National Technical University of Athens,
Department of Surveying Engineering,
Laboratory of Higher Geodesy and
DIONYSOS Centre for Satellite Tracking

8th Semester Course: «Hydrography - Oceanography»
Academic Year 2009-10

Full Name:

University Coming From:

Due Date for this Homework**: 23 March 2010**

Homework – Theme #2

Objective: The scope of this homework is to familiarize you with the geological evolution and features of the oceans, the physical/chemical properties of the sea water, as well as the instrumentation and techniques used for measuring the various characteristic parameters describing the properties of the oceans.

What you are asked to do is to prepare a brief technical report which will include the sections outlined below. The content of each section should include a synthesis of your understanding of the questions posed and the sub-topics mentioned. Your source of information can be any of the reference books you have access to or from your searches in the Internet using, for example, as starting points the web links provided. In order to prepare your Homework Technical Report you should use the template provided in the web pages of the course.

SECTION 1 - What are the main features underlying the geological evolution of Earth which relate to the formation of the oceans? In this context, what are the main features of the theory of the movement of the tectonic plates, how this explains the formation of the ocean floor up to date and what is the main evidence that confirms the theory of plate tectonics? Explain how new oceanic crust is created at the mid-ocean ridges, and what is the most typical example of mid-ocean ridge?

> **Hints**: Refer to the arguments made by the German meteorologist Alfred Wegener, and especially with regard to the existence of the Pangea, the Panthallasa, the Sea of Tethys, the Gondwana, etc. and how the geological processes involved in their formation contributed to the formation of the oceans. Describe the causes of the movement of tectonic plates, lists the various types of movements and different types of contact boundaries of the tectonic plates and provide a map with the larger and smaller tectonic plates.
>
> - http://pubs.usgs.gov/gip/dynamic/understanding.html

SECTION 2 - What are the main topographical features of the ocean basins? List the main morphological units of the sub-oceanic areas. How do the morphological characteristics of the ocean bottom affect the dynamic processes of the water masses in the oceans? What are the main submarine structures of volcanic

origin and in which oceans they usually occur? - What are the main water zones (bathymetric zoning) that we distinguish in the oceans?

> **Hints**: Give the names of the various features of the bottom of the oceans and how they are defined. Make a reference to which of these different morphological features are widely found or are significantly limited in the different oceans. List the effects of the morphological characteristics of the ocean bottom in the circulation, the tides, the hydrothermal springs, etc. – Make a reference to the biological and oceanographic conditions which provide a division of the ocean into different zones in terms of the depth. How do the characteristics of the marine environment change or affected in these layers?
> For all the above, use appropriate graphs to illustrate the various definitions and enrich your answers by giving examples (e.g. pictures, maps, etc.).

- http://en.wikipedia.org/wiki/Oceanic_trench
- http://www.mbgnet.net/salt/oceans/zones.htm

SECTION 3 - What are the main characteristics of the chemical composition of the sea water and how these influence the sea water's physical/chemical properties such as salinity and conductivity, heat capacity, density, potential density and neutral density etc.? What is the so-called "rule of fixed proportions" and what is its importance for the oceans and the Earth in general. How the salinity of sea water defined and what is is the cause of its origin? Explain how salinity, temperature and density, are interrelated and explain how the knowledge of their distribution in the waters of the oceans affect the understanding of the dynamic behavior of the oceans.

> **Hints**: Refer to the molecular structure of seawater and explain the different properties such as heat capacity, thermal expansion, etc. Refer to the key elements that constitute the chemical composition of sea water, and explain the so-called "law of constant proportions" and how this affects the sea water's composition changes over time and the causes of ocean mixing. How the salinity of seawater was measured in the past and at the present and what is the typical geographical distribution of the salinity near the sea surface of the oceans. Refer to the differences in distribution in the surface temperature of the oceans and the vertical temperature distribution in the main layers of the oceans according to depth.

- http://sam.ucsd.edu/sio210/lect_2/lecture_2.html
- http://ocw.mit.edu/NR/rdonlyres/Mechanical-Engineering/2-693Spring-2004/72537AFB-3F97-4669-A719-BEC808D1893B/0/seawater.pdf

SECTION 4 – Write a brief account on the instruments and methods of measuring the physical/chemical parameters of the ocean, e.g. temperature, conductivity, salinity, pressure (depth) and dissemination of sound.

> **Hints**: make a reference to the various measurements conducted by oceanographic vessels and from stationary positions or selected from satellites and, describe briefly the main instruments used, and the principles of their operation. Enrich your answers by making references to the relations that describe the measurements and/or provide appropriate pictures illustrating the instruments and the measuring operations.

- http://ocw.mit.edu/NR/rdonlyres/Mechanical-Engineering/2-693Spring-2004/59D33DB2-19AD-4DA5-9B91-86701E91E3CC/0/lec24.pdf