SIO 171
Introduction to Physical Oceanography

Spring quarter 2016, 29 March through 02 June, Vaughn Hall 384
Tuesday/Thursday 11:00am - 12:20 pm plus Discussion Session TBA

Description: Essential observational material will be presented, but emphasis is on the physics governing currents, waves and turbulent motions that are observed in the ocean. No previous familiarity with oceanography is assumed, but the treatment will make full use of physical concepts and mathematical skills at the upper division level expected in the prerequisite courses.

Prerequisites: Math 20C and Physics 2C or 4C

Weekly course structure: two 1.5 hours lecture, 1 hour discussion section as needed.

Final Evaluation: In-class final exam plus participation/performance in discussion sections.

Reference Material. There will be no single text. Rather, for each topic I will reference specific websites and scientific papers. There will be many web sites and papers; the lectures are intended to hit the most important points and enable you to read the professional literature with an understanding off fundamentals.

Two very general ocean references are:

http://oceanworld.tamu.edu/resources/ocng_textbook/contents.html
www-pord.ucsd.edu/~ltalley/sio210

Please be sure to note and to abide by any stated restrictions on reproduction or dissemination of figures or text from any sites and/or scientific papers.

General Policy. Although some purely descriptive and ultimately observational material must be presented, particularly in the first weeks, the emphasis is on the fluent use of upper division mathematics and physics in making, characterizing and understanding observations and in reading modern research literature. Because this the first time this class is offered, content and level will evolve; I expect to be able to remedy individual lacunae in background as the course develops. Because expected enrollment is relatively small, students will be expected to present homework problems orally at the board in discussion session.

SYLLABUS

WEEK 1. WHAT WE MEASURE IN THE OCEAN AND HOW WE MEASURE IT.
1. 29 Mar Tu earth shape, measuring position
2. 31 Mar Th measurement platforms, measuring depth, temperature sensors, salinity sensors, current sensors (mechanical and acoustic)

WEEK 2. DESCRIPTIVE OVERVIEW OF OCEAN WATER PROPERTIES AND MOTIONS.
3. 05 Apr Tu TBA
4. 07 Apr Th

WEEK 3. FLUXES OF HEAT, MOMENTUM … AND MECHANISMS.
5. 12 Apr Tu flux definition; radiative, diffusive, advective; advection-diffusion equation, simple solutions,
6. 14 Apr Th adv/diff in turbulent fluid, eddy diffusivities

WEEK 4. FINISH FLUXES, ATMOSPHERIC FLOW.
7. 19 Apr Tu estimation/observation of eddy diffusivity vert/horiz
8. 21 Apr Th atmosphere; air-sea fluxes, winds, coriolis force, hurricane, Hadley cell, westerlies, role of eddies and 'negative diffusivity'

WEEK 5. DYNAMICS OF LARGE-SCALE OCEAN CURRENTS.
9. 26 Apr Tu pressure, hydrostatics, rotation, coriolis and centrifugal forces, satellite altimetry, interpretation of hydrographic sections h-sections, thermal wind 0/1000 maps.
10. 28 Apr Th Ekman flow and up/downwelling, PV conservation, teacup spindown, Sverdrup flow, western boundary currents and simple models, stommel-aarons in lab

WEEK 6. FINISH LARGE-SCALE DYNAMICS. START OCEAN WAVES.
11. 03 May Tu Ventillation, mode water formation, theories of the thermocline
12. 05 May Th Surface gravity waves, qualitative and stationary phase solution

WEEK 7. MORE OCEAN WAVES.
1X. 10 May Tu On the beach: refraction (shallow water solution), setup, rips, alongshore current and observations, hurricane storm surge (quantitative estimates: inverted barometer, wind stress)
14. 12 May Th Tsunami; mechanism, observations (Alaska '64), Indonesia, Kurils, models, 'hot spots' harbor resonances

WEEK 8. TIDES.
15. 17 May Tu tides; tide generating force, constituents,
16. 19 May Th earth tides, ocean tides, length of day evolution

WEEK 9. INTERNAL WAVES.
17. 24 May Tu internal waves at (idea, modes, beams) obs of group vel, beams, vertical structure, surface expression of internal tides
18. 26 May Th mixing and fine structure

WEEK 10.
19. 31 May Tu coastal upwelling, El Nino
20. 02 Jun Th numerical models: discretization of simple equations, idea of data assimilation, gloss a major model, limitations of models