

Faculty of Science Course Syllabus
Department of Oceanography
OCEA 4250/5250
Acoustical Oceanography
Fall 2016

Instructors: David Barclay dbarclay@dal.ca LSC Ocean 5672
 Alex Hay alex.hay@dal.ca LSC Ocean 5670

Lectures: Tues/Thurs, 1:05 – 2:25 pm, LSC-Ocean Wing, Reilly Room

Office hours: Barclay - Monday, 1:00 – 2:30 pm

Laboratories: 0

Tutorials: 0

Course Description

This course covers the basic theory of acoustics in fluids, sound propagation and scattering in the ocean environment, and the applications to acoustic remote sensing of the ocean interior and seabed. Topics include: normal modes; ray theory; ambient noise, scattering from particles, bubbles and biota; sonar theory and operation; and acoustic inversions.

Course Prerequisites

Intended for first-year graduate students in physical oceanography, but graduate students or senior undergraduates in Mathematics or Physics are invited to take it (subject to instructor approval). Familiarity with vectors, vector calculus, ordinary differential equations, partial differential equations, complex variables and classical mechanics required.

Course Objectives/Learning Outcomes

The students should expect to gain a theoretical and phenomenological basis of sound propagation and scattering in the ocean, and learn about inversion methods for measuring physical and bio-geo-chemical properties of the ocean.

Course Materials

Textbook: Clay and Medwin, *Acoustical Oceanography*
 Jensen et al, *Computational Ocean Acoustics*

Complimentary and alternate:

- Urlick, *Principles of Underwater Sound* (survey text)
- Frisk, *Ocean and Seabed Acoustics* (propagation, geoacoustics)
- Tolstoy and Clay, *Ocean Acoustics* (propagation, analytic)
- Morse and Ingard, *Theoretical Acoustics* (mainly scattering)
- Morse and Feschbach, *Methods of Theoretical Physics, Part II*
- Pierce, *Acoustics*

Website: noise.phys.ocean.dal.ca/teaching.html

Course Assessment

Component	Weight (% of final grade)	Date
<i>Final exam</i>	30%	TBD
<i>Assignments</i>	50%	~weekly
<i>Term Project</i>	20%	November 22nd

An alternative-grading scheme will be available in the form of Final exam (75%), assignments (10%), and Term Project (15%). The scheme that produces the higher grade will be automatically applied.

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D	(50-54)
A (85-89)	B (73-76)	C (60-64)	F	(<50)
A- (80-84)	B- (70-72)	C- (55-59)		

Course Policies

Late assignments will not be accepted. There is no option for a make-up midterm in the case of an absence.

Three lectures at the end of the course will be reserved in the case of course overrun or lectures lost to snow days. In the case of no snow days (!), the special topics of compressible fluids, acoustics and stability will be covered.

Course Content

- Week 1 – Acoustics and waves*
- Week 2 – Acoustics in fluids, solids & the ocean*
- Week 3 – Analytical propagation, wave number integration*
- Week 4 – Analytical and computational propagation, normal modes*
- Week 5 – Computational propagation, ray theory*
- Week 6 – Computational propagation, Parabolic Equation*
- Week 7 – Ambient noise*
- Week 8 – Transducers and beam patterns*
- Week 9 – Scattering in fluids*
- Week 10 – Interface waves and scattering*
- Week 11 – Scattering at a solid interface and geoacoustic inversion*
- Week 12 – Term project presentation, Tomography*
- Week 13 – Thermometry and current research topics in AO*

ACCOMMODATION POLICY FOR STUDENTS

Students may request accommodation as a result of barriers related to disability, religious obligation, or any characteristic protected under Canadian Human Rights legislation. The full text of Dalhousie's Student Accommodation Policy can be accessed here:

http://www.dal.ca/dept/university_secretariat/policies/academic/student-accommodation-policy-wef-sep--1--2014.html

Students who require accommodation for classroom participation or the writing of tests and exams should make their request to the **Advising and Access Services Centre (AASC)** prior to or at the outset of the regular academic year. More information and the ***Request for Accommodation*** form are available at www.dal.ca/access.

ACADEMIC INTEGRITY

Academic integrity, with its embodied values, is seen as a foundation of Dalhousie University. It is the responsibility of all students to be familiar with behaviours and practices associated with academic integrity. Instructors are required to forward any suspected cases of plagiarism or other forms of academic cheating to the Academic Integrity Officer for their Faculty.

The Academic Integrity website (<http://academicintegrity.dal.ca>) provides students and faculty with information on plagiarism and other forms of academic dishonesty, and has resources to help students succeed honestly. The full text of Dalhousie's ***Policy on Intellectual Honesty*** and ***Faculty Discipline Procedures*** is available here:

http://www.dal.ca/dept/university_secretariat/academic-integrity/academic-policies.html

STUDENT CODE OF CONDUCT

Dalhousie University has a student code of conduct, and it is expected that students will adhere to the code during their participation in lectures and other activities associated with this course. In general:

“The University treats students as adults free to organize their own personal lives, behaviour and associations subject only to the law, and to University regulations that are necessary to protect

- the integrity and proper functioning of the academic and non – academic programs and activities of the University or its faculties, schools or departments;
- the peaceful and safe enjoyment of University facilities by other members of the University and the public;
- the freedom of members of the University to participate reasonably in the programs of the University and in activities on the University's premises;
- the property of the University or its members.”

The full text of the code can be found here:

http://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

COPYRIGHT

All members of the Dalhousie community are expected to comply with their obligations under Canadian copyright law. Dalhousie copyright policies and guidelines, including our Fair Dealing Guidelines, are available at <http://www.dal.ca/dept/copyrightoffice.html>. Copyright questions should be directed to the Copyright Office at copyright.office@dal.ca.

SERVICES AVAILABLE TO STUDENTS

The following campus services are available to help students develop skills in library research, scientific writing, and effective study habits. The services are available to all Dalhousie students and, unless noted otherwise, are free.

Service	Support Provided	Location	Contact
General Academic Advising	Help with <ul style="list-style-type: none"> - understanding degree requirements and academic regulations - choosing your major - achieving your educational or career goals - dealing with academic or other difficulties 	Killam Library Ground floor Rm G28 Bissett Centre for Academic Success	In person: Killam Library Rm G28 By appointment: <ul style="list-style-type: none"> - e-mail: advising@dal.ca - Phone: (902) 494-3077 - Book online through MyDal
Dalhousie Libraries	Help to find books and articles for assignments Help with citing sources in the text of your paper and preparation of bibliography	Killam Library Ground floor Librarian offices	In person: Service Point (Ground floor) By appointment: Identify your subject librarian (URL below) and contact by email or phone to arrange a time: http://dal.beta.libguides.com/sb.php?subject_id=34328
Studying for Success (SFS)	Help to develop essential study skills through small group workshops or one-on-one coaching sessions Match to a tutor for help in course-specific content (for a reasonable fee)	Killam Library 3rd floor Coordinator Rm 3104 Study Coaches Rm 3103	To make an appointment: <ul style="list-style-type: none"> - Visit main office (Killam Library main floor, Rm G28) - Call (902) 494-3077 - email Coordinator at: sfs@dal.ca or - Simply drop in to see us during posted office hours All information can be found on our website: www.dal.ca/sfs
Writing Centre	Meet with coach/tutor to discuss writing assignments (e.g., lab report, research paper, thesis, poster) <ul style="list-style-type: none"> - Learn to integrate source material into your own work appropriately - Learn about disciplinary writing from a peer or staff member in your field 	Killam Library Ground floor Learning Commons & Rm G25	To make an appointment: <ul style="list-style-type: none"> - Visit the Centre (Rm G25) and book an appointment - Call (902) 494-1963 - email writingcentre@dal.ca - Book online through MyDal We are open six days a week See our website: writingcentre.dal.ca