SIOC 237C: Optical-Biological Interactions in the Ocean

INSTRUCTOR:

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Office hours: Immediately after each course meeting or by appointment

PREREQUISITES:

Graduate standing or consent of instructor

COURSE DESCRIPTION:

Units: 4; Grade: Letter grade only

This is a course with an emphasis on the interactions of underwater light with marine biology including marine plankton and animals. Topics will include basic physics of interaction of light and matter, light absorption, scattering, and fluorescence of marine plankton, effects of environmental growth conditions on phytoplankton optical properties, effects and feedback associated with interactions of light with marine organisms, methodology for studying the optical properties of marine plankton, and applications of optics to the study of ocean biology. Course meetings will consist of approximately 75% lectures by instructor (Lec on Schedule) and 25% student presentations & discussions (Dis on Schedule) of selected contemporary papers on topics relevant to optical-biological interactions in the ocean. Final evaluation is based on the presentation of a paper and a few sets of homework problems.

COURSE GOALS:

(1) To gain basic understanding of mechanisms by which light interacts with matter and how light interacts with biological constituents of seawater
(2) To appreciate the links and interactions between underwater light and biological constituents and processes within the ocean
(3) To become acquainted with optical methods and tools applicable to the study of ocean biology and biogeochemistry
(4) To directly engage with the primary literature and identify topics at the frontier of bio-optical oceanography
(5) To enhance skills in communicating science and debating scientific issues via oral form

READING:

Recommended textbooks:

(1) J.T.O. Kirk "Light and Photosynthesis in Aquatic Ecosystems", Cambridge Univ. Press, 1994.
Half of the book is an introduction to ocean optics, the other half is devoted to the effects of light on biology.

(2) S. Johnsen "The Optics of Life: A Biologist's Guide to Light in Nature", Princeton University Press, 2012.
Excellent introductory text on many essential aspects of optics and its role in life and biology. Highly recommended for biology-oriented students.

(3) N.G. Jerlov “Marine Optics”, Elsevier, 1976.
Classic text in marine optics.

(4) C. Mobley "Light and Water. Radiative Transfer in Natural Waters", Academic Press, 1994.
Excellent text on advanced theory of radiative transfer. Includes excellent chapters (Part I) that can serve as standard reference work on basic ocean optics. Highly recommended for physics-oriented students.

GRADING:

Homework problems: 35%
Presentation/discussion of selected literature: 50%
Participation/preparedness for debates and discussions: 15%

ASSIGNMENTS:

Each student will formulate a research question in the area of bio-optical oceanography and will select a paper for the presentation & discussion sessions. The papers selected by students for their presentations can address the topical areas presented in lectures or other areas of interest to the student and relevance to the general theme of the course. The selection of papers must be consulted with instructor and approved for the presentation. A student is expected to be involved in debating scientific issues presented by other students. A few sets of homework problems will be also assigned throughout the duration of the course.

SCHEDULE:

Course meetings will take place twice a week of 1 hr 20 min duration each. Days/time will be determined in consultation with students at the beginning of the quarter. There will be two types of activities: lectures by instructor (Lec) and presentations & discussion of selected literature by students (Dis).

Week	Type of Activity	Topic
1	Lec	Basic physics of interaction of light with matter
2	Lec	Methodology of the study of optical properties of marine organisms
3	Lec	Light absorption, scattering, and fluorescence of phytoplankton; bioluminescence of marine organisms
4	Lec	Intra- and interspecies variability of phytoplankton optical properties; effects of environmental growth conditions on phytoplankton optical properties; optical properties of heterotrophic bacteria
5	Lec	Effects and feedbacks associated with interactions of light with marine organisms such as viral infection of microorganisms, prey-predator interactions, and camouflage and vision of animals
6	Lec	Applications of optics to the study of ocean biology such as applications of satellite-based ocean color remote sensing in the study of phytoplankton biomass, diversity of phytoplankton communities, and primary productivity in the ocean
7	Lec	Applications of optics to the study of ocean biology (contd.)
8	Lec/Dis	Applications of optics to the study of ocean biology (contd.) Presentations and discussion of selected literature
9	Dis	Presentations and discussion of selected literature
10	Dis	Presentations and discussion of selected literature