Course Title: Introduction to Environmental Physics			
Course code: UES 102	**No. of credits: 3**	**L-T-P:** 30-15-0	**Learning hours: 45**
Pre-requisite course code and title (if any): None			
Department: Natural and Applied Sciences			
Course coordinator: Dr. Ranjana Ray Chaudhuri		**Course instructor:**	
Contact details:			
Course type: Major		**Course offered in:** Semester 2	

Course Description

This course provides a fundamental knowledge of environmental physics to undergraduate students from diverse backgrounds. Environmental physics focuses on matter and energy exchange between various components of the Earth and associated processes at various spatial scales. The course will enable the students to develop a better understanding of the origin and propagation of various environmental processes and phenomena, and the physical controls governing their behavior. Upon completion of this course, students will have acquired the necessary knowledge to analyze the physical mechanisms involved in addressing real-world environmental challenges.

Course objectives

The course aims to build the following basic understanding among students:

- Selected fundamental concepts and principles in physics.
- How environmental processes and interactions are driven and regulated by these principles.
- How these concepts are used in practical environmental applications.

Course content

Module	Topic	L	T	P
1	**Measurement of Physical Properties; Properties of Gases and Liquids**			
	Being an introductory module in environmental physics, this module builds a general foundation for understanding the following basic concepts regarding the measurement of different physical variables, properties of gases and liquids, and associated fluid dynamics: Measurement: international system of units, length, time, and mass Properties of gases and liquids: pressure, volume, temperature, density, viscosity, heat and thermal conductivity, diffusion, vapor pressure, brief introduction to fluid dynamics, turbulence; Tutorial - dispersion of pollutants	4	2	
2	**Motion**			
	This module focuses on developing fundamentals of the various principles involved with entities in motion and the associated forces. These principles are essential in understanding physical processes such as the movement of air masses, global atmospheric circulation, landslides, etc. The contents of this module are as follows: Motion: motion along a straight line, displacement, velocity and speed, acceleration, momentum, circular motion, relative motion, friction; Tutorials - landslides (slope, force, friction), pressure gradient force and atmospheric circulation, Coriolis force	4	2	
3	**Waves**			
	This module introduces principles of wave physics to students and the various applications of these fundamentals to practical applications in environmental investigations. The contents of this module are as follows: Waves: oscillation and resonance, types of waves, amplitude, wavelength and frequency, wave velocity, propagation, and interference; Tutorials - sound waves (intensity and sound level), noise, Doppler effect, applications of	4	2	

	SONAR and RADAR			
4	**Gravitation**			
	This module introduces students to the fundamental laws and various phenomena associated with gravitational force. Its focus is primarily to impart a basic understanding of how this force impacts earth processes as well as how we practically harness it for applications such as observation through artificial satellites in terrestrial orbits. The contents of this module are as follows: Gravitation: Newton's law of gravitation, gravitational force, acceleration due to gravity, tides, Kepler's laws of planetary motion; Tutorials - artificial satellites - types of Earth orbits and orbital velocity.	3	1	
5	**Thermodynamics**			
	Transport of energy and matter as regulated by thermodynamics is the prime driver for many environmental processes and interactions, including the interactions between living organisms and their physical environment. These processes across environmental components are driven by the same transfers irrespective of their scale of operation. This module introduces various concepts and principles of heat transfer to students as covered under following topics: Thermodynamics: temperature and heat, laws of thermodynamics, thermal expansion, heat transfer mechanisms, convection, conduction, insulation, radiation; Tutorials - specific heat, latent heat, lapse rate	4	2	
6	**Energy and Radiation Environment**			
	This module introduces various concepts related to energy and its sources as well as introduces students to properties of electromagnetic radiation and transport of radiant energy as covered under the following topics: Energy: potential energy, kinetic energy, work and power, conservation of energy, energy sources Radiation environment: absorption and emission of radiation, Planck's law, radiance and irradiance, electromagnetic radiation - spectrum of solar radiation, atmospheric attenuation, terrestrial radiation; Tutorials - radiative properties of natural materials (water, soils, rocks, snow, vegetation), greenhouse effect	4	2	
7	**Energy from the Nucleus**			
	This module introduces students to the domain of radioactivity and concepts related to harnessing nuclear energy. It also enables them to understand the environmental and health hazards associated with exposure to such energy. The contents of this module are as follows: Energy from the nucleus: stable isotopes, radioactivity, radioactive decay and half-life, nuclear fission, nuclear reactor, thermonuclear fusion; Tutorials - the relation between radiation and health (exposure), case studies (nuclear accidents)	3	2	
8	**Optics**			
	This module introduces principles associated with light and its interaction with different surfaces. It also focuses on practical applications of these principles in various environmental investigations as covered under the following topics: Optics: reflection, refraction, interference, diffraction, polarization, total internal reflection, dispersion of light; Tutorials - applications of LASER in environmental science, optical instruments, and their applications	4	2	
	Total	**30**	**15**	

Evaluation criteria

- Minor Test 1: Written test [at the end of teaching of modules 1, 2 and 3] -- 20%
- Minor Test 2: Written test [at the end of teaching of modules 4, 5 and 6] -- 20%
- Major Test: Written test [at the end of the semester, full syllabus] -- 40%
- Assignment: 20%

Learning outcomes

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

- Understand the basic concepts and principles in different branches of physics like energy, thermodynamics, waves, and optics. [Test 1, Test 2, Tutorials/Assignments, Major Test]
- Realize the physics behind major environmental issues. [Tutorials/Assignments, Major Test]

Pedagogical approach

- The course will be delivered through class lectures and tutorials.
- Visual media and tools like Phyphox will be used to make the learning process interesting and interactive for students.

Reading resources

- C. Smith (2001). *Environmental Physics*. Routledge Introductions to Environment, Taylor and Francis.
- E. Boeker and R.V. Grondelle (2011). *Environmental Physics: Sustainable Energy and Climate Change*. Wiley, 3rd Ed.
- Giambattista (2010). *Fundamentals of Physics*. McGraw-Hill Education (India) Pvt Ltd.
- Giancol, D.C. (2002). *Physics: Principles, with Applications*. New Jersey: Prentice Hall.
- J. L. Monteith and M. H. Unsworth (2013). *Principles of Environmental Physics: Plants, Animals, and the Atmosphere*. Academic Press, Elsevier, 4th Ed.
- P. Hughes and N.J. Mason (2014). *Introduction to Environmental Physics: Planet Earth, Life and Climate*. Taylor and Francis.

Student Responsibilities

The students must come prepared with readings suggested during the class and ensure timely assignment submission. They are also expected to participate and further strengthen their understanding of concepts through classroom discussions.

Course Designed by:

- Dr. Prateek Sharma, Professor & Vice-Chancellor, Delhi Technological University, Shahbad Daulatpur, Main Bawana Road, Delhi
- Dr. Amit Singh, Assistant Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi

Course Reviewers:

The course is reviewed by the following reviewers:

- Dr. Krishan Kumar, Professor, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi
- Dr. Anshumali, Professor, Indian Institute of Technology (ISM) Dhanbad