Course – Plan

School :School of Scinces
Department : Environmental Science
Course Code : ES 529
Course Title : Environmental Physics L2-T0-P0-CR2

Instructor/s: Dr. Amit Prakash

Abstract:
This course provides a framework for quantitative reasoning and problem solving skill development in budding environmental scientists. The course addresses the issues of transport processes across different environmental matrices essential for environmental studies.

Objectives:
To introduce the concept of flows and forces acrross different environmental matrics
To study the dynamics of atmospheric heat, mass and momenttum transport from local regional and global perspective
To understand the concepts of radiative forcing and its impact on global warming

Prerequisites of the course:
Basic knowledge of intermediate level mathematics and physics is required.

Course Outline:
Properties of Gases and Liquids: Physical properties of gases such as density, heat capacity, and molecular diffusivity, exchanges between organisms or land surfaces and their environment; Evaporation of water from soils, plants, and animals, surface water bodies; Cloud Physics.

Transport of Heat, Mass and Momentum:Transport of heat, mass, and momentum in the atmosphere across different interface such as soil, vegetation, water. Mass transfer by Gases, water vapour and particles. Mass diffusion, Mass exchange between air, plants and animals. Properties of turbulance, Roughness parameters, Aerodynamic resistance, Bowen ratio, flux gradients, wind speed gradients. Turbulent transfer, profiles and fluxes across vegetation canopies. General equation for transport within a gas . Verticle fluxes, Eddy Covariance. Conduction, Convection and Advection in gases, liquids and solids. Diffusion coefficients for momentum, heat, water vapor, and other gases and dependence on temperature. Transient heat balance. Sensible heat flux, latent heat flux.

Radiation Environment: Properties of Electromagnetic radiation, Principles of radiation absorption and emission, Concepts of BlackBody, Wein's law, Kirchoff's law, Planck's law, Stefan-Boltzman's law; Radiative exchange between layers and surfaces, radiative resistance; Cosine law, Spectral reflectivity and absorptivity, Beer's law, Kubelka-Munk Equations. Irradiance and radiance. Principle of scattering

and absorption of shortwave and long wave radiation, Aerosol Optical depth, Single scattering Albedo, Radiation balance, concept of radiative forcing.

TextBooks:

1.Monteith J. and Unsworth, M., Principles of Environmental Physics: Plants, Animals, and the Atmosphere, 4e, Academic Press, 2013.
2.Campbell G.S., Norman, J.M., An Introduction to Environmental Biophysics, 2e, Springer-Verlag, New York, 1997.
3.Iqbal M., Introduction to solar Radiation, Academic press, 1983.

ReferenceBooks:

1.Petty, G.W. (2006). A First Course in Atmospheric Radiation, second ed. Sundog Publishing.
2.Foken, T. (2008). Micrometeorology. Springer-Verlag, Berlin, Heidelberg.
3.Jacobson, Mark Z.(2005). Fundamentals of Atmospheric Modelling, Cambridge University Press.

Pedagogy:

Lectures, Assignments and presentations.

Time Plan

Lecture No.	***Topics***
1	Introduction and course overview
2	Physical properties of gases and gaseous mixtures such as air
3	heat capacity of gases; molecular diffusivity of gases
4-5	exchanges between organisms, land surfaces and their environment
6-7	Transport of heat, mass and momentum in the atmosphere
8	Mass exchange between air, plants and animals
9	Properties of turbulance, Roughness parameters
	UNIT TEST - 1
10-11	Aerodynamic resistance, Bowen ratio
12-13	Turbulent transfer, profiles and fluxes across vegetation canopies;
14	Mean and turbulent flux gradients, wind speed gradients
	UNIT TEST - 2
15	General equation for transport within a gas.

16	Verticle fluxes, Eddy Covariance
17-18	Conduction, Convection and Advection in gases, liquids and solids
19-21	Diffusion coefficients for momentum, heat, water vapor, and other gases and its dependence on temperature.
MID TERM TEST	
22-24	Transient heat balance. Sensible heat flux, latent heat flux.
25-26	Properties of Electromagnetic radiation, Principles of radiation absorption and emission,
UNIT TEST – 3(ASSIGNMENT TYPE)	
27-28	Concepts of BlackBody, Wein's law, Kirchoff's law, Planck's law, Stefan-Boltzman's law.
29	Radiative exchange between layers and surfaces, radiative resistance
UNIT TEST - 4	
30-31	Cosine law, Spectral reflectivity and absorptivity, Beer's law, Kubelka-Munk Equations.
32-33	Principle of scattering and absorption of shortwave and long wave radiation,
34-35	Aerosol Optical depth, Single scattering Albedo,
36	Radiation balance, concept of radiative forcing.
END TERM TEST	

Evaluation Plan

Test/ Assignments	Marks	Tentative Date
Unit Test – 1	20	3^{rd} to 4^{th} Week
Unit Test – 2	20	6^{th} week
Mid Term	30	9^{th} week
Unit Test – 3	20	12^{th} week
Unit Test – 4	20	14^{th} Week
End Term	35	17^{th} to 19^{th} week

Expected Outcome:

At the successful completion of this course, student will develop the understanding of the inherent forces and flows responsible for various naturally occuring events.