The course work requirements for Physical Oceanography graduate students are outlined below. As an individual student's program must also reflect their background and areas of interest, waivers for School requirements should be referred to the Graduate Program Coordinator, and waivers to Physical Oceanography requirements may be granted by the faculty adviser.

**PHYSICAL OCEANOGRAPHY COURSES**

Physical Oceanography graduate students are expected to complete the following courses:

**OCEAN 500 CURRENT PROBLEMS IN OCEANOGRAPHY (1)** An introduction to Physical Oceanography faculty and facilities. For First Year Physical Oceanography Students.

**OCEAN 510 PHYSICS OF OCEAN CIRCULATION (3)** Structure of ocean basins; physical properties of seawater and the equation of state; heat, salt, and fresh water budgets; Coriolis effect and geostrophic balance; major current systems and water masses; mixing and stirring in the ocean; modern experimental methods in physical oceanography.

**OCEAN 511 PHYSICAL FLUID DYNAMICS (3)** Eulerian equations for mass-motion; Navier-Stokes equation for viscous fluids, Cartesian tensors, stress-strain relations; Kelvin's theorem, vortex dynamics; potential flows, flows with high-low Reynolds numbers; boundary layers, introduction to singular perturbation techniques; water waves; linear instability theory. Prerequisite: AMATH 403 or permission of instructor. Offered: jointly with AMATH/ATMS 505


**OCEAN 513 GEOPHYSICAL FLUID DYNAMICS II (3)** Theories, models of large-scale dynamics of oceans, atmospheres. Potential vorticity, Q principles; Rossby waves, ray tracing, Green's function, setup of general circulation; atmospheric "channels" versus ocean "basins"; wave-mean flow interaction, mountain drag, internal momentum flux; "Lagrangian" motion of particles, tracers; cascades, eddy flux of heat, moisture, Q. Prerequisite: OCEAN 512.

**OCEAN 514 WAVES (3)** Application of marine hydrodynamics principles to wave motion in oceans

**OCEAN 515 OCEAN CIRCULATION: OBSERVATIONS (3)** Modern large- and mesoscale ocean observations, interpreted in terms of contemporary circulation theories. Spectrum of temporal variability; eddies and eddy fluxes; ventilation; advection and diffusion in the abyss; transports of heat and salt; climatic scale of variability; modern methods for determining circulation. Prerequisite: OCEAN 510 or permission of instructor.

**OCEAN 517 METHODS & MEASUREMENTS IN PHYSICAL OCEANOGRAPHY (2)** The principal instruments and experimental methods of modern Physical Oceanography. Devices and systems to measure pressure, temperature, electrical conductivity, sea state and velocity will be discussed in the classroom, and complete systems will be examined/operated in the laboratory.
APPLIED MATHEMATICS COURSES

Physical Oceanography graduate students are expected to take three courses in Applied Mathematics, Statistics, and/or Data Analysis. These courses should be chosen in consultation with the student’s committee who should take into account undergraduate courses taken as well as the student’s area of research. We recommend one course on differential equations, one course on numerical methods for solving partial differential equations, and one course on data analysis methods. Below is a list of possible courses that physical oceanography students can take to build their analysis and mathematical abilities:

An Ordinary Differential Equations course that can be taken is:
AMATH 568 Advanced Methods for Ordinary Differential Equations (5) Winter

Numerical methods courses that can be taken include:
AMATH 581 Scientific computing (5) Fall

Data analysis courses that are recommended include:
ATM S 552 Objective Analysis (3) Winter
OCE 569 Oceanographic Data Analysis (3)
OCE 569 Oceanographic Data Analysis Laboratory (3) Spring
STAT/EE 520: Spectral Analysis of Time Series (4) Winter

For more advanced courses in the above topics, students can consider the following courses:
AMATH 569 Advanced Methods for Partial Differential Equations (5)
ATM S 581/AMATH 586/MATH 586 Numerical Analysis of Time Dependent Problems (5) Spring
STAT 530/EE 524: Wavelets: Data Analysis, Algorithms and Theory (3) (Spring)
AMATH 582 Computational Methods for Data Analysis (5) Winter
AMATH 584/MATH584 Applied Linear Algebra and Introductory Numerical Analysis(5)

An introductory course on probability and statistics would also be beneficial for many students, such as
STAT 481 Introduction to Mathematical Statistics (5)

Other courses in AMATH, ATM S, STAT, EE or ESS, depending on the background and interests of the student, can also be taken in lieu of any of the above courses.

For students who need more background in applied mathematics before beginning the more advanced courses, courses that can be taken the summer before starting graduate school are AMATH 351 Introduction to Differential Equations and Applications (3), or AMATH 301 Beginning Scientific Computing (4).

SEMINARS FOR ADVANCED STUDENTS

OCEAN 569 seminars are offered each quarter and are intended to give students a wide perspective on many specialized facets of the practice of physical oceanography. Most are offered in alternate years, or even more sporadically, so it is recommended that all students beyond their first year regularly sample these offerings in order to gain as much breadth as possible in physical oceanography. Recent and scheduled seminars include:

GFD Laboratory Models, Dr. Rhines
Internal Wave Interactions, Dr. Kunze
Tropical Oceanography, Dr. Eriksen
Remote Sensing/Satellite Oceanography, Dr. Martin
Geophysical Fluid Dynamics III, Dr. Thompson
Numerical Modeling, Dr. Kawase
Time-Series Analysis, Dr. Eriksen
Estuarine Circulation & Mixing, Drs. Gregg & MacCready

Coastal Processes, Dr. Hickey
Abyssal Circulation of the Ocean, Dr. Riser
Ocean Mixing Processes, Dr. Gregg
Circulation of Puget Sound, Dr. Gregg
Polar Oceanography, Dr. D’Asaro
Ocean Tracers, Dr. Warner
Upper Ocean Processes, Dr. Kunze
Lagrangian Methods in Oceanography, Dr. Riser

THE SCHOOL OUT-OF-OPTION REQUIREMENTS

Every graduate student is required to take a minimum of one 3-credit, numerically-graded, 500-level course from each option outside their own for a total of three courses and 9 credits. Each option will provide a list of courses (see http://www.ocean.washington.edu/academics/grad-req.html) that can be taken to fulfill this requirement. The student is expected to complete this breadth requirement prior to receiving an MS degree. A Graduate Student Affairs committee, chaired by the Graduate Program Coordinator, will address any requests for waivers.