PHYSICAL OCEANOGRAPHY (11:628:451, 4 credits)

Instructors

Professor Robert Chant
Professor Javier Zavala-Garay

Prerequisites

Two terms of calculus

Course Materials

Primary texts:

Stewart, R. H. Introduction to Physical Oceanography, available online at http://oceanworld.tamu.edu/resources/ocng_textbook/PDF_files/book_pdf_files.html

Knauss, J. A. Introduction to Physical Oceanography, 2nd edition, ISBN 978-1577664291

Other references:

Tomczak, M. and J. Godfrey. Regional Oceanography: An Introduction, 2nd edition, ISBN 978-8170353065

Apel, J. R. Principles of Ocean Physics, available online at https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwispNTF2PLMAhWJQD4KHZzgDfUQFggdMAA&url=http%3A%2F%2Fwww.sisal.unam.mx%2Flabeco%2FLAB_ECOLOGIA%2FOF_files%2F31355312-Principles-of-Ocean-Physics.pdf&usg=AFQjCNHQEB5tPbLrdwDmGLG282ZvndXoOQ&sig2=4oSS62xFMjqZV9xDbmCaZw&cad=rja

Bowden, K. F. Physical Oceanography of Coastal Waters, ISBN 978-0853126867

Brown, J. et al. Ocean Circulation, The Open University, ISBN 0-7506-3716-1

Brown, J. et al. Waves, Tides and Shallow Water Processes, 2nd edition, The Open University, ISBN 978-0750642811

Neumann, G. and W. J. Pierson. Principles of Physical Oceanography, ISBN 978-0137097418

Talley, L. D. et al. Descriptive Physical Oceanography, 6th edition, ISBN 978-0750645522

Pond, S. and G. L. Pickard. Introductory Dynamical Oceanography, 2nd edition, ISBN 978-0750624961

Topics

I. Physical and chemical properties of seawater
   - Temperature, salinity and density
   - Equation of state
   - Stability
   - Surface heat flux
   - Sea ice

II. Conservation equations
   - Global balances of heat, water, and salt
   - The continuity equation
   - Diffusion

III. Equations of motion
    Local and field acceleration
    Pressure gradient
    Coriolis force
    Gravity
    Friction
IV. Effects of earth's rotation
    Inertial motion
    Geostrophic flow
    Margule's equation
    Barotropic and baroclinic fluids
    Ekman motion
V. Ocean circulation
    North Atlantic gyre
    Gulf Stream and California Current systems
    Equatorial currents
    El Nino/Southern Oscillation
    Decadal oscillations/Impacts on biological processes
    Thermohaline circulation
    Water masses
VI. Coastal processes
    Surface gravity waves
    Tides
    Estuarine circulation
    Semienclosed Seas (Arctic Ocean and Mediterranean Sea)

Course Learning Goals and Assessment

The Learning Goals for the Marine Science program are posted on our website at http://marine.rutgers.edu/main/academics/undergraduate/program-description. The learning goals for this course apply to Program Learning Goal 1 (to master the basic biological, chemical, physical, and geological principles of marine science), Goal 2 (analyze and interpret contemporary oceanographic datasets), Goal 3 (show evidence of scientific literacy, and to communicate the information effectively both orally and in writing), and Goal 4 (evaluate contemporary global issues and the ethics of how the ocean's resources are used).

Students completing this course will be able to:

Goal A. Apply basic principles underlying physical processes in the ocean
Instructional activities: lectures, assigned readings
Assessment method: performance on exams, homework assignments, in-class participation

Goal B. Build on basic physical principles and develop mathematical equations of physical processes in the ocean
Instructional activities: lectures, assigned readings

Assessment method: performance on exams, homework assignments, in-class participation

Goal C. Apply physical principles and mathematical equations to make predictions about waves, tides, currents, and the large-scale ocean circulation
Instructional activities: lectures, assigned readings
Assessment method: performance on exams, homework assignments, in-class participation

Goal D. Discuss why physical oceanography is important in the Earth system and to evaluate interactions with other components of the system, particularly the atmosphere
Instructional activities: lectures, assigned readings
Assessment method: performance on exams, homework assignments, in-class participation, course presentation

Grading

Three exams 25% each
Homework 20%
Course presentation 5%