Physics 6389; Space Science Special Topics: Planetary Atmospheres.
Call #: 13749

Professor: Brian A. Tinsley
Fall, 2005. CB1.116, Tuesday-Thursday, 2:00 pm to 3:15 pm.

Recommended books:

Wallace and Hobbs, Atmospheric Science, Academic Press, 1977. (WH)
(A new edition of Wallace and Hobbs should be out in November)
Rogers and Yau, A Short Course in Cloud Physics, 3rd. ed. 1989. (RY)
Hargreaves, The Solar-Terrestrial Environment, Camb. U.. Press, 1992. (H)

Other books for reference:

Goody and Walker, Atmospheres, Prentice Hall, 1972. (GW)
Irabarne and Cho, Atmospheric Physics, Reidel, 1980. (IC)
Brasseur & Solomon, Aeronomy of the Middle Atmosph., Reidel, 1984. (BS)

Essential material from the reference books and elsewhere will be supplied by the professor in the lecture notes.

Grades will be based on 75% on mid-term and final exams, 15% on homework problems, and 10% on a term paper.

Syllabus:

1. Introduction: Planet. Atmosph.& Solar input	WH 1-25, GW 1-31, H 98-111.
barometric law –hydrostatic equilibrium	
atmospheric composition of the planets	
orbital elements for planets –effect on climate	
temperature structure and 'spheres' of atmospheres	
adiabatic lapse rate	
the sun, solar activity, solar wind and coronal mass ejections	notes, H 132-150
solar irradiance and its variations	H 210-213
absorption of solar radiation in the atmosphere –	
- the Chapman function	
2. Photodissociation, Photoionization, Photochemistry	BS 89-109, 201-219
Schumann-Runge continuum and bands - O and O_3 production	
balance of photochemical production and loss – photochemical models	
diffusion in the upper atmosphere	
the exosphere and atmospheric escape	GW 135-139, notes
recombination, optical emission	
airglow processes – resonant scattering, chemical association –	
ionic reactions and photoelectron excitation	H 233-236, notes
aurorae – auroral morphology	H 327-341
observed effects of solar activity on climate	notes, journal papers

3. Atmospheric temperatures GW 44-70, WH 316-354
effective temperatures, surface temperatures
heat transport by convection – lapse rate
radiative transfer
greenhouse effect on Earth and Venus
heat transport by conduction in the thermosphere H 103-108

4. Large scale circulation WH 359-448
driving forces: gravity, pressure gradient, Coriolis force, viscosity
continuity equation
balanced wind
direct thermal circulation, ion drag
Hadley cell, Rossby waves, Brewer-Dobson circulation
Circulation of Venus

Mid term exam

5. Atmospheric electricity WH 18-20, notes, journal papers.
global circuit fundamentals, thunderstorm generators
ionization by galactic cosmic ray flux and atmospheric radioactivity
ion-ion recombination
aerosol distributions, diurnal and seasonal variations
volcanic aerosols and production of ultrafine particles
attachment of ions to aerosol particles
ion concentration and mobility
column resistance, global distribution
global circuit and polar cap ionospheric potential pattern
global Jz distribution
variations in Jz due to solar/cosmic ray variability,
variations due to relativistic electrons, solar energetic particles.

6. Cloud physics, electrical effects RY 81-96, notes, journal papers
formation of clouds
ion-induced nucleation, cloud condensation nuclei
space charge in clouds
growth of droplets, contact ice nucleation
microphysics of droplet-aerosol interactions
electric effects on cloud microphysics
correlations of cloud properties and/or atmospheric dynamics
with Jz variations
application to problem of long term climate correlations with solar activity

Term papers presented

Final exam.