Course Title: Atmosphere and Oceans			
Course Code: UES 307	**No. of Credits: 4**	**L-T-P: 42-18-0**	**Learning Hours: 60**
Pre-requisite Course Code and Title (if any): None			
Department: Natural and Applied Sciences			
Course Coordinator:		**Course Instructor:**	
Contact Details:			
Course Type: Minor		**Course Offered In:** Semester 5	

Course Description

The course has been designed to introduce the students to the basics of atmosphere and oceans. It provides a fundamental understanding of the atmosphere's evolution, structure and dynamics, including atmospheric circulations and water in the atmosphere. The course enables learners to identify oceanic processes, circulations and dynamics. It further introduces atmosphere-ocean interactions and the human impacts on these interactions.

Course Objectives

- To understand the origin, structure, and dynamics of the atmosphere and oceans.
- To explore the key processes such as circulation patterns and interactions between the atmosphere and ocean systems.
- To assess climatic and human impacts on atmospheric and oceanic systems.

Course Content

Module	Topic	L	T	P
1	**Introduction to Atmosphere**			
	This module focuses on introductory knowledge about atmosphere, its structure, and key processes including heat transfer. It also sets the context for the subsequent modules. Structure of the atmosphere and atmospheric layers; pressure-altitude relationship, latent and sensible heat; types of heat transfer, greenhouse effect, Earth's energy budget.	8	2	
2	**Water in the Atmosphere**			
	This module explains the atmospheric moisture and different measurements of humidity. Students will explore cloud formation and air saturation processes, including adiabatic cooling. The module will also cover different precipitation processes and atmospheric liftings. Relative humidity, saturation vapor pressure, dew point; cloud formation, cloud condensation nuclei, adiabatic cooling; precipitation processes	8	2	
3	**Atmospheric Circulations**			
	This module will discuss tricellular meridional circulation. It will also cover different air masses, fronts, cyclones, anti-cyclones, and climate zones. Pressure belts: Hadley, Ferrel, and Polar cells; air masses, fronts, atmospheric stability and instability; cyclones: temperate and tropical cyclones, climate zones and classification; Indian Monsoon	8	2	
4	**Oceans**			
	This module will help students understand the origin and three-layered structure of the oceans. It will also incorporate different properties of ocean water such as temperature, salinity, density, and their variations.	8		

	Earth's oceans; physical properties of ocean water: ocean temperature and salinity and their distributions, thermocline, halocline; processes affecting ocean density, pycnocline		2	
5	**Ocean Circulations**			
	This module explains the oceanic circulations and dynamics. Students will explore surface and deep ocean currents, including the role of Ekman transport and the global conveyor belt. Surface currents: Coriolis force, Ekman spiral and transport; upwelling, downwelling, gyres; deep ocean currents: thermohaline circulations and global conveyor belt.	8	2	
6	**Atmosphere-Ocean Interactions and Their Significance**			
	This module focuses on atmosphere-ocean interactions and the significance of these interactions. It also discusses the impact of the changing climate on these interactions. Differential heating of atmosphere and oceans, land and sea breezes; Atmosphere-ocean interactions and impacts of climate change; El Niño-Southern Oscillation (ENSO) and its impacts, Indian Ocean Dipole (IOD)	8	2	
	Total	48	12	

Evaluation Criteria

- Minor Test 1: Written test [at the end of teaching of modules 1 and 2] -- 20%
- Minor Test 2: Written test [at the end of teaching of module 3 and 4] -- 20%
- Major Test: Written test [at the end of the semester, full syllabus] -- 50%
- Tutorials/assignment: -- 10%

Learning Outcomes

Upon completion of the course, the students will be able to

- Develop a fundamental understanding of the atmosphere and the water in the atmosphere. [Module 1 and 2, Minor Test 1, Major Test]
- Gain knowledge about tricellular meridional circulation, air masses, fronts, cyclones, and Indian monsoons. [Module 3, Minor Test 2, Major Test]
- Develop an understanding of the oceans, its three-layered structure, and physical properties. [Module 4, Minor Test 2, Major Test]
- Understand surface currents, deep ocean circulations, atmosphere-ocean interactions, human impacts on these interactions, and Indian monsoons teleconnection with ENSO, IOD and Atlantic Nino. [Module 5 and 6, Tutorials, Major Test]

Pedagogical Approach

- The course will be delivered through classroom lectures, class exercises, and tutorials. It will be further connected with real-life examples and case studies.
- The course will focus on classroom discussions and assignments that will help to make this study more participatory, robust, and productive.

Reading Resources

- Neil C Wells (2001). *The Atmosphere and Ocean - A Physical Introduction*. 3rd Edition, Wiley.
- Geoffrey K Vallis (2019). *Essentials of Atmospheric and Oceanic Dynamics*. Cambridge University Press.
- John Marshall, R Alan Plumb (2007). *Atmosphere, Ocean and Climate Dynamics: An Introductory Text*. Academic Press.

- Frederick Lutgens, Edward Tarbuck, Redina Herman (2018). *The Atmosphere: An Introduction to Meteorology*. 14th Edition, Pearson.
- C Donald Ahrens, Robert Henson (2017). *Essentials of Meteorology*. 8th Edition, Brooks Cole.
- Lynne Talley, George Pickard, William Emery, James Swift (2011). *Descriptive Physical Oceanography: An Introduction*. 6th Edition, Academic Press.
- Robert H Stewart (2009). *Introduction to Physical Oceanography*. Orange Grove Books
- M Grant Gross (1990). *Oceanography, a View of the Earth*. Prentice Hall.
- Holton, J.R., An Introduction to Dynamic Meteorology, 4th Edn , Elsevier, 2004.
- Tropical Meteorology: GC Asnani

Student Responsibilities

The students must come prepared with readings suggested during the classes and ensure timely submissions of tutorials and assignments. They are also expected to attend classes regularly, participate, and contribute to classroom discussions to strengthen their understanding further. Their other responsibilities include feedback and discipline.

Course Designed by:

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Course reviewed by:

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- Dr. Lakshmi Kumar T V, Associate Professor (Atmospheric Science), School of Environmental Sciences, Jawaharlal Nehru University