Earth Space and Atmospheric Sciences 2110 - Spring 2012
Intermediate Meteorology
Professor Paul L. Sirvatka

Description: A quantitative first look at the science of meteorology. Physical concepts will be examined using algebraic methods to prepare students for material using higher mathematics. Operational, physical, and dynamical meteorology will be discussed to give students an overall understanding of atmospheric science. Equations of motion, thermodynamics, and the primitive equations will be among the topics covered.

Prerequisite: Math 1431, and either Earth Science 1110 or 1115, or consent of instructor

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TuTh 2:00-4:00PM
I will also be available at other times. Please try to set up an appointment if you wish to see me at any time. Please feel free to contact me with questions using email as well.

Text: Atmospheric Science – An Introductory Survey, 2nd Edition, Wallace and Hobbs.

Additional Materials: #2 pencils are required *daily*. Calculators with scientific notation will also be required daily. A three-ring notebook is necessary to assist in maintaining sufficient organization.

Attendance: Attendance is extremely important. Much of the material is covered only in class. It is expected that you will attend all classes. Contact the instructor as soon as possible in the event of an unavoidable absence.

Labs and quizzes cannot be made up. Only in exceptional circumstances can tests be given at a time other than the announced date. Exceptions must be pre-arranged. A missed test is a zero.

Grading:

Unit exams	~ 70%
Homework	~ 10%
Final Project	~ 20%

Grades will be curved based upon expected results and class participation and attitude. Generally speaking, the grades will be as follows:
A – 80%; B – 70%; C – 50%; D – 40%; F < 40%
All work must be completed. An incomplete will be given only in an exceptional circumstance. It is the student's responsibility to withdraw from the course due to non-attendance. Failure to withdraw will result in an "F". Late assignments will be penalized to a maximum credit of 50% at the discretion of the instructor. Students wishing to take this course on a pass/fail basis must earn a grade of a "C" or higher to receive a "Satisfactory" for the course. In order to fulfill the general education requirements a letter grade must be received.

Course Objectives: Upon successful completion of this course the student should be able to do the following:

1. Define and use various forms of foundational physical laws as they relate to meteorology, including the Ideal Gas Law, the 4 Laws of Thermodynamics, and Newton's Laws of Motion
2. Define scale height and use it in expressing vertical distributions of pressure and density
3. Derive the virtual temperature
4. Derive the hypsometric equation from the hydrostatic equation and the Ideal Gas Law
5. Define and contrast the specific heat of air at constant pressure and at constant volume
6. Derive potential and equivalent potential temperature
7. Explain a Carnot heat engine and determine the work, efficiency, and changes in entropy of atmospheric processes that liken an engine

8. Differentiate between various uses of the Del operator
9. Convert zonal, meridional and vertical velocities from Cartesian to spherical coordinates
10. Evaluate and interpret a total derivative
11. Differentiate between an Eulerian and LaGrangian description of motion
12. Formulate the Coriolis force from the earth's apparent centrifugal force
13. Express the pressure gradient force in Cartesian and natural coordinates
14. Define the geostrophic and gradient balance and calculate corresponding wind velocities
15. Differentiate between trajectories and streamlines
16. Interpret the significance of the thermal wind in baroclinic disturbances
17. Differentiate between a barotropic, equivalent barotropic, and baroclinic atmosphere
18. Explain a method for expressing mass continuity and interpret its results
19. Summarize the primitive equations
20. Describe the development of thermally direct and thermally indirect circulations
21. Define baroclinic instability in qualitative terms
22. Describe the energy cascade
23. Summarize blackbody radiation and its governing laws

Expectations: The student is expected to attend all classes, participate fully in classroom discussions and cooperate in learning experiences with other classmates. The expected workload is two hours of work for every hour of time spent in class. This will vary from week to week with some weeks having more work required and other weeks having less. Nonetheless, because this class is a sophpmore level course, higher quality work is expected.

Final Exam: A final exam will be given. See http://www.cod.edu/schedule/ for a listing of the final schedule.

The following list represents things meteorology majors at COD ought to know before leaving our program. Most of these things will be covered in this class. However, some are covered well in in other classes. The final project will be to discuss thoroughly each one of these, professionally and with diagrams. This should be something that you will use the rest of your academic career.

1. Bergeron Process
2. Buys-Ballot Law
3. Chinook, Santa Ana and Katabatic Winds
4. Cloud Types
5. Conservation of Angular Momentum
6. Derivation of Poisson's Equation
7. Energy Cascade
8. Facts about the Geostrophic Wind
9. Four Laws of Thermodynamics
10. Geostrophic Equation
11. Global Warming vs. the Greenhouse Effect
12. Gradient Winds
13. Hydrostatic Equation
14. Hypsometric Equation
15. Ideal Gas Law
16. Instability (Absolute/Conditional)
17. Jet Streak and Associated Circulations
18. Mass Continuity Equation
19. Newton's 3 Laws of Motion
20. Q-G Omega Equation (Qualitative)
21. Rayleigh Scattering (Why is the Sky Blue?)
22. Sea Breeze/Land Breeze Circulations
23. Station Model (Surface/Upper Air)
24. Stephan-Boltzmann Law
25. Thermal Wind
26. Thermally Direct/Indirect Circulations
27. Thermodynamic Diagram
28. Three-Cell Model
29. Virtual Temperature
30. Wien's Displacement Law