INSTRUCTOR: Jerry Y. Harrington  
OFFICE: 513 Walker Building  
PHONE: 863-1584  
EMAIL: harring@mail.meteo.psu.edu  
WEB: http://www.meteo.psu.edu/~harring  
OFFICE HOURS: Monday, Wednesday 5pm – 6:30pm

TEACHING ASSISTANT: Kara Sulia  
OFFICE: 412 Walker Building  
EMAIL: kjs5066@psu.edu  
OFFICE HOURS: Tuesday, Thursday 2pm – 3:30pm

CLASS MEETINGS:  
12 Walker Building  
9:05am – 9:55am Monday, Wednesday, and Friday

PREREQUISITES:  
METEO 431 (Atmospheric Thermodynamics)

COURSE TEXTBOOKS:  
*Physics and Chemistry of Clouds Explained* by Lamb and Verlinde  
Document available on Angel.

*A Short Course in Cloud Physics* by Rogers and Yau (Recommended)  
*Introduction to Atmospheric Chemistry* by Jacob (Recommended)

COURSE DESCRIPTION:  
METEO 437 is a 3 credit lecture course that is designed to provide you with basic knowledge on the physical and chemical basis of clouds in the atmosphere.

GRADING:  
Midterm 1 (Thursday, February 11, 6 – 8pm) : 25%  
Midterm 2 (Thursday, March 25, 6 – 8pm) : 25%  
Final Exam : 25%  
Quizzes (every second Friday) : 15%  
Homework : 10%  

Location of Midterm Exams: Room 203, E E West
COURSE PHILOSOPHY:
“I see and I forget, I hear and I forget, I do and I understand.” - Confucius

If you merely read books and listen to others, you will never really learn anything new. New knowledge is only truly gained by thinking and working things through for yourself. The difference is like that between one who simply reads about an experience and one who lives it. - Paraphrase of one of Schopenhaurs’ Aphorisms.

“The main job of a teacher is to free the student from the teacher” - Zen Buddhist Saying

COURSE OBJECTIVES:
1. Students can demonstrate familiarity with microphysical principles and how they determine the structures of the atmosphere and clouds. (relate to program objectives 1 and 2)
2. Students can demonstrate the ability to apply principles of cloud microphysics and atmospheric chemistry to the solution of atmospheric problems. (relate to program objectives 1 and 3)

COURSE OUTCOMES:
1. Students can demonstrate knowledge of cloud properties. (relate to program outcomes a, b, and c)
2. Students can demonstrate knowledge of the thermodynamic drivers of cloud development and evolution. (relate to program outcomes b, c, and d)
3. Students can demonstrate knowledge of basic atmospheric chemistry and its role in atmospheric phenomena. (relate to program outcomes b, c, and d)

COURSE EXPECTATIONS:
It is expected that you have a good understanding of mathematics (through differential equations), physics (mechanics, electricity and magnetism, thermodynamics), and chemistry (reaction rates, etc.). These are implied prerequisites for the course! Students with weak backgrounds in these fundamental disciplines are advised to either postpone enrollment in this course, or get up to speed now! Your ability to understand the material in this course depends critically on how well you learned your math, physics, chemistry, and (especially) thermodynamics!

I expect active participation from all students in the course, each week. I also expect each student to keep up with the material on her/his own. This includes reviewing lecture notes, reading assigned material, and reading material from the reserve books in the library. It is never possible to fully understand the material in a course simply by attending lectures. It is best to think of me as a guide through the relevant material, but it is you who must do all the hard work that goes along with the learning process. Like anything else, what you get out of this course depends on what you put into it in terms of work, and in terms of your attitude. Working hard, thinking a lot, and maintaining a positive perspective are the best ways to gain the most from this course!

ACADEMIC INTEGRITY:
Cheating and plagiarism are serious offenses that may be grounds for failing an assignment, an exam, or even the course. Please review the College policies related to academic integrity on the web at <http://www.ems.psu.edu/students/integrity/>.
I. INTRODUCTION
• Atmospheric Organization and Issues
• Cloud Types and Properties, The Hydrological Cycle
• Thermodynamics Review

II. ATMOSPHERIC TRANSPORT AND TRANSFORMATIONS
• Atmospheric Constituents
• Principles of Interaction
• Formation of New Substances

III. CLOUD DEVELOPMENT
• Thermodynamic Drivers
• Cloud Macrophysics
• Supersaturation Development

IV. CLOUD MICROPHYSICS
• Phase Nucleation
• Growth of Cloud Particles
• Precipitation

SUPPLEMENTARY READINGS: (Available on Reserve in EMS Library):

<table>
<thead>
<tr>
<th>CALL NUMBER</th>
<th>AUTHOR(S)</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>QC921.5.R63 1988</td>
<td>Rogers and Yau</td>
<td>A Short Course in Cloud Physics</td>
</tr>
<tr>
<td>QC921.5 F55 1962</td>
<td>Fletcher</td>
<td>The Physics of Rainclouds</td>
</tr>
<tr>
<td>TD174.H55 1997</td>
<td>Hill</td>
<td>Understanding Environmental Pollution</td>
</tr>
<tr>
<td>QC861.2 H63 2000</td>
<td>Hobbs</td>
<td>Basic Physical Chemistry for the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Atmospheric Sciences</td>
</tr>
<tr>
<td>QC879.6 H62 2000</td>
<td>Hobbs</td>
<td>Introduction to Atmospheric Chemistry</td>
</tr>
<tr>
<td>QC921.5 M3 1971</td>
<td>Mason</td>
<td>The Physics of Clouds</td>
</tr>
<tr>
<td>QC921.5 P78 1997</td>
<td>Pruppacher and Klett</td>
<td>Microphysics of Clouds and Precipitation</td>
</tr>
<tr>
<td>TD883.T85 1997</td>
<td>Turco</td>
<td>Earth under Siege</td>
</tr>
<tr>
<td>QC882.T93 1977</td>
<td>Twomey</td>
<td>Atmospheric Aerosols</td>
</tr>
<tr>
<td>QC861.3.W35 2006</td>
<td>Wallace and Hobbs</td>
<td>Atmospheric Science</td>
</tr>
</tbody>
</table>