Concepts in Physical Oceanography

Winter 2016: OCOR-5601

Instructor: Prof. Alex Soloviev
Nova Southeastern University Oceanographic Center
E-mail: soloviev@nova.edu; ph.: 1 (954) 262-3659

Class hours:
Monday 6:30 pm – 9:30 pm, Forman 100

Office hours: TBD

TA: TBD

September 17, 2015 (evolving)

Required Textbooks (electronic copies available via the NSUOC Library)

- **Ocean Circulation** (Second Edition) by A. Colling. Published by The Open University Course Team, 2001.

  http://novacat.nova.edu/record=b2519703~S13 or
  http://novacat.nova.edu/record=b2528177~S13

- **Waves, Tides and Shallow-Processes** (Second Edition) by J. Wright, et al. Published by the Open University Course Team, 2000.

  http://novacat.nova.edu/record=b2525369~S13

For help to access book contact Jaime M. Goldman, Oceanographic Center Library, 954-262-3681, jaime.goldman@nsu.nova.edu.

Recommended Textbook

- Introduction to Physical Oceanography by Robert Stewart: http://oceanworld.tamu.edu/home/course_book.htm (PDF and Web Version)

Course Outline

This course is intended to give students a view to how wind, radiation, gravity, friction, and the Earth's rotation determine the ocean's temperature and salinity patterns and currents. Some important process we will study include heat budget of the oceans, exchange of heat with the atmosphere and the role of the ocean in climate, surface mixed layer, waves in the ocean, geostrophy, Ekman transport, upwelling, Rossby waves, subtropical gyres, western and eastern boundary currents. Students will learn how to explain physical features of the ocean ranging from microscopic turbulence to global circulation.

Course Syllabus

Unit	Date	Agenda
1.	Jan 4	Introduction: What is physical oceanography and why should I care?
2.	Jan 11	Properties of seawater and physical setting, measurement tools
3.	Jan 18	Rotation and dynamics Math review (vectors, scalars etc.) Coriolis force geostrophy
4.	Jan 25	Wind-Driven Circulation I the equations of motion Ekman transport and pumping coastal upwelling and downwelling
5.	Feb 1	Wind-Driven Circulation II gyres of the world Sverdrup relation potential vorticity western intensification equatorial circulation Antarctic Circumpolar Current ASSIGNMENT 1 is due (upload to the Blackboard Dropbox)
6.	Feb 8	Buoyancy-Driven Circulation and the Big Picture: Oceans and Climate global distribution of temperature and salinity water masses how deep water forms buoyancy-driven flows I: no rotation buoyancy-driven flows II: Deep Western Boundary Currents air-sea fluxes

basics of climate
why the ocean is important for climate

7. Feb 15 MIDTERM EXAM

8. Feb 22 Gravity Waves and Mixing.
   - what is a wave?
   - dispersion
   - internal waves
   - instabilities: Kelvin-Helmholtz, salt fingers, Langmuir circulation
   - turbulence
   - mixed layer evolution

9. Mar 1 Long Waves in Rotating Fluid and Eddies
   - Tsunamis
   - Poincare waves and Kelvin waves
   - Rossby waves
   - instability of geostrophic currents
   - mesoscale eddies in the ocean

   ASSIGNMENT 2 is due (upload to the Blackboard dropbox)

10. Mar 8 Coastal Processes (ASSIGNMENT 3: group presentations)
    - estuaries
    - river outflow plumes
    - costal fronts

    Tidal Forces and Tides
    - tidal forcing
    - large scale tides
    - tides near coasts

11. Mar 15 Monsoon
    - monsoon circulation
    - El Nino
    - equatorial waves
    - El Nino-Southern Oscillation
    - Tropical cyclones
    - Climate change

12. Mar 22 FINAL EXAM

Grades %

Quizzes	7
Class Discussions*	9
Three home assignments	24
Mid-Term Exam	20
Final Exam	40
Total**	100%

* Missed class will result in the subtraction of 1 point from the final grade
** The final grades may be curved

Quizzes

9 Quizzes (online, via Blackboard). Only 7 quizzes will enter the final grade (the first quiz is for training purposes only; one lowest grade quiz will be dropped)..
Quizzes will have strict deadline Sunday 11:55 pm.

Midterm Exam

Units 2-6, multiple-choice, calculating, matching, problem solving (in class, closed notes). Sample problems can be found in the textbooks, etc.

Final Exam

Same as midterm but for units 8-11 (in class, closed notes).

Home Work

- Read materials for the next lecture and prepare one question for the class discussion. Everyone submiting question will get 1 point to the final grade (see section Grades). In addition, one best question and one best answer will be awarded as 1 bonus point each to the final grade as a result of discussion each class)
- Solve text-book problems—answers are available at the end of the book (no grading, but similar problems may be on exasm).
- Assigments 1 and 2 (individual work): 12 points total.
- Assignment 3 (group presentations**)**: 12 points**.**

Standards for Class Courtesy

- Keep nametags on the table; drop it to the special box after the class.
- Late arrival should be an exception. When necessary, sit on entering side; do not disturb class.
- Talking-with everyone or with no one.
- Questions can be asked at any time during the lecture.

Honor Code

Students should be familiar with the NSU Honor Code (you will find it in the catalog). Neither cheating, plagiarism nor fabrication will be tolerated. **Any student found cheating during the exams or to have plagiarized or fabricated statements (including passages from web pages) will receive an automatic 'F' for the class.**

Learning Disabilities

All disabilities have to be documented by NSU's Center for Health & Counseling, and instructors receive a formal letter requesting that we make accommodations for any student with disabilities. Please contact us at the beginning of the course about your special requirements you might need. Contact us after the lessons, in our offices, by phone or mail within the first week of the semester.

Course Learning Outcomes

Students will learn:

- how wind, radiation, gravity, friction, and the Earth's rotation determine the ocean's temperature and salinity patterns and currents
- the complex nature of the relationships between oceanic and atmospheric processes
- how physical processes may influence marine organisms.

At the end of the course, students will be able to effectively communicate the subject of this course, including terminology and main concepts of physical oceanography.

Learning Outcomes for Programs OCMB, CZMT and MEVS

The course will help students to acquire and demonstrate:

- a full understanding of the scientific method.
- in-depth knowledge of a specific aspect of physical oceanography.
- in-depth understanding of estuarine and coastal zone processes.
- a generalized knowledge of physical oceanography concepts as they relate to the marine environment.