Falk Feddersen: SIO211A Linear Waves (Winter 2016)

Linear Waves

SIO 211A Section XXXXX
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Meetings
Class: Monday/Wednsday time 12:30-13:50 : Center for Coastal Studies Basement Conference Room
Office Hours: TBD on first day of class

Description Most of the class is concerned with linear wave theory as it applies to the ocean. The emphasis is on gravity waves of various types but other waves will also be discussed. The course will begin with an introduction/review of the wave equation and relevant principles that should be familiar from Fourier analysis. The first part of the course will then proceed through ocean-related waves in (mostly) homogenous media. The second part of the course will proceed through wave in inhomogenous media which will involve refraction, caustics, and many other interesting phenomena. The class will principally draw on two different sets of lecture notes. The first are those presented to Myrl Hendershott by his former students David Chapman and Paola Malanotte-Rizzoli. The second are a set of lecture notes for 211A put together by Rick Salmon that I am editing and revising. Lectures will be at the level of SIO214 (fluids) and SIO 203a (math A) and make use of material covered in both. You will also make use of tools developed in data analysis.

Course Requirements Students should enroll in four (4) units. First year students should register as letter. Others can register as S/U. Students are expected to complete all the assigned homework, quizes, projects, and a final exam. There will be regularly assigned homework. There will be occasional short class quizzes as with GFD. There will be a short quiz due on the first day of class that does not count toward your grade. There will be three projects. The first two you will use data from surface gravity and internal waves. The third project is an in situ surfzone lab. The goal is to either confirm or reject the theoretical constructs you're learning. The final grade will be based 1/2 on problem sets (HW + quizes), 1/4 on projects and 1/4 on final exam.

Syllabus

Basics and Review

- Week 1A: Classic Wave Equations: Linear superposition, plane waves, phase speed, standing vs. propagating

Homogenous Media

- Week 1B: Surface Gravity Waves A. Linearization, Derivation, Disperison Relationship (PROJECT 1)
- Week 2A: Surface Gravity Waves B. Flux-conservation equations, wave energy, energy flux, group velocity
- Week 2B: Surface Graivty Waves C. Deep water, dispersion, group velocity, stationary phase
- Week 3A: Acoustic Waves A. Perfect fluid and derivation of acoustic wave equation
- Week 3B: Acoustic Waves B. Energy conservation, reflection, transmission
- Week 4A: Internal Gravity Waves A. Boussinesq approximation, Wave equation derivation, solutions and dispersion relationship
- Week 4B: Internal Gravity Waves B. Energy conservation
- Week 5A: Internal Gravity Waves C. Normal modes (PROJECT 2)
- Week 5B: Linear shallow water equations A. wave equation, plane waves, dispersion relationship, inertial motions
- Week 6A: Linear shallow water equations B. Kelvin waves, tides, and Rossby waves
- Week 6B: Linear shallow water equations C. Harbor seiches, edge waves, shelf waves
- Week 7A: Linear shallow water equations D. Diffraction (SURFZONE LAB)

Non-homogeneous Media

- Week 7B: Ray theory, Snells law,
- Week 8A: Action Conservation
- Week 9A: Wave-current interaction
- Week 9A: Global surface gravity wave modeling : surf prediction
- Week 10A: Internal Gravity Waves: non-constant N, critical layers
- Week 10B: Synthesis

Lecture notes
The two principal lecture note sources are the following

- Myrl's Wave Lecture Notes by Chapman and Mallanote-Rizzoi
- Salmon/Feddersen Wave Lecture Notes by Chapman and Mallanote-Rizzoi(not ready yet)

The component of the lecture notes relevant to each lecture will be shared well in advance. **Other Resources** There are some books that have relvant material in them. These include

- Kundu, Fluid Mechanics: Chapter on Gravity Waves (same book as SIO 214)
- Myrl's chapter on Ocean Tides
- Pedlosky, J. Waves in the Ocean and Atmosphere. Introduction to Wave Dynamics. (should be in class reserves)
- Lighthill, Waves in Fluids (in class reserves)
- Whitham, Linear and Nonlinear waves (in class reserves)
- Mei, CC, The Applied Dynamics of Surface Gravity Waves (in CCS basement)

If you have any questions or comments, please contact me at falk@coast.ucsd.edu.
