Syllabus

Ben-Gurion University of the Negev

Department of Geological & Environmental Sciences

Introduction to Physics of Atmospheres and Oceans

Course number: ???????

Prof. Yosef Ashkenazy

Semester 1, Year 2015-2016

2 credit points

Course Description:

The atmosphere and ocean are important in our daily life, from personal and more general point of views. The course will provide the basic knowledge and tools that are required to understand and analyze global and local climate phenomena. The course is based on simple mathematical/physical analysis of the governing geophysical fluid dynamics equations.

Course Objectives:

The course goals are to provide basic knowledge on the physics of the atmosphere and oceans and to teach the students the ways to analyze basic climate phenomena.

Course Structure:

Lecture: 12-14

Exercise: During the lectures

Course requirements:

Pre-requisite: Calculus, Physics 1,2.

Structure of Final Course-Grade:

	Component	Weight
1.	Homework	20%
2.	2 mid-term exams	2×40%
	Total:	**100%**

Lecturer Details:

Reception hours: ???
E-mail: ashkena@bgu.ac.il
Telephone: 08-6596858

Detailed description of the course:

1. **Introduction**
   - 1.1. General overview of ocean dynamics.
   - 1.2. General overview of atmospheric dynamics.
   - **1.3.** Course outline and course goals.
2. **Characteristics of the atmosphere**
   - 2.1. Geometry
   - 2.2. Chemical composition of the atmosphere
   - **2.3.** Physical properties of dry and moist air
3. **The global energy balance**
   - 3.1. Planetary emission temperature
   - 3.2. The atmospheric absorption spectrum
   - **3.3.** The greenhouse effect
4. **The vertical structure of the atmosphere**
   - 4.1. Vertical distribution of temperature and greenhouse gases
   - **4.2.** The relation between pressure and density: hydrostatic balance
5. **The meridional structure of the atmosphere**
   - 5.1. Radiative forcing and temperature
   - 5.2. Pressure and geothermal height
   - 5.3. Moisture
   - 5.4. Winds

First mid-term exam

6. **The equations of fluid motion**
   - 6.1. Differentiation following the motion
   - 6.2. Equation of motion for a nonrotating fluid
   - 6.3. Conservation of mass
   - 6.4. Thermodynamics equation
   - 6.5. Equations of motion for a rotating fluid
   - **6.6.** The Coriolis force
7. **Balanced flow**
   - 7.1. Geostrophic motion
   - 7.2. The Taylor-Proudman theorem
   - 7.3. The thermal wind equation
   - **7.4.** Subgeostrophic flow: the Ekman layer
8. **The ocean and its circulation**
   - 8.1. Physical characteristics of the ocean

8.2. The observed mean circulation
8.3. Inferences from geostrophic and hydrostatic balance
8.4. Ocean eddies

9. **The wind-driven circulation**
   9.1. The wind stress and Ekman layers
   9.2. Response of the interior ocean to Ekman pumping
   9.3. The depth-integrated circulation: Sverdrup theory
   9.4. Effects of stratification and topography
10. **Climate and climate variability**
   10.1. The ocean as a buffer of temperature change
   10.2. El-Nino and the Southern Oscillation
   10.3. Paleoclimate

Second mid-term exam

Recommended Reading:

- John Marshall and Alan Plumb, *Physics of Atmospheres and Oceans*, Lecture Notes (http://paoc.mit.edu/labweb).
- Dennis L. Hartmann, *Global Physical Climatology*, Academic Press (1994).
- John T. Houghton, *The Physics of Atmospheres*, Cambridge University Press (1977).
- David Randall, *The General Circulation of the Atmosphere,* available at http://kiwi.atmos.colostate.edu/group/dave/at605.html