2.688: PRINCIPLES OF OCEANOGRAPHIC SYSTEMS AND SENSORS
FALL 2019

INSTRUCTORS

Anna Michel* (amichel@whoi.edu)
Sam Laney (slaney@whoi.edu)
Julien Bonnel (jbonnel@whoi.edu)
Peter Traykovski (ptraykovski@whoi.edu)
Mike Jakuba (mjakuba@whoi.edu)

*Note: Michel is the lead instructor for the class and should be your main point of contact with questions about the class. **Please utilize amichel@whoi.edu to contact her.** Specific questions about content covered in a class should be directed to the instructor of that specific class.

CLASS SCHEDULE

Tuesday 10:30 – 12:00: Clark 331; MIT classroom TBD
Thursday 10:30 – 12:00 Smith Conference room (no videolink)
Thursday 1:00 – 4:00 PM Lab roomn TBD

Note: Videolink will be available from MIT on Tuesdays only.

All students are expected to be at WHOI for Thursday lectures and laboratories. Please let us know of any scheduling issues.

CLASS OVERVIEW

This class examines the principles behind oceanographic sensors, their use in oceanographic applications, and their role in complex oceanographic engineered systems.

The class covers 6 modules:

1. Platforms
2. Signal Processing
3. Acoustics
4. Sensing
5. Hydrography
6. Navigation

PREREQUISITES:

2.671: Instrument and Measurement
18.075: Advanced Calculus for Engineers

CLASS GOALS

This class introduces theoretical and practical principles of design of oceanographic sensor systems. After completing the six cross-disciplinary modules in the class, students will understand the main principles of field-going oceanographic instrumentation for acoustic, current, temperature, pressure, electric, magnetic, gravity, salinity, velocity, heat flow, and optical measurements. Students will be able to describe the limitations on the design of these devices imposed by ocean environment. Students will also be able to analyze a range of instrument data and be able to connect that data to ocean science.

OFFICE HOURS

Office hours are by appointment. Please contact instructors to set up a time to meet.

GRADES

Grades will be partitioned as follows:

- Class participation 10%
- Lab effort and lab reports 20%
- Homework and Problem sets 20%
- Independent Study Project:
    - Project proposal 5%
    - Mid-term presentation 15%
    - Final presentation 30%

MIT grading guidelines can be found at http://catalog.mit.edu/mit/procedures/academic-performance-grades/#gradestext

Passing Grades: Graduate students who satisfactorily complete the work of a subject by the end of the term receive one of the following grades:

A: Exceptionally good performance demonstrating a superior understanding of the subject matter, a foundation of extensive knowledge, and a skillful use of concepts and/or materials.

B: Good performance demonstrating capacity to use the appropriate concepts, a good understanding of the subject matter, and an ability to handle the problems and materials encountered in the subject.

C: Adequate performance demonstrating an adequate understanding of the subject matter, an ability to handle relatively simple problems, and adequate preparation for moving on to more advanced work in the field.

CLASS PARTICIPATION

We expect students to arrive in class having completed any assigned readings or pre-class assignments and be prepared to contribute to the class discussions. Students who do not already have Matlab should obtain a WHOI or MIT license for the computational work and problem sets.

LABS

Labs will be held on Thursdays and will include hands on experiments, field tests and deployments, computational work, and visits to relevant labs and facilities at WHOI.

HOMEWORK AND PROBLEM SETS

Homework will consist of readings, problem sets, and preparation for in class activities (e.g. sharing information with the class in a short presentation). Any assignment that is required to be submitted must be done so online using Stellar. Please ensure that you have Matlab installed on your computer for the semester. Late homework will be docked 10% per day. If you need an extension on a homework assignment due to research-related travel or other extenuating circumstances, please reach out to the instructor well before the assignment is due.

STELLAR

Stellar will be used for the class website:
https://learning-modules.mit.edu/class/index.html?uuid=/course/2/fa19/2.688#info

The class website will contain readings for the course, a portal for submitting problem sets and other material, and the course calendar. All communications will be made through Stellar so please check the website frequently.

	Date	Topic	Subtopic	Instructor	Lab
1	9/5	Introduction to class and ocean instrumentation		Michel	No lab
2	9/10	Platforms I	ASVs	Traykovski	
3	9/12	Platforms I	Drones	Traykovski	Lab: Drones
4	9/17	Signal Processing I	Time domain, frequency domain	Bonnel	
5	9/19	Signal Processing I	Filtering, time-frequency analysis	Bonnel	Lab: Signal processing
6	9/24	Acoustics I	Basic acoustics	Bonnel	
7	9/26	Acoustics I	Ray and modal propagation	Bonnel	Lab: Ocean acoustics
8	10/1	Sensing I	Biological Sensing	Laney	
9	10/3	Sensing I	Optics and Biooptics	Laney	Lab: Radiometry
10	10/8	Sensing II	Chemical Sensing	Michel	
11	10/10	Sensing II	Chemical Sensing	Michel	Lab: Atlas Scientific
12	10/17	Hydrography	CTD Overview	Laney	Lab: CTD calibrations
13	10/22	Hydrography	Calibration	Laney	
14	10/24	Project Presentations		Michel/Laney	Lab: Project Presentations
15	10/29	Hydrography	Transient response	Laney	
16	10/31	Hydrography	Applications	Laney	Lab: CTDs: transient
17	11/5	Navigation	Conventional Techniques	Jakuba	
18	11/7	Navigation	The Kalman Filter and SLAM	Jakuba	Lab: Kalman Filter practical
19	11/12	Platforms II	Ships, Vehicles, & Deep Submergence	Michel	
20	11/14	Platforms II	Moorings, Buoys, OOI	Michel	Lab: OOI
21	11/19	Platforms II	Satellite Remote Sensing	Michel	
22	11/21	Acoustics II	Current Measurements	Traykovski	Lab: TBD
22	11/26	Acoustics II	Bathymetric Mapping	Traykovski	
25	12/3	Project Presentations		Michel/Laney	
26	12/5	Project Presentations		Michel/Laney	Lab: Project Presentations
27	12/10	Project Presentations		Michel/Laney	