

**Applied Environmental Chemistry and  
Microbiology**  
Subject Code:ENVD01

<b>Unit-1</b>	<p><b>Introduction-</b></p> <p>Importance of Environmental Chemistry as applied to Environmental Engineering, Calculation of molar masses, Determination of percent composition of compounds, Solubility and concentration units in solution, Gas laws, Henry's and Raoult's law.</p> <p>Types of reactions - REDOX, Balancing chemical equations, Exothermic and endothermic reactions (determination of energy), acid/base (Calculation of pH of combined solutions), precipitation, reversible and irreversible reactions. Concepts of equivalent mass in relation to acids, bases, salts and oxidizing and reducing agents. Chemical equilibrium - Kc and its determination, Prediction of equilibrium by test quotient. (Including problems).</p>
<b>Unit-2</b>	<p><b>Chemical kinetics -</b></p> <p>Reaction rates, laws and orders; Half-life of a reaction; Temperature dependence and Arrhenius equation, Catalysis, Enthalpy and entropy, Gibbs free energy.</p> <p><b>Inorganic chemistry-</b></p> <p>Alkanes – Simple Carbon Chains, Drawing Organic Molecules, Functional Groups, Alkenes, Alkynes, Other Groups, Branches; Aromatic Compounds, Isomers and Congeners; Essentials of Polymer Chemistry - Addition Polymers, Condensation Polymers, Common Polymers, Polymer Concerns</p>
<b>Unit-3</b>	<p><b>Colloidal and surface chemistry-</b></p> <p>Colloids - Types, properties and environmental significance. Colloidal dispersions in water, air and emulsions. Theory of colloids - double layer theory, zeta potential, destabilization of colloids (SchulzeHardy rule) as applied to coagulation process. Absorption and adsorption process, adsorption isotherms (Problems on isotherms).</p>
<p><b>Applied Environmental Microbiology</b></p>	
<b>Unit-4</b>	<p><b>Introduction-</b></p> <p>Microscopic flora and fauna and their importance in environmental protection, microorganisms of importance in air, water and soil environment. Microbial enumeration techniques.</p> <p><b>Microbial metabolism-</b></p> <p>Metabolic activity, anabolism and catabolism, influencing parameters, microbial metabolism of toxic chemicals and trace organics, bio concentration and bio magnification.</p> <p>Bacteria: Morphology, spore formation, typical bacterial growth curve, Nutritional requirements, Growth Models specific growth rate and generation time, numerical problems.</p> <p>Algae: Occurrence, morphology, classification and environmental applications</p>

	Fungi: Classification, characteristics and environmental applications Virus: Types, characteristics and enumeration methods
<b>Unit-5</b>	<p><b>Enzymes-</b> Classification, kinetics of enzymatic reactions, Michaelis - Menten equation, factors influencing enzyme reactions, problems.</p> <p><b>Recent trends-</b> Use of microbial consortia in water and wastewater treatment, Emerging Microbial Contaminants- chemical and antibiotic resistant microbes, Microbes for remediation of oil and metal contaminated sites.</p>

### References:

1. Chemistry for Environmental Engineering and Science by Sawyer C.N. & McCarty, P.L.
2. Chemistry for Environmental Engineering by Armen S. Casparian & Gergely Sirokman.
3. Microbiology for Sanitary Engineers by McKinney R.E.
4. Microbiology by Pelczar, Chan and Ried.
5. Chemistry for Environmental Engineering and Science by Sawyer C.N. and McCarty, P.L.
6. Microbiology for Environmental Scientists and Engineers by Gaudy and Gaudy.
7. Ecosystem Modeling in Theory and Practice: An Introduction with Case Histories by Mall C.A.S and Day J.W.
8. Textbook of Microbiology by Chakraborty P.

### Journal extracts

Non-predatory peer reviewed journal articles.

### Science Direct/Springer/Taylor & Francis/Wiley Journals

Water Research, Colloids and Surfaces; Chemosphere, Water Research, Environmental management; Journal of Hazardous materials; EIA review, Cleaner Production, Environmental Science and Pollution Research, etc.

### American chemical society Journals

- o Industrial and Engineering Chemistry Research (acs.org)
- o Environmental Science and Technology (acs.org)

# Pollutant Transport Modeling in Environmental Systems

## Subject Code:ENVD02

<b>Unit-1</b>	Models as comprehensive tools in environmental management; Diffusion and dispersion; Molecular, turbulent and shear diffusion; Fick's laws of diffusion and convection; Turbulent and shear flow equations.
<b>Unit-2</b>	Steady state water quality modeling; Models for non-conservative pollutants in rivers, 1D oxygen balance models – Streeter Phelps equation; Critical point method; Estimation of decay and reaeration rates; Measurement of errors in modeling. (Derivations and Problems)
<b>Unit-3</b>	Mixing zones in rivers; 2D analysis of pipe and diffuser outfalls; lateral mixing coefficients, critical point method (Derivations and Problems); Dissolved oxygen models for lakes (Stratified and Completely mixed); Eutrophication models – Nutrient loading models for rivers and lakes
<b>Unit-4</b>	Subsurface Water Quality Assessment: Basic one and two dimensional mass balance equations and their analytical solutions. Impacts of point source discharges and leachate from land fill sites. Simple problems.
<b>Unit-5</b>	Impact of Wastewater Application on Land: Effects of application rates, mode etc., on different types of soils. Sodium Absorption Ratio (SAR). Microbiological effects in different soils with and without treatment of wastewater. Seasonal effects. Design problems.

### References:

1. Systems Approach to Water Quality management by *Thomas R.V.*
2. Models for Water Quality Management by *Biswas A.K.*
3. Modeling and Control of River Water Quality by *Rinaldi S.D, Soncini R.*
4. Principles of Water Quality Management and Control by *Thomann and Mueller.*
5. Steven C. Chapra (1997), Surface water Quality Modeling, McGraw Hill Inc.

### Journal extracts

Non-predatory peer reviewed journal articles.

### Science Direct/Springer/Taylor & Francis/Wiley Journals

Journals on Environmental Modeling

### American chemical society Journals

- o Industrial and Engineering Chemistry Research (acs.org)
- o Environmental Science and Technology (acs.org)

## Water and Wastewater Treatment Systems

### Subject Code:ENVD03

<b>Unit-1</b>	<p>Water Sources, need for water supply schemes-types and objectives. Drinking water quality parameters, guidelines and standards - International, national, regional and local. Population forecasting methods, limitations and numerical problems. Water treatment: Unit operations and processes, treatment flow sheets for different sources of water. Design principles of aeration, sedimentation - types of settling, sedimentation with coagulation and flocculation, pulsators, DAF, filtration and disinfection. Miscellaneous treatment-defluoridation, water softening, arsenic removal -numerical problems.</p>
<b>Unit-2</b>	<p>Recent trends: Advances in water treatment, SCADA systems for treatment and supply, economics, Package treatment units and patented material, implications of 24x7 supply. House service connections - HDPE, EF tapping, Ferrule, MDPE service pipe, Control valve and water meter. Intermittent residual chlorine boosting in the water distribution system, water quality in distributionsystem. Application of nanomaterials in water treatment</p>
<b>Unit-3</b>	<p>Need for sanitation, Urban and rural sanitation systems. Sources of domestic wastewater, Types of sewerage systems. Characteristics of wastewater. Estimation of dry and wet weather flow, estimation of storm water flow; simple problems.</p> <p>Hydraulic design of sewers - Hydraulic formulae, self-cleansing and non-scouring velocities, hydraulic elements curve, Design of sewers.</p> <p>Sewer appurtenances - Housed drainage connection - Tee, bends, closets, traps, manholes, invertedsiphons. Materials of sewers, laying, joining and testing.</p>
<b>Unit-4</b>	<p>Unit operations and unit processes, process flow sheets. Reaction kinetics, biokinetic coefficients and types of reactors. Unit operations - Pumps, screens, equalization, comminutor, grit chamber, oil and grease removal, primary sedimentation tank, design criteria and examples.</p> <p>Unit processes - Aerobic, Anoxic and Anaerobic systems, Suspended and attached growth systems, activated sludge process and modifications, trickling filters, rotating biological contactors, SBR, secondary sedimentation, design criteria and examples</p>
<b>Unit-5</b>	<p>Sludge Treatment - Quantification and characteristics, SVI, CSI, sludge digestion-aerobic and anaerobic, quantification of Methane, sludge thickeners, sludge drying beds,sludge filter press, design criteria and examples.</p> <p>Recent Trends in Wastewater Treatment: Decentralized wastewater treatment Systems - DeWATS, Tertiary and advanced wastewater treatment systems</p>

## **References:**

1. Wastewater Engineering, Treatment and Reuse by Metcalf and Eddy.
2. Environmental Engineering by Peavy H.S, Rowe D.R and Tchobanoglous G.
3. Wastewater Treatment Plants - Planning, Design and Operation by Quasim S.R.
4. CPHEEO Manual on Wastewater Treatment (Recent Edition)
5. Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), "Environmental Engineering", McGraw Hill Book Co.
6. Viessman W, Hammer M.J., Perez E.M., Chandik P.A., (2009), 'Water supply and pollution control' eighth edition,  
PHI Learning Private Ltd., New Delhi.
7. CPHEEO manual on water supply and treatment (recent edition)
8. Weber M.J. (1974), "Physico chemical Processes", McGraw Hill International

## **Journal extracts**

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## Atmospheric Environmental Engineering

### Subject Code:ENVD04

<b>Unit-1</b>	<p><b>Introduction-</b></p> <p>Composition and structure of the atmosphere; sources, characterization and classification of atmospheric pollutants, air pollution episodes. Effects of air pollutants on human health, vegetation, animals and materials and monuments. Visibility and other related atmospheric characteristics. Units and conversions</p>
<b>Unit-2</b>	<p><b>Water treatment methods -</b></p> <p>Wind circulation, solar radiation, lapse rates, atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth, Ventilation coefficient, Temperature Inversions, plume behavior, Wind rose diagram, general characteristics of stack emissions, heat island effect.</p> <p><b>Air quality monitoring -</b></p> <p>Respirable and non-respirable particulate matter. Monitoring of gaseous pollutants - CO, CO<sub>2</sub>, Hydrocarbons, SOX and NOX, photochemical oxidants. Monitoring equipment and sampling devices - stack sampling (Isokinetic sampling), air samplers, and gas exhaust analyzer. Air Pollution Index.</p>
<b>Unit-3</b>	<p><b>Pollutant dispersion modeling-</b></p> <p>Point, line and areal sources models. Box model, Gaussian plume dispersion model - for point source (with and without reflection), Gaussian dispersion coefficient, Pasquill and Gifford atmospheric stability classification. ISCST3 and AERMOD model, Determination of ground level concentrations. Infinite line source Gaussian model. Plume rise and effective stack height calculations.</p>
<b>Unit-4</b>	<p><b>Air pollution control equipment-</b></p> <p>Mechanisms, Control equipment for particulate matter - gravity settling chambers, centrifugal collectors, wet collectors, scrubbers, fabric filters, electrostatic precipitator (ESP) - Design principles and criteria with design. Control Equipment for gaseous pollutants - adsorption, absorption, condensation and combustion. Design principles</p>
<b>Unit-5</b>	<p><b>Indoor air pollution-</b></p> <p>Sources, indoor air contaminants, effects and control. air changes per hour (ACH), IAQ Standards</p>

**References:**

1. Air Pollution - Its Origin and Control by Wark K, Warner C.F, and Davis W.T.
2. Air Pollution by Perkins H.C.
3. Air Pollution Control Theory by Crawford M.
4. Air Pollution by Stern A.C.
5. Air Pollution: The Effects of Air Pollution by Stern A.C.
6. Environmental Engineering - A Design Approach by Sincero, A.P. and Sincero, G.A.

**Journal extracts**

Non-predatory peer reviewed journal articles

## Integrated Solid Waste Management

### Subject Code:ENVD05

<b>Unit-1</b>	<p><b>Introduction-</b></p> <p>Sources and engineering classification, characterization, generation and quantification; Objectives, principles, functional elements of solid waste management system - Regulatory aspects of solid waste management, major problems. Environmental implications of open dumping, Construction debris - management and handling, E-Waste Management, Rag pickers and their role.</p>
<b>Unit-2</b>	<p><b>Waste generation</b> - Rate of generation, frequency, storage and refuse collection, physical and chemical composition, quantity of waste, engineering properties of waste, prediction, modelling concepts.</p> <p><b>Collection, segregation and transport</b> - Handling and segregation of wastes at source, Collection (primary and secondary) and storage of municipal solid wastes, collection equipment, transfer stations, collection route optimization and economics, regional concepts. System dynamics</p>
<b>Unit-3</b>	<p><b>Waste minimization-</b></p> <p>Reduce, recover, recycle and reuse, case study, guidelines.</p> <p><b>Treatment of solid waste-</b></p> <p>Refuse processing technologies. Mechanical and thermal volume reduction. Biological and chemical techniques for energy and other resource recovery: composting, vermicomposting, termigradation, fermentation. Incineration of solid wastes.</p>
<b>Unit-4</b>	<p><b>Disposal methods-</b></p> <p>Impacts of open dumping, site investigation and selection, sanitary land filling - Types, geotechnical considerations, design criteria and design, Liners - earthen, geo membrane, geo synthetics and geotextiles.</p> <p><b>Operational aspects of landfills-</b></p> <p>Daily cover, leachate disposal, Ground Water monitoring, leachate and gas collection systems - Design, leachate treatment. Landfill Final Cap Design and Water Balance, Modelling (HELP - Hydraulic Evaluation of Landfill Performance), post-closure environmental monitoring; landfill remediation.</p>
<b>Unit-5</b>	<p><b>Recent developments in MSW reuse and disposal-</b></p> <p>Power Generation, Blending with construction materials and Best Management Practices (BMP). Community based waste management, Waste as a Resource concept, Public private partnership (PPP).</p> <p><b>Role of various organizations in Solid Waste Management-</b></p>



**References:**

1. Solid Waste Engineering Principles and Management Issues by Tchobanoglous G., Theissen H., and Eliassen R.
2. Handbook of Solid Waste Disposal by Pavoni J.L.
3. Environmental Engineering by Peavy, Rowe and Tchobanoglous.
4. Solid Waste Management by Mantell C.L.
5. WHO Manual on Solid Waste Management.
6. Solid Waste Engineering by Vesiland A.
7. Management of Solid Wastes in Developing Countries by Frank Flintoff.

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**Applications of Statistics in Environmental  
Engineering  
Subject Code:ENVD06**

<b>Unit-1</b>	<p><b>Introduction -</b></p> <p>Sample and Population; Discrete and Continuous; Subdivisions - Descriptive, Inferential and Decision Theory; Collection, Arranging and Presentation of data; Frequency grouping; Frequency and relative frequency distribution; Cumulative frequency; Surge's rule; Frequency polygon; Ogives; Problems.</p>
<b>Unit-2</b>	<p><b>Characteristics and distributions -</b></p> <p>Central Tendency - Averages: Arithmetic mean (Ungrouped data and Grouped data); Median (Ungrouped data and Grouped data); Mode (Ungrouped data and Grouped data); Skewness; Geometric mean; Weighted mean; Moving averages - equations to river hydraulics; Problems.</p>
<b>Unit-3</b>	<p><b>Probability -</b></p> <p>Basic concepts; Types - Classical approach, Relative frequency approach, Subjective approach; Probability rules; Problems.</p> <p><b>Probability distribution -</b></p> <p>Binomial distribution - derivation; Poisson distribution - derivation; Normal distribution - errors, Gauss function, Area under normal curve, Use of standard normal probability distribution table; Problems.</p>
<b>Unit-4</b>	<p><b>Correlation and regression analysis -</b></p> <p>Scatter Diagrams; Correlation coefficient; Multiple correlation coefficient; Simple linear regression; Multiple regression equation; Estimation using regression line; Method of Least Squares; Standard error of estimate; Problems</p>
<b>Unit-5</b>	<p><b>Testing hypothesis -</b></p> <p>Concepts basics; Null hypothesis; Level of Significance; Degrees of Freedom; Hypothesis testing of Means; The Chi-Squared test; F distribution; Students t-test; DoE - Analysis of Variance - within samples and between samples; Problems</p>

**References:**

1. Basic Statistical Methods for Engineers and Scientists by Adam M. Neville and John B. Kennedy.
2. Statistics for Management by Richard I. Levin and David S. Rubin.
3. Statistics for Experiments - An Introduction to Design, Data Analysis, and Model Building by George E. P. Box, William G. Hunter, and J. Stuart Hunter.

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