ICTP DIPLOMA PROGRAMME IN EARTH SYSTEM PHYSICS 2015-16

SYLLABUS

PHYSICS OF THE OCEANS - [12 lectures: 18 hours] - M. Gacic, P. Poulain

Physics of the Oceans: overview

Miroslav GACIC

Lecture 1

Introduction

- Physical Oceanography – definition and aims;
- world ocean geography;
- temporal and spatial variability of motion in the ocean.

Temperature, salinity and density

- Temperature and salinity, definitions;
- geographic distribution (spatial and temporal characteristics);
- density;
- measurements and calculations;
- potential temperature;

The oceanic heat budget

- Heat budget terms;
- direct and indirect calculations of heat fluxes;
- geographic distribution of terms;
- meridional heat transport;
- global warming.

Lecture 2

The freshwater budget

- Freshwater sources and sinks for the world ocean;
- geographic distribution of terms;
- global warming and freshwater budget;
- estuarine and anti-estuarine circulation.

Geostrophic currents

- Geostrophic aproximation;
- hydrostatic equilibrium;
- thermal wind relation;

- barotropic and baroclinic flow;
- interior flow and boundary layers;
- limitations of the geostrophic aproximation.

Lecture 3

Wind influence and bottom friction

- Ekman layer and Ekman balance;
- Ekman mass transport;
- inertial oscillations;
- bottom boundary layer.

Lecture 4

Vorticity in the ocean

- Definition of vorticity;
- conservation of vorticity;
- vorticity and friction;
- Ekman pumping.

Lecture 5

World ocean circulation and global processes

- Global conveyor belt;
- western intensification;
- coastal and open ocean upwelling.

Lecture 5

Waves in the ocean

- Rossby waves;
- Kelvin waves (equatorial and coastal);
- baroclinic and barotropic wave solutions.

Lecture 6

Equatorial dynamics and climate variability

- Equatorial waves
- El Nino and teleconnections;
- Observing and predicting El Nino.

Suggested reading:

- Stephen Pond and George L. Pickard, 2009: Introductory Dynamical Oceanography. Second Edition, The open University, Oxford.

- Benoit Cushman Roisin, 1994: Introduction to Geophysical fluid Dynamics, 320 pp., Prentice Hall, Englewood Cliffs, New Jersey 07632.

- Robert H. Stewart, 2000: Introduction to Physical Oceanography, Dept. Of Oceanography, Texas A&M University, 343 pp.

- Matthias Tomczak, 2002: An Introduction to Physical Oceanography, Flinders University of South Australia in Adelaide, 13 lectures.

  (http://www.mt-oceanography.info/IntroOc/newstart.html)

Physics of the Oceans: instrumentation

Pierre-Marie POULAIN

Lecture 1

Introduction: why and how to observed and study the oceans
Observing the oceans: from the classical methods to the most advanced techniques

Lecture 2

Autonomous systems: moored buoys, surface drifters, sub-surface floats and profilers, gliders, AUVs, etc.)

Lecture 3

Remote sensing: ADCP, acoustic tomography, HF coastal radars

Lecture 4

Remote sensing from satellites: Introduction and principles

Lecture 5

Remote sensing from satellites:

Passive methods (sea surface temperature and salinity, ocean colour)

Lecture 6

Remote sensing from satellites:

Active methods (altimetry, scatterometry, SAR)

Suggested reading:

- Chapter 1. Data Acquisition and Recording
  Data Analysis Methods in Physical Oceanography
  W. J. Emery & R. E. Thomson
  Elsevier

- Oceanographic Instrumentation
  An Introduction to Physical Oceanography (M. Tomczak)
  http://www.mt-oceanography.info/IntroOc/lecture13.html

- Underwater gliders for ocean research
  http://pordlabs.ucsd.edu/rdavis/publications/MTS_Glider.pdf