# Physical Meteorology I: Thermodynamics

(METR 3213)

## Fall 2006 Syllabus

**General information:** The course introduces basic principles of atmospheric thermodynamics. It provides formal description and physical interpretation of thermodynamic processes including atmospheric heating and cooling mechanisms, heat energy transport and transformations, interactions between different water phases in the atmosphere, and buoyancy effects. The course also covers applications of thermodynamic charts and diagrams in meteorological analysis and forecasting.

**Time and place:** Mon, Wed, and Fri, 10:00 - 10:50 a.m., Room 1350, National Weather Center (NWC).

**Instructor:** Dr. Evgeni Fedorovich (http://weather.ou.edu/~fedorovi/fedorovich.html),
School of Meteorology, Room 5419, NWC, Phone: 405-325-1197, E-mail: fedorovich@ou.edu

**Office hours:** daily during afternoon hours; ***by appointment only!***

**Calling and e-mailing the instructor:** should be used ***only*** for scheduling office hour appointments or informing the instructor of emergencies associated with class attendance; all academic questions should be asked in the class or during the office hours.

**Prerequisites:** Grade of C or better in MATH 2443, PHYS 2524, and METR 2023/2024.

**Required texts:**

Wallace, J. M., and P. V. Hobbs, 2006: *Atmospheric Science: An Introductory Survey*. Academic Press / Elsevier, 483 pp.

*The Use of The SKEW T, LOG P DIAGRAM in Analysis and Forecasting*, 1990; AWS/TR-79/006 Revised. Air Weather Service, Scott Air Force Base, Illinois 62225-5008.

**Supplementary text:** Bohren, C. F., and B. A. Albrecht, 1998: *Atmospheric Thermodynamics*. Oxford University Press, 402 pp.

**Grading:** Three intermediate tests (September, October, November): 20% each (worst grade to be dropped). Three surprise quizzes: 10% each (worst grade to be dropped). Final exam (December): 40%. No make-up tests/quizzes. Grade cutoffs: A - ≥85%, B - ≥70%, C - ≥50%, D - ≥30%, F - <30%.

**Course outline**

***Part I.*** *Introduction.* Composition of the atmosphere. Distribution of atmospheric mass and gaseous constituents. Temperature distribution. Radiative transfer of energy and its role in the thermal regime of the atmosphere.

***Part II.*** *Basic notions and equations.* Gas laws. Virtual temperature. Hydrostatic equation. Geopotential. Hypsometric equation. Isobaric surfaces and pressure reduction methods.

***Part III.*** *First law of thermodynamics.* Principle of conservation of energy. Joule's law. Specific heats. Enthalpy. Concept of air parcel. Adiabatic processes. Adiabatic lapse rate. Potential temperature.

***Part IV.*** *Atmospheric moisture.* Water vapor in the air. Moisture parameters. Evaporation and condensation. Saturated-adiabatic processes and lapse rate. Equivalent potential temperature.

***Part V.*** *Static stability.* Stability of unsaturated and saturated air. Conditional and convective instability. Buoyancy.

***Part VI.*** *Second law of thermodynamics.* Carnot cycle. Reversible and irreversible processes. Statements of the Second Law. Entropy. Clausius-Clapeyron equation.

***Part VII.*** *Thermodynamic diagrams.* Pseudoadiabatic charts. Temperature – entropy, skew $T - \ln p$ diagrams and their applications.

**Note:** *Any student in this course who has a disability that may prevent him or her from fully demonstrating his or her abilities should contact Dr. Evgeni Fedorovich personally to discuss accommodations necessary to ensure full participation and facilitate your educational opportunities.*