GEOS 110 The Earth –Ocean – Atmosphere System

Course Outline

1.Instructor

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2. Course Overview

We will study the interactions among the hydrosphere, atmosphere, biosphere, cryosphere and lithosphere that together make up the Earth System.
This interdisciplinary view of our planet highlights the manner in which all systems of the earth control or influence each other on time-scales from days to billions of years.
We will discuss briefly the origin and nature of planet Earth, the evolution of continents, ocean basins, ocean and atmosphere.
It is clear that the state of the Earth has dramatically and abruptly changed many times in the past with major environmental repercussions.
In order to understand the causes and effects of past changes, such as climatic change, and to learn from them about the future we will investigate the relationships among dynamic earth processes, such as volcanism, mountain-building, and ocean currents and climate.
This course will explore what is clearly known and what is speculated, and how we can attempt to accurately predict our future.

3. Intended Learning Outcomes

After successfully completing all components of this course students will be able to:

1. Describe the stages of origin of Solar System and Earth
2. Discuss the segregation and structure of Earth
3. Understand the basics of plate tectonics and associated processes
4. Discuss the origin and nature of Earth's atmosphere, ocean basins and oceans
5.Describe and interpret short-term and long-term Geologic, Oceanic and Atmospheric processes and their interactions in terms of energy transfer and geochemical cycles
6. Make meaningful scientific observations and collect, analyze and interpret quantitative data with reference to Geologic, Oceanic and Atmospheric processes.
7. Use simple laboratory equipment to study and measure wave velocity.
8. Use standard tide and current tables and software.
9. Plot and interpret relationships among temperature, salinity and density of seawater, and how these properties vary over time.
10. Understand current transport and be able to assess the role of currents in global heat transfer.

11. Identify relationships among surface ocean currents and atmospheric circulation.
12. Analyze grain size of sediment samples and interpret current environment and sedimentary environment of deposition from sediment data.
13. Determine salinity of water samples and the relationship of salinity to temperature, density and dissolved gases.
14. Describe the energy budget of the atmosphere, and its short-term and long-term variability.
15. Describe the chemical evolution of the atmosphere.
16. Identify coastal processes at the land-sea interface
17. Relate ocean-floor topography and ocean depth data to processes of sea-floor spreading and the age of ocean basins.
18. Discuss the use of isotopes as geochemical tracers
19. Discuss examples of climatic change, e.g. "Cretaceous greenhouse," Cenozoic changes, Quaternary events.
20. Make reasoned predictions about future climate change

3. Required Materials

(a) **Texts** No single text is adequate. There will be assigned readings and web sites, including:

Our Changing Planet, Mackenzie
Global Environment: Water, Air and Geochemical Cycles, Berner and Berner
Meteorology Today, Ahrens
Introductory Oceanography, Thurman and Burton

(b) Other

Hand lens, pencils, coloured pencils, drawing compass, ruler.

4. Course content and schedule

Instruction **Classroom** 3 hours, Mon., Tues., Thurs 15:30-16:20
Lab 3 hours, Wed 15:30-18:20

14 weeks

5. Assessment

(a) Lab exercises 10 X 2.5%
(b) Lab quiz 10%
(c) Written exams 20, 20, 25%

6. Grading system

Letter grades will be assigned according to the A&S system.

7. Laboratory Exercises

Labs will include "paper exercises", hands-on labs and web-based exercises on the following topics:
Maps and Charts, Ocean floor topography
Water masses and T-S diagram
Heat Budget, Ocean structure
Temperature, Pressure and General circulation of the atmosphere
Ocean Surface Currents, Real-time data, e.g. El Nino and La Nina
Waves and tides, coastal and estuarine processes
Geochemical Cycles
Carbon Isotopes and Oxygen Isotopes

8. Major topics to be discussed

1. A brief history of Earth-, Ocean-, and Atmospheric Science.
2. The Universe, the Solar System, Early Earth processes.
3. Plate tectonics, continents, ocean basins.
4. The "Systems" approach to Earth, Oceanic and Atmospheric interactions.
5. Geochemical cycles, Global energy balance.
6. Marine sediments and the record of past environments.
7. Ice, water, water vapour and sea water.
8. Chemistry of seawater – dissolved ions and gases, inorganic carbon and carbonates.
9. Ocean-atmosphere interaction.
10. Oceanic circulation.
11. Atmospheric circulation.
12. Waves, water dynamics and tides.
13. The land-sea interface; coastal processes.
14. Introduction to nutrients and life in the ocean.
15. Climate variability, global warming, ozone depletion, sea-level change.