Atmospheric Thermodynamics by W. Petty, Sundo Publishing Co., 2008
- (2) An Introduction to Atmospheric Thermodynamics by A. A. Tsonis, Cambridge, 2007, 2nd Ed.
- (3) Introduction to Theoretical Meteorology by S. L. Hess, Krieger Publishing Co., Reprint Ed. 1979

Suggested Materials

None

Grading Policy

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|----------------|-----|
| (1) Labs | 30% |
| (2) Midterm | 30% |
| (3) Final Exam | 40% |

Grading Scale

| Grade | A | A- | B+ | B | B- | C+ | C | C- | D+ | D | F |
|--------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| Scores | 94-100 | 90-93 | 87-89 | 83-86 | 80-82 | 77-79 | 73-76 | 70-73 | 67-69 | 60-66 | 0-59 |

Assignments & Academic Calendar (Subjected to change)

Topics, Reading Assignments, Due Dates, Exam Dates (optional: withdrawal dates, holidays, etc.)

| Date | Lecture # | Lecture Title | Remarks |
|-------|-----------|---|---------|
| 1/15 | 1 | Introduction to the course and labs | 1.1 |
| 1/17 | 2 | Basic concepts | 1.2 |
| 1/22 | 3 | Equation of State of an Ideal Gas | 2.1 |
| 1/24 | 4 | Mixture of Ideal Gases | 2.2 |
| 1/29 | 5 | Work | 3.1 |
| 1/31 | 6 | Heat | 3.2a |
| 2/5 | 7 | Kinetic Theory of Gases | 3.2b |
| 2/7 | 8 | First Law of Thermodynamics | 3.3 |
| 2/12 | 9 | Internal Energy, Heat Capacity & Enthalpy | 3.4 |
| 2/14 | 10 | Adiabatic Process | 3.5 |
| 2/19 | 11 | Carnot Cycle | 4.1 |
| 2/21 | 12 | Carnot Cycle | 4.1 |
| 2/26 | 13 | Second Law of Thermodynamics | 4.2 |
| 2/28 | | Midterm | |
| 3/4-8 | | Spring Break | |
| 3/12 | 14 | Entropy | 4.3 |
| 3/14 | 15 | Water-Air System – Isotherms on the Phase Diagram | 5.1 |
| 3/19 | 16 | Thermal Properties of Water Substance | 5.2 |
| 3/21 | 17 | Equation of State for Moist Air | 5.3 |
| 3/26 | 18 | Phase Change & Latent Heat | 5.4 |
| 3/28 | 19 | The Clausius-Clapeyron Equation | 5.5 |
| 4/2 | 20 | Saturated Adiabatic Process | 5.6 |

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| 4/4 | 21 | Moisture Variables - I | 5.7 |
| 4/9 | 22 | Moisture Variables - II | 5.7 |
| 4/11 | 23 | Thermodynamic Diagrams | 6.1 |
| 4/16 | 24 | Thermodynamic Diagrams | 6.1 |
| 4/18 | 25 | Thermodynamic Diagrams | 6.1 |
| 4/23 | 26 | Thermodynamic Diagrams | 6.1 |
| 4/25 | 27 | Hydrostatic Equilibrium | 7.1 |
| 4/30 | 28 | Geopotential & Scale Height | 7.2 |
| 5/2 | 29 | Hypsometric Equation | 7.3 |
| 5/6-10 | | Final Exam | |

Course Policies

Make-up exams

No make-up mid exams are allowed. With advanced & excused absences with evidence, the homework and final exam with appropriate weights will be used to evaluate the overall grade.

Extra Credit

No Extra Credit

Late Work

Late submission of homework and model projects must be within a reasonable period of time permitted by the instructor.

Special Assignments

Not applicable

Academic Integrity

Enrollment in the class means that you agree to abide by the expectations of North Carolina A&T State University about academic integrity. For specific information refer to your Student Handbook. Also, refer to the most current Undergraduate Bulletin for the academic dishonesty policy. The North Carolina A&T State University's Academic Honor Code will be enforced.

Your responsibilities in the area of honor include, but are not limited to, avoidance of cheating, plagiarism and improper or illegal use of technology. Your presentations, assignments, and quizzes are expected to be your own work. Any questions about these should be directed to the professor. It is permissible to request assistance from a librarian when doing database research as long as the selection and organization of the research for the presentation is in your own work.

Class Attendance

The College of Arts and Sciences requires students to be on time for class and to attend class on a regular basis. If the student has unexcused absences, is late for class or leaves class early, the student's grade may be lowered.

(See attendance policy set forth by the instructor in the course syllabus.)

Excused absences will comply with the following university policy on makeup work: "Sickness (verification needed); death of relative (immediate family); participation in an approved university related activity; acting in the capacity of a university representative (band, choir, sports, related travel, etc.); extraordinary circumstances including court appearances, family emergency~ at the discretion of the professor, etc. require a signed statement.

NOTE: "Other reasons for class absences are not acceptable."

Classroom Citizenship

Normal classroom decorum is expected.

Technical Support

If you experience any problems with your A&T account you may call Aggie Tech Support (formerly Help Desk) at 336.334.7195.

Field Trip Policies / Off-Campus Instruction and Course Activities

Not applicable

Student Affairs website <http://www.ncat.edu/~staffair/>;

Student Handbook: <http://www.ncat.edu/~deanofst/Handbook.htm>;

Student Travel Procedures and Student Travel Activity Waiver

<http://businessfinance.ncat.edu/policies%20and%20procedures%20index.htm>

Off-campus, out-of-state, and 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 the website address: Student Travel Procedures and Student Travel Activity Waiver

<http://businessfinance.ncat.edu/policies%20and%20procedures%20index.htm>.

Additional information is available from the office of Student Affairs, please check the website at <http://www.ncat.edu/~staffair/>.

Below is a description of any travel and/or risk-related activity associated with this course.

Other Policies (e.g., copyright guidelines, confidentiality, etc.)

Student Handbook: <http://www.ncat.edu/~deanofst/Handbook.htm>

Family Educational Rights and Privacy Act http://www.ncat.edu/~registra/ferpa_info/index.htm

Student Conduct & 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 undergraduate http://www.ncat.edu/~acdaffrs/Bulletin_2008-2010/2008-2010_Undergraduate_Bulletin.pdf and graduate bulletins: 2008-2010 Graduate Catalog.doc <http://www.ncat.edu/~gradsch/cstudents.html> and student handbook <http://www.ncat.edu/~deanofst/Handbook.htm> for detailed information 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.

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

01.27.09 – Submitted to Faculty Senate by LEW