Course Syllabus
CLIM 412/GEOL 412 &
CLIM 512/EVPP 505
Physical Oceanography
Fall 2019

Instructor: Barry A. Klinger
bklinger@gmu.edu
http://mason.gmu.edu/~bklinger
Office Hours: email to schedule
classroom: Research Hall 121

Catalog Description

Course describes the global patterns of temperature, salinity, currents and waves in the world's oceans, and how these patterns influence marine biota, climate, and human activity. Course introduces key concepts which explain physical features of the ocean ranging from microscopic turbulence to global circulation. ***3 credits***

Prerequisites: MATH 113 or MATH 115, and PHYS 160 or PHYS 243, or permission of instructor.

Student Evaluation

Homework: 8-12 problem sets.
Project: Term paper on physical oceanography subject.
Exams: Midterm and final with mixture of mathematical problems and short essay questions.
Different Levels: Graduate version of class has additional questions on problem sets and exams and higher expectations for term paper.
Grades: Homework 25%, Term Paper 25%, Midterm 20%, Final Exam 30%

Mathematical Level of Course

Physical oceanography at a professional level makes wide use of vector calculus (such as MATH 213 or MATH 215). Just as calculus concerns how a quantity varies in one dimension, vector calculus concerns multiple dimensions because ocean quantities depend on the three dimensions of latitude, longitude, and depth. This course is taught on the assumption that students are not familiar with vector calculus. However, some of the readings use the notation of vector calculus. In many cases, deep knowledge of advanced math is not necessary to understand the conclusions, and the course will teach students enough notation to follow text which uses it.

Graduate students familiar with vector calculus should consider taking CLIM 712 rather than this course.

Recommended Reading

Different students may find different reading options most useful, so the class has a recommended reading list rather than required reading.

Textbooks and Notes – Recommended Reading	
Afanasyev, Y. D., 2016: *Physical Oceanography: A Short Course for Beginners*, CreateSpace Independent Platform	*Very concise, hits major points, moderate amount of math.* **Strongly recommended.**
Knauss, J. A., and N. Garfield, 2016: *Introduction to Physical Oceanography*, Waveland.	*Comprehensive and well-organized, some advanced math but most sections understandable to less mathematically advanced students.*
Colling, A. (ed.), 2001, *Ocean Circulation,* 2nd edition, Butterworth-Heinemann Open University Course Team, 2000, *Waves, Tides, and Shallow-Water Processes,* 2nd edition, Butterworth-Heinemann	*Very understandable and no advanced math, but need 2 books to cover course and organization of 1st book is not very good.*

Background Reading

Students may find these textbooks useful for additional information related to the course.

Textbooks and Notes – Background Reading	
Klinger, B. A., and T. W.N. Haine, 2019: *Ocean Circulation in Three Dimensions,* Cambridge University Press	*Observational, conceptual, and theoretical look at large-scale ocean circulation; ask instructor about access.*
Marshall, J., and R. A. Plumb, 2007: *Atmosphere, Ocean and Climate Dynamics: An Introductory Text*, 344 pp., Academic Press.	*Conceptual and mathematical basis of ocean and atmosphere fluid dynamics for undergraduates and graduate students.*
Talley, L. D., G. L. Pickard, W. J. Emery, and J. H. Swift, 2011: *Descriptive Physical Oceanography, An Introduction (6th Edition),* 555 pp, Elsevier.	*Comprehensive observational textbook.*

Learning Goals

Graduates of the class should understand

- basic techniques of physical oceanography
- distributions of salinity, temperature, velocity, and other variables in the ocean
- key elements of theories of ocean circulation
    - fundamental laws, including effects of rotation, pressure, friction
    - roles of different forces in driving ocean behavior
    - role of ocean in climate, biological productivity
- Process of analyzing and solving simple problems in physical oceanography

Lecture Outline (see course outline for detailed schedule and readings)

1. Introduction: purpose and methods of course, observation methods
2. Distribution of Properties: math review, seawater, surface maps
3. Equations of Motion: heat and water exchange, forces
4. Earth's Rotation: Coriolis force, geostrophy
5. Wind-Driven Flow: Ekman transport, upwelling
6. Wind-Driven Gyres: major gyres, western boundary currents
7. Deep Meridional Overturning
8. Oceans and Climate
9. Gravity Waves and Mixing
10. Waves in a Rotating Fluid; Eddies
11. Tides: forcing and ocean response
12. Coasts: estuaries, river outflow plumes, fronts
13. El Nino, global warming, and climate variability

Lecture outline is subject to change.

Some Important Mason Policies

Updated Spring 2016

Electronic Communications

Students must use their MasonLive email account to receive important University information, including communications related to this class.

Disability Accommodations

If you have a documented learning disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with **Office of Disability Services** to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

Office of Disability Services: http://ods.gmu.edu

Academic Integrity

The integrity of the University community is affected by the individual choices made by each of us. Mason has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to follow at all times are that: (1) all work submitted be your own; (2) when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. No grade is important enough to justify academic misconduct. Plagiarism means using the exact words, opinions, or factual information from another person without giving the person credit. Writers give credit through accepted documentation styles, such as parenthetical citation, footnotes, or endnotes. Paraphrased material must also be cited, using MLA or APA format. A simple listing of books or articles is not sufficient. Plagiarism is the equivalent of intellectual robbery and cannot be tolerated in the academic setting. If you have any doubts about what constitutes plagiarism, please see me.

Office of Academic Integrity: http://oai.gmu.edu/
Honor Code:
http://oai.gmu.edu/the-mason-honor-code-2/

Mason Diversity Statement

George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.

An emphasis upon diversity and inclusion throughout the campus community is essential to achieve these goals. Diversity is broadly defined to include such characteristics as, but not limited to, race, ethnicity, gender, religion, age, disability, and sexual orientation. Diversity also entails different viewpoints, philosophies, and perspectives. Attention to these aspects of diversity will help promote a culture of inclusion and belonging, and an environment where diverse opinions, backgrounds and practices have the opportunity to be voiced, heard and respected.

The reflection of Mason's commitment to diversity and inclusion goes beyond policies and procedures to focus on behavior at the individual, group and organizational level. The implementation of this commitment to diversity and inclusion is found in all settings, including individual work units and groups, student organizations and groups, and classroom settings; it is also found with the delivery of services and activities, including, but not limited to, curriculum, teaching, events, advising, research, service, and community outreach.

Acknowledging that the attainment of diversity and inclusion are dynamic and continuous processes, and that the larger societal setting has an evolving socio-cultural understanding of diversity and inclusion, Mason seeks to continuously improve its environment. To this end, the University promotes continuous monitoring and self-assessment regarding diversity. The aim is to incorporate diversity and inclusion within the philosophies and actions of the individual, group and organization, and to make improvements as needed.