CLIM 412
PHYSICAL OCEANOGRAPHY

-- SYLLABUS --

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

Credits: 3

Instructor: Barry Klinger

Office Hours: To Be Determined

Course 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.

Homework: 8-12 problem sets.

Project: Term paper on physical oceanography subject, 5-10 pages long.

Exams: Midterm and final exam with mixture of mathematical problems and short essay questions.

Grades:

Homework 25%, Term Paper 25%, Midterm 20%, Final Exam 30%

Required Texts:

Open University Course Team, 2001, *Ocean Circulation*, Butterworth-Heinemann, Oxford, UK.

Lecture Content:

- 1. Introduction
    - What is physical oceanography and why should I care?
    - Tools of the trade: measurement, math, models
    - Instruments and observations
    - Properties of seawater
- 2. Distribution of properties
    - Surface temperature and salinity
    - Heat and freshwater exchange with the atmosphere
    - Mixed layer, thermocline, and water masses
- 3. The effect of rotation on currents
    - Math review: vectors, etc.
    - The Coriolis force
    - Geostrophy
- 4. Wind-driven circulation – the local view
    - Ekman transport and pumping
    - Coastal upwelling and downwelling
    - Biological primary productivity and Ekman pumping
- 5. Wind-driven circulation – basin-wide circulations
    - Description of the gyres of the world
    - Potential vorticity and western boundary currents
    - Equatorial circulation
    - Antarctic Circumpolar Current
- 6. Deep Meridional Overturning Circulation
    - How deep water forms
    - Deep western boundary currents
    - Global deep circulation and meridional overturning cells
    - What drives the deep meridional overturning circulation?
- 7. Oceans and Climate

    - Basics of climate
    - Why the ocean is important for climate
- 8. Introduction to Waves
    - What is a wave?
    - Dispersion
- 9. Gravity Waves and Mixing
    - Surface Gravity Waves and Tsunamis
    - Internal Waves
    - Turbulence, mixing, and biological productivity
- 10. Waves in a Rotating Fluid; Eddies
    - Poincare waves and Kelvin waves
    - Rossby waves
    - Mesoscale eddies in the ocean
- 11. Tides and Coastal Processes
    - Tidal forcing
    - Large scale tides
    - Tides near coasts
- 12. Coastal Processes
    - Estuaries
    - River outflow plumes
    - fronts
- 13. El Nino and low-frequency variability
    - El Nino-Southern Oscillation
    - Decadal variability
    - Global warming and the future of the seas