| Course Type | Course Code | Name of the Course | L | T | P | Credits |
|---|---|---|---|---|---|---|
| DE | NESD501 | Environmental Modelling | 3 | 0 | 0 | 3 |

**Course Objectives**

- To provide basic knowledge on mathematical model construction.
- To analyze environmental problems mathematically.

**Overall Learning Outcomes**

Upon successful completion of this course, students will be able to:

- Describe the transport of various kinds of contaminants.
- Formulate mass balances and develop mathematical models.
- Critically evaluate and solve and models for varied physico-chemical conditions.

| Unit No. | Topics to be covered | Contact Hr (L) | Learning outcomes |
|---|---|---|---|
| I | Introduction, Water Quality, Development of Mathematical Models, Reaction Kinetics, Mass Balance, Steady state solutions, Types of loadings, Types of Reactors, C-diagrams, Reactors in series and parallel, Incompletely mixed systems, Advection, Diffusion, Dispersion, Distributed systems (steady state and Time variable), Control Volume approach (Steady state solutions). | 10 | To understand and formulate the Basic Advection Dispersion equation for different environmental components. |
| II | River Quality modelling, Streeter Phelps model, Fate and transport of pollutants in rivers and streams, Pulse and step inputs, transport in estuaries, Fate and transport of pollutants in lakes, step and pulse input models, Reactions in subsurface, Fate and transport of pollutants in subsurface systems, Step and pulse input models. | 11 | To understand the application of basic mass transport equation for different water systems like river, lakes and subsurface. |
| III | Meteorological modelling: Comparison of boundary layer (BL) and free atmosphere characteristics, diurnal cycle of the ABL, convective BL, potential temperature, degree of turbulence, variance of the vertical and horizontal velocity, comparison between day time and night time BL, prediction of CBL height and Monin-Obukhov length (L). | 10 | To gain knowledge about meteorological changes in the boundary layer. |
| IV | Air quality modelling (AQM): Major AQM types & scales, steps in model formulation, types of input required for dispersion modelling, Preparation of meteorological data for air quality models (surface and upper air data). Emission quantification for point, area and line sources. The box model, Gaussian plume and puff model, Receptor Models such as Chemical Mass Balance (CMB) and Positive Matrix Factorization (PMF). Performance evaluation of models: Model parameterization, calibration and validation, sensitivity analysis and its role, errors and uncertainty analysis. Application of commonly used regulatory models (AERMOD, CALPUFF and CALRoads) and their applications to industrial problems. Different models used for environmental modleiing | 11 | To model air pollution from various sources like point, line and area and understand various software used for this purpose. |
| | | 42 | |

**Text Books:**


1. Lazaridis, M., First principles of meteorology and air pollution, Environmental pollution series volume 19, Springer 2011.
2. Dunnivant, F.M., Anders, E., A Basic Introduction to Pollutant Fate and Transport: An Integrated Approach with Chemistry, Modeling, Risk Assessment, and Environmental Legislation. John Wiley & Sons 2006.


**Reference books:**


1. Paolo, Z., Air pollution modelling, Springer, 1990.
2. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous Environmental Engineering (Indian Edition) McGraw-Hill, 2017
3. Steven C. Chapra, Surface Water-Quality Modelling, Waveland Press, 2008
4. Stull, R. "Practical Meteorology: An algebra-based survey of atmospheric science" – version 1.02b. Univ. of British Columbia. 2017