SIOC 202B: Fundamentals of Wave Physics: Optics Part (Spring 2024)

INSTRUCTOR:

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Office hours: After the class or scheduled via email

PREREQUISITES:

Students admitted to the SIO graduate program or permission of instructor.

COURSE DESCRIPTION:

Units: 4 (combined with SIO202B: Seismic Part); Grade: Letter grade only; Required a passing score on midterm and final exams and participation in lectures.

This course is an introduction to physics of light as it pertains to the study of propagation of light within the ocean, interactions of light with seawater constituents, and applications of optical methods in oceanography. Course meetings will consist of lectures by an instructor (see Lec on Schedule).

COURSE GOALS:

(1) To gain basic understanding of the nature and properties of light and mechanisms by which light interacts with matter.
(2) To become acquainted with concepts and methods of aquatic optics which are used to characterize radiative transfer processes, light fields, and optical properties within natural water bodies.
(3) To appreciate the links and interactions between underwater light, optical properties, and constituents of natural water bodies.
(4) To appreciate the strong flavor of diversity of optical applications in oceanography.

READING:

Ocean Optics Web Book: https://www.oceanopticsbook.info/
A collaborative web-based, dynamically growing, community resource that addresses both the education and reference needs of the broad optical oceanography and ocean color remote sensing communities, which is freely accessible to all. Recommended as an excellent resource on fundamentals of ocean optics.

C. Mobley "Light and Water. Radiative Transfer in Natural Waters" Academic Press, 1994.
A comprehensive text on radiative transfer in aquatic environments. Part I can serve as a standard reference work on introduction to ocean optics. Required reading: Chapters 1 and 3.

J.T.O. Kirk "Light and Photosynthesis in Aquatic Ecosystems", Cambridge Univ. Press, 1994. The first part of the book is an introductory text on ocean optics. Recommended reading: Part I.

S. Johnsen “The Optics of Life. A Biologist's Guide to Light in Nature”, Princeton University Press, 2012.
Lucid account of all the essential aspects of light and optical processes in nature, especially as they pertain to biological research. Recommended reading.

N.G. Jerlov “Marine Optics”, Elsevier, 1976.
Classic text in ocean optics.

Handbook of Optics, 2nd edition, McGraw-Hill, Inc. 1995.
Includes a chapter on Optical Properties of Water (Chapter 43 by C. Mobley)

Example textbooks covering basic topics of electromagnetic theory, nature and properties of light, and interaction of light and matter:
Hecht, E., Physics, Brooks/Cole Publishing Co, 1994.
Hecht, E., Optics, Addison-Wesley, 1998.

GRADING:

Midterm exam: 50%
Final exam: 50%

ASSIGNMENTS:

Students will receive take-home problem sets for midterm and final exams. Students are expected to work on these exams alone and return the problem sets with solutions by the deadline.

SCHEDULE:

Course meetings will include lectures by instructor (Lec) and will take place twice a week of 1 hr 20 min duration each during a 5-week period of the quarter. If needed, days/time can be adjusted in consultation with students at the beginning of the quarter.

Week	Type of Activity	Topic
1	Lec	Basic physics of light: The nature and properties of light
2	Lec	Interaction of light and matter
3	Lec	Radiometry, light fields within and leaving the ocean
4	Lec	Inherent and apparent optical properties of the ocean
5	Lec	Radiative transfer in the ocean