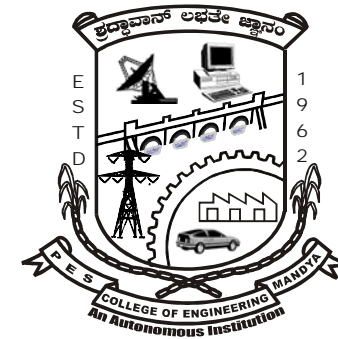


# Syllabus

VI Semester B.E. Program  
Environmental Engineering



**P.E.S. College of Engineering**

Mandya - 571 401. Karnataka  
( An Autonomous Institution under VTU Belgaum)

Grant -in- Aid Institution

(Government of Karnataka)

Accredited by NBA, New Delhi

Approved by AICTE, New Delhi.

Ph : 08232- 220043

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# MANAGEMENT & ENTREPRENEURSHIP

Course Code : P08EV61  
Credits: 04

Total Hours : 52  
Hours per week : 04

## PART - A Unit -1

### Management

Introduction - Meaning - nature and characteristics of Management, Scope and functional areas of management - Management as a science, art or profession - Management & Administration - Roles of Management, Levels of Management, Development of Management Thought - early management approaches - Modern management approaches. 07 hrs.

## Unit - 2

**Planning** : Nature, importance and purpose of planning process - objectives Types of plans (Meaning only) - Decision making - Importance of planning steps in planning & planning premises - Hierarchy of plans. 06 hrs.

## Unit - 3

**Organizing and Staffing** : Nature and purpose of organization - principles of organization - Types of organization - Departmentation - Committees - Centralisation Vs Decentralisation of authority and responsibility - Span of control - MBO and MBE (Meaning only) Nature and importance of Staffing - Process of Selection & Recruitment (in brief). 06 hrs.

## Unit - 4

Directing & Controlling Meaning and nature of directing - Leadership styles, Motivation Theories, Communication - Meaning and importance - Coordination, meaning and importance and Techniques of Coordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control (inbrief). 07 hrs.

## PART - B Unit - 5

**Entrepreneur** : Meaning of Entrepreneur, Evolution of Concept, Functions of Entrepreneur, Types of Entrepreneur, Intrapreneur - an emerging class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship, Stages in entrepreneurial process, Role of Entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship - its Barriers. 07 hrs.

## Unit - 6

### Small Scale Industry

Definition; Characteristics; Need and rationale : Objectives, Scope, role of SSI in Economic Development. Advantages of SSI. Steps to start an SSI - Government policy towards SSI, Different Policies of SSI., Government Support on SSI., during 5 year plans. Impact of Liberalization, Privatisation, Globalization on SSI. Effect of WTO / GATT Supporting Agencies of Government for SSI Meaning. Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition only). 07 hrs.

## Unit - 7

**Institutional Support** : Different Schemes, TECKSOK, KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI, NSIC, SIDBI, KSFC. 05 hrs.

## Unit - 8

### Preparation of Project

Meaning of Project, Project Identification, Project Selection, Project Report, Need and significance of Project, Contents, formulation, Guidelines by Planning Commission for Project Report, Network Analysis, Errors of Project Report, Project Appraisal. Identification of Business Opportunities. Market Feasibility Study : Technical Feasibility Study, Financial Feasibility Study & Social Feasibility Study. 07 hrs.

### QUESTION PAPER PATTERN

In the examination EIGHT questions shall be set covering all the units, out of which the student shall answer any FIVE full questions. Selecting atleast two from each unit.

### REFERENCES :

1. Principles of Management - P.C. Tripathi, P.N. Reddy, Tata McGraw Hill, 1. (Chapters 1,2,3,4,5,14,15,16,17)
2. Dynamics of Entrepreneurial Development & Management - Vasant Desai -Himalaya Publishing House (Chapters1,2,4,6,8,9,10,13,15, 16,17,18,19,20,21,22, 42,46,47)
3. Management Fundamentals - Concepts, Application, Skill Development - Robert Lusier - Thomson (Chap 1,4,12).
4. Entrepreneurship Development - SS Khanka - S Chand & Co. (Chap 1, 2, 5, 11, 12, 3. 13, 16, 18, 20)
5. Management - Stephen Robbins - Pearson Education / PHI - 17th Edition, 2003.

# ENVIRONMENTAL TRANSPORT PROCESSES

Course Code : P08EV62  
Credits: 04

Total Hours : 52  
Hours per week : 04

## PART - A Unit - 1

Introduction to different transport mechanisms. Process Dynamics: Transport and Reaction Process, Material Balance Relationships, Kinetic Approach to Equilibrium. Factors Affecting Equilibrium Concentration and Temperature Effects. 08 Hrs.

## Unit - 2

Mechanics of Mass Transport: Diffusive Mass Transport & Convective Mass Transport in Molecular and Turbulent Flow Regimes (without proof). Combined Convective-Diffusion Equation for 1, 2 & 3 Dimensions. Analytical Solutions for 1-D & 2-D Cases & Simple Problems for Instantaneous Cases. 08 hrs.

## Unit - 3

Chemical Thermodynamics: Free Energy Formation, Entropy Formation, Non-identity correction, Ionic Strength Considerations, Theoretical Equations for the Active Co- efficiencies, Effect of Ionic Strength on the Value of Equilibrium Constant, Simultaneous Reactions. 10 hrs.

## PART - B Unit - 4

Fundamentals of Process Kinetics: Mass Law Relationships, Reaction Orders, Limitations of Mass Law Relationships, Application of First Order Reaction, Parallel, Reversible and Enzyme reactions. 06 hrs.

## Unit - 5

Gas Absorption and Adsorption - Two film theory, Particle Treatment, Flootation & aerosol separation, Ion Exchange, Electrodialysis, Leaching 06 hrs.

## Unit - 6

Flow through bed of solids: Carmon - Kazeny Equation; Membrane Filters and Ultrafiltration Process. Flow through porous plates, vacuum filtration. 06 hrs.

## Unit - 7

Groundwater Quality: Basic differential equations with analytical solutions for 1-D and 2-D for instantaneous cases. 04 hrs.

## Unit - 8

Description of Water Quality Processes in Natural Water Bodies: Lake, River, Estuary and Oceans. 04 hrs.

## QUESTION PAPER PATTERN :

In the examination EIGHT full questions shall be set covering all the units, out of which the students shall answer FIVE full questions. Selecting atleast two from each unit.

## REFERENCES :

1. Benefield, L.D., Judkins (Jr) J.F., and Weand B.L., "Process Chemistry for Water and Wastewater Treatment".
2. Rich, L.G., (1973), "Environmental Systems Engineering", Mc Graw Hill.
3. Thomann & Mueller, (1987), "Principles of Water Quality Modelling and Control", Harper & Row.
4. Treybul, R.E., (1960), "Mass Transfer Operation", McGraw Hill, Kogakusha.
5. Weber, W.J., (1972), "Physico - Chemical processes for Water Quality", John Wiley & Sons.
6. Linvil G Rich, Unit operation of sanitary engineering, Willey toppan Co.Ltd.,

# ATMOSPHERIC ENVIRONMENTAL ENGINEERING

Course Code : P08EV63  
Credits: 04

Total Hours : 52  
Hours per week : 04

## PART - A

### Unit - 1

Introduction: Definitions and terminologies, atmospheric structure and composition. Air pollution episodes- Bhopal Gas Tragedy, Los Angeles and London smog. 06 hrs.

### Unit - 2

Sources and Classification of Air Pollutants: Natural and anthropogenic, emission inventory source classification, primary and secondary pollutants. Units of measurements of air pollutant. Simple problems on unit conversion. Air pollution due to automobiles. 06 hrs.

### Unit - 3

Effects of Air Pollution: Effects on human health and welfare, vegetation, animals, materials and structure/monuments, visibility and related atmospheric characteristics, Acid rain, Green house effect, Ozone depletion and Heat island effect. 04 hrs.

### Unit - 4

Air Pollution Meteorology: Meteorological factors- heat, solar radiation, temperature, lapse rate, wind, humidity, precipitation, mixing height, pressure, atmospheric stability conditions, wind velocity profile, windrose diagram. Inversion -types, plume behavior under different atmospheric stability. 10hrs.

## PART - B

### Unit - 5

Measurement of Air Pollutants and Air Pollution Laws: Measurement of gaseous (CO, HC, NO<sub>x</sub>, SO<sub>2</sub>) and particulate pollutants, Sampling train, sampling methods/techniques, stack sampling techniques. Air pollution laws and standards: Air pollution indices- determination of air pollution index by different methods. 08 hrs.

### Unit - 6

Atmospheric Dispersion of Stack Effluents: Plume rise, effective stack height, plume rise formulations, guide lines for fixing stack height, problems on plume rise calculations. Gaussian plume model- for point source. Downwind ground-level concentration computation, maximum ground level concentration. 08 hrs.

## Unit - 7

Air Pollution Control Equipments: General methods, control by process changes, Design of particulate control devices-settling chambers, inertial separators, cyclones, fabric filters, scrubbers (wet collectors), electrostatic precipitators. Control of gaseous pollutants- adsorption, absorption, 06 hrs.

## Unit - 8

Noise Pollution: Sources of noise, effects of noise pollution, units & measurement of noise, control of noise pollution, standards. Equations & Applications. 04 hrs.

## QUESTION PAPER PATTERN :

In the examination EIGHT questions shall be set covering all the units, out of which student shall answer FIVE questions. Selecting atleast two from each unit.

## REFERENCES :

1. Boubel, R.W., Donald, L.F., Turner, D.B., and Stern, A.C., (1994), " Fundamentals of Air Pollution", Academic Press.
2. Crawford, M., (1980), "Air Pollution Control Theory", TMH Edition, Tata Mc Graw Hill Publishing Co. Ltd., New Delhi.
3. Henry. C. Perkins, (1980), "Air Pollution", McGraw Hill.
4. Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), "Environmental Engineering", Mc Graw Hill Book Co.
5. Sincero, A.P and Sincero, G.A., (1999), "Environmental Engineering - A Design Approach", Prentice Hall of India.
6. Wark, K., Warner, C.F. and Davies, W.T., (1998), "Air Pollution- Its Origin and Control", Harper & Row Publishers, New York.

# WASTEWATER COLLECTION AND DRAINAGE SYSTEM

Course Code : P08EV64

Credits: 04

Total Hours : 52

Hours per week : 04

## PART - A

### Unit - 1

Types of Surface and Underground Drainage Systems and their Merits and Demerits. Types of Sewers - Lateral, Sub-main, Main, Intercepting and Out-fall Sewers. 06 hrs.

### Unit - 2

Quantity of Domestic Wastewater: Sources - Rate of Domestic Sullage and Wastewater Flow, Infiltration and Exfiltration, Design Flow. 06 hrs.

### Unit - 3

Storm Water Run-off: Estimation of Run-off, Factors, Design, principles of Drains and Sewers. 06 hrs.

### Unit - 4

Design of Sewers and Drains: Self Cleansing and Non-scouring Velocities. Formulae, Design of different types (L, U and V Drains) suitable for Rural and Urban Areas, Pressure Sewers. 08 hrs.

## PART - B

### Unit - 5

Appurtenances: Manholes, Lamp Holes, Street Inlets, Inverted Syphon, House Drainage Connection, Sewer Junction and Transitions. Wastewater Pumping: Necessity, Types of Pumps, Location of Pumping Station, Operation and Maintenance. 10 hrs.

### Unit - 6

Disposal of Sullage Water of Rural Communities: Disposal Methods - Septic Tank and Soak Pits, Disposal in Natural Valley, Agricultural Land, Low Lying Area, etc., Development of Disposal Sites. 08 hrs.

### Unit - 7

Measuring and Sampling of Flow in Sewers, Laying, Jointing and Testing of Sewer Lines, Loads on buried pipes. 06 hrs.

## Unit - 8

Maintenance of Drainage and Sewerage Systems: Inspection, Cleaning, Repair and Rehabilitation. Preventive Maintenance. 02 hrs.

## QUESTION PAPER PATTERN :

In the examination EIGHT full questions shall be set covering all the units, out of which the students shall answer FIVE full questions. Selecting atleast two from each unit.

## REFERENCES :

1. Hammer, M.J., (1986), "Water and Wastewater Technology", SI Version, 2nd Edition, John Wiley and Sons.
2. Fair G.M., Geyer H.C., and Okun D.A., (1968), "Water and Wastewater Engineering", Vol. I & II, John Wiley and Sons.
3. Metcalf and Eddy, (2003), "Wastewater Engineering, Treatment and Re use", 4th Edition, Tata McGraw Hill Edition, Tata McGraw Hill Publishing Co. Ltd.
4. Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), "Environmental Engineering", Mc Graw Hill Book Co.
5. National Building Codes (NBC) and Bureau of Indian Standards (BIS) Codes.
6. S.K.Garg - II "Waste Water Collection and Drainage Systems.

# WASTEWATER TREATMENT ENGINEERING

Course Code : P08EV65  
Credits: 04

Total Hours : 52  
Hours per week : 04

## PART - A Unit - 1

Introduction: Objectives of Wastewater Treatment, Unit Operations and Processes. Flow Sheets for Wastewater Treatment Systems. 04 hrs.

## Unit - 2

Unit Operations: Screening, Comminutor, Grit Chamber, Settling; Discrete, Flocculant, Zone & compression settling, Design Criteria and Examples. Chemical aided sedimentation. 08 hrs.

## Unit - 3

Unit Processes: Objectives of Biological Treatment, Types of Process, Suspended & attached Growth Systems, Aerobic & Anaerobic Systems, Activated Sludge Process and its Modifications, Trickling Filters, Rotating Biological Contactor, Biofilters, Secondary Sedimentation Tank, Design criteria and examples. 10 hrs.

## Unit - 4

Stabilization Ponds - Aerobic, Facultative & Anaerobic Lagoons, Septic Tanks and their Design Aspects. 04 hrs.

## PART - B Unit - 5

Sludge Treatment: Solids sources and characteristics, Sludge Pumping, Sludge Thickening, Stabilization, Conditioning, De-watering. 08 hrs.

## Unit - 6

Sludge Digestion: Aerobic and Anaerobic Digesters, Design Criteria with examples. Methane qualification. 06 hrs.

## Unit - 7

Sludge & Effluent Disposal: Sludge drying beds - Principles and Design Criteria, Effluent disposal - into land, into estuaries, into ocean, sewage farming, Application of Bio-solids to land, Tertiary treatment of sewage.. 06 hrs.

## Unit - 8

Operation and Maintenance of Treatment Units: In-plant Monitoring, Operational Problems and Solutions, Preventive Maintenance, Disposal of Wastes from various Units. 06 hrs.

## QUESTION PAPER PATTERN :

In the examination EIGHT full questions shall be set covering all the units, out of which the students shall answer FIVE full questions. Selecting atleast two from each unit.

## REFERENCES :

1. Hammer, M.J., (1986), "Water and Wastewater Technology", SI Version, 2nd Edition, John Wiley and Sons.
2. Karia, G.L., and Christian, R.A., (2006), "Wastewater Treatment - Concepts and Design Approach", Prentice Hall of India Pvt. Ltd., New Delhi.
3. Metcalf and Eddy, (2003), "Wastewater Engineering, Treatment and Reuse", 4th Edition, Tata McGraw Hill Edition, Tata McGraw Hill Publishing Co. Ltd.
4. Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), "Environmental Engineering", Mc Graw Hill Book Co.
5. Raju, B.S.N., (1995), "Water Supply and Wastewater Engineering", Tata McGraw Hill Pvt. Ltd., New Delhi.
6. Sincero, A.P., and Sincero, G.A., (1999), "Environmental Engineering - A Design Approach", Prentice Hall of India Pvt. Ltd., New Delhi.

# ENVIRONMENTAL BIOTECHNOLOGY

Course Code : P08EV661

Credits: 04

Total Hours : 52

Hours per week : 04

## PART - A

### Unit - 1

Biochemistry: Introduction, Lipids, sugars, polysaccharides, nucleotides, RNA, DNA, amino acids, proteins, hybrid biochemicals, hierarchy of cellular organisms. 05 hrs.

### Unit - 2

Metabolic Pathways, Kinetics of Enzyme Catalyzed Reactions: Applied Enzyme Catalysis - Hydrolysis of starch cellulose. Enzyme mixtures - pectic enzymes. Immobilized enzyme technology. Immobilization methods, industrial process, analytical applications, kinetics. 10 hrs.

### Unit - 3

Multiple Interacting Microbial Populations: Neutralism, mutualism, commensalism and amensalism. Classification of interaction between two species. Competition - Volterra's analysis for growth of two species and simple problems. 04 hrs.

### Unit - 4

Kinetics of Substrate Utilization: Product utilization and biomass production in cell cultures, ideal reactors for kinetics management, kinetics for balanced growth, transient growth kinetics, structured kinetic models. 07 hrs.

## PART - B

### Unit - 5

Biotechnology: Introduction to microbial biotechnology, uses of enzymes and biomass production, isolation and purification of enzyme engineering, protein engineering, immunotoxins, metabolic engineering for over production of metabolites. 08 hrs.

### Unit - 6

Uses of Microbes: Isolating and culturing of microorganisms, production of organic compounds like, ethanol and acetone by microbial fermentation, production of enzymes by microorganism. 05 hrs.

### Unit - 7

Sewage treatment using microbial systems, nitrogen fixing and pollutant degrading genes, biocontrol agents. 05 hrs.

### Unit - 8

Specific Biotechnological Applications to: Pollution control, restoration of degraded lands, free-cells and immobilized cell technology for wastewater treatment [Batch and Continuous Stirred Tank Reactor (CSTR)], aerobic and anaerobic digestion, biogas from wastes. 08 hrs.

### QUESTION PAPER PATTERN :

In the examination EIGHT full questions shall be set covering all the units, out of which the students shall answer FIVE full questions. Selecting atleast two from each unit.

### REFERENCES :

1. Bailey and Ollis, (1990), "Biochemical Engineering and Fundamentals", McGraw Hill International Edition.
2. Dubey, R.C., "A Textbook of Biotechnology", S. Chand and Co., New Delhi.
3. Gupta, P.K., (2000), "Elements of Biotechnology", Rastogi Publications, Meerut.
4. Sawyer, C.N., Mc Carty, P.L., and Parkin, G.F., (2003), "Chemistry for Environmental Engineering and Science", 5th Edition, TMH Edition, Tata Mc Graw Hill Co. Ltd., New Delhi.

## GEO-ENVIRONMENTAL ENGINEERING

Course Code : P08EV662

Credits: 04

Total Hours : 52

Hours per week : 04

### PART - A

#### Unit - 1

Introduction: Definition of Geo-environment and its Components. Global Degradation of Environment, Ecologically Sustainable Industrial Development. 04 hrs.

#### Unit - 2

Dynamics of Geo-environment: Residence Time, Chemical Composition, Pools and Fluxes, Dynamics of the Processes of Geo-environment, Speciation, Anthropogenic Impact, Biogeochemical Cycles. 08 hrs.

#### Unit - 3

Soil Factor of Ecology: Residual and Transported Soils, Weathering, Soil Texture, Soil Classification, Soil Moisture, Water Vapour, Organic Matter, Soil Microbes and Soil Erosion, Soil Conservation in India. 06 hrs.

#### Unit - 4

Environment of Soils: Soil Properties in Relation to Plant Growth, Soil Types in Relation to their Agricultural Potential, Soil Management for Sustainable Agriculture, Soil Management Scenarios for Developing Countries, Contamination of the Soils, Heavy Metal Pollution of the Soil. 08 hrs.

### PART - B

#### Unit - 5

Environment of Sediments: Introduction, Water Mixing Processes, Deposition of Sediments, Heavy Metals in Coastal Sediments, Heavy Metals in the Hydrocycle, Trace Metals in the Aquatic System, Quantification of Environmental Impact in Sediments. 06 hrs.

#### Unit - 6

Mining and Geo-environment: Introduction, Geological Characteristics in Relation to Mining, Acid Mine Drainage (AMD), Mercury Pollution due to Artisanal Gold Mining, Environmental Effects of Coal Mining Industry, Beneficial Use of Mining Wastes, Restoration of Mined Land. 08 hrs.

#### Unit - 7

Pollution of Geo-environment: Introduction, Underground Sources of Contamination, Septic Tank, Chemical Storage, Manure Pits, Landfills, Contaminated Ground and its Treatment, Methods of Waste Disposal, Planning of Waste Disposal Facility. 06 hrs.

#### Unit - 8

Geo-environment and Health: Geo-medicine. Essential Elements, Etiology of Diseases Related to Trace Elements, Trace Element Deficiency Disorders, Cardiovascular Diseases, Mining Environment and Health, Dusts and Health Risks. 06 hrs.

### QUESTION PAPER PATTERN :

In the examination EIGHT question shall be set covering all the units, out of which the student shall answer any FIVE full questions. Selecting atleast two from each unit.

### REFERENCES :

1. Aswathnarayana V., (1995), Geo-environment - An Introduction, Capital Books Private Limited, New Delhi.
2. Mishra P.C. (1989), Soil Pollution and Soil Organisms, Ashish Publishing House, New Delhi.
3. Miller R.W., Donahu R.L., (1997), Soils in our Environment, Prentice Hall of India Private Limited, New Delhi.
4. Rao & Banerjee (1996), Environmental Geotechnology with Geosynthetics, Proceedings of International Seminar and Techno Meet.
5. N.S. Subramanian, AUVS Sanbamurthy (2000), Ecology, Narosa Publishing House, New Delhi.

## ENVIRONMENTAL SYSTEMS OPTIMIZATION

Course Code : P08EV663

Credits: 04

Total Hours : 52

Hours per week : 04

### PART -A

#### Unit - 1

Introduction: Definition and Engineering Applications of Optimization. Statement of an Optimization Problem, Classification of Optimization Problems. 04hrs.

#### Unit - 2

Classical Optimization Techniques: Single Variable Optimization, Multivariable Optimization with No Constraints, with Equality Constraints and with Inequality Constraints. (Statement of Theorem without Proof). 06 hrs.

#### Unit - 3

Linear programming: Graphical and Simplex Methods of solving L.P, Two-phase Method, Big-M Technique. 10 hrs.

#### Unit - 4

Linear Programming II; Introduction Revised simplex method. Duality in Linear programming, Sensitivity Analysis and Parametric analysis. 06 hrs.

### PART - B

#### Unit - 5

Transportation Problem: Definition & Applications of Transportation Model. I.B.F.S (Initial Basic Feasible Solution) of the Transportation Problem, North West Corner Rule and Vogels Approximation Methods, Application to Wastewater Reuse and Solid Waste Management. 08 hrs.

#### Unit - 6

Non Linear Programming: One dimensional minimization methods, Elimination Methods, unrestricted search, exhaustive search, interval halving method, Golden section method & their comparison. 04 hrs.

#### Unit - 7

Simulation: Basic Concepts, Development & Implementation of Simulation Process, Pre-simulation Activities, Developmental & Operational Activities and Random Number Generation Techniques. 06 hrs.

### Unit - 8

Application of Linear Programming to: Problems on Air Pollutant Transport, Air Pollution Control, Wastewater Treatment Problem, Formulation for Non-point Source Pollution from Dairy Farms and Combined Sources from Urban Areas. 08 hrs.

### QUESTION PAPER PATTERN :

In the examination EIGHT full questions shall be set covering all the units, out of which the students shall answer FIVE full questions. Selecting atleast two from each unit.

### REFERENCES :

1. Douglas A Haith (1982), Environmental Systems Optimization, Jhon Wiley & Sons.
2. Hamdy A TAHA (1995), Operations Research An Introduction, 5th Edition, Prentice Hall of India Pvt. Ltd.,
3. Singiresu S Rao (1998), Engineering Optimization - Theory & Practice, New Age International Pvt., Ltd.,
4. S.D.Sharma, 'Operations & Research', Kedarnath, Ramnath & Co., Meerut. CPHEEO 'Manual on Sewage Treatment', Ministry of Urban Development - G.O.I New Delhi.

## ATMOSPHERIC ENVIRONMENTAL LABORATORY

Course Code : P08EV67

Total Hours : 42

Credits: 04

Hours per week : 03

Introduction to Atmospheric Monitoring: Particulate Sampling - Dust Fall, Pollution Suspended Particulates and Total Particulate Matters using H.V.A.S. Experimental on Respirable Dust.

Estimating Sulphur Dioxide and Nitrogen acids in Ambient Air Using High Volume Air Sampler\*.

Stack Sampling Techniques and Demonstration of Stack Monitoring.

Exercises on Ambient Gas Monitoring using GASTEC Device.

Exercises on Auto Exhaust Analysers, Two gas/Four gas analyser for petrol vehicle & smoke density meter for diesel vehicles.

Exercises on Noise Measuring Instruments.

Exercises on Luxmeter ( Light Intensity measuring Instrument)

Demonstration on Wind Monitoring and Analysis of Data for Windrose Diagrams.

Demonstration of Rain Gauges.

Demonstration / Exercises on Air Pollution Control Devices - Bag Filter, Scrubber, Cyclone and ESP.

**Note:** Experiments to be conducted for 8-hr and 24-hr cycles.

### REFERENCES:

1. Perkins H. C., Air Pollution and Control
2. Stern, Air Pollution Theory and Control
3. Peavy Rowe & Techobanoglous - Environmental Engineering, McGraw Hill Publications Ltd.,
4. Relevant IS Codes.

## BIO-CHEMICAL PROCESS LAB

Course Code : P08EV68

Total Hours : 42

Credits: 04

Hours per week : 03

BOD and COD Analysis for Municipal, Industrial Wastewater and Leachates.

Bench Scale Experiment - Aeration, Trickling Filter and Rotating Biological Contactor.

Oxidation Ditch, Upflow Filter Bed and Reverse Osmosis Experiments.

Experiments for Organic Contaminant and Heavy metal removal using adsorption columns.

Tertiary Treatment by Physico-Chemical Methods - Flocculation, Filtration. Water Hyacinth and Duckweeds for Wastewater treatment and polishing.

Experiments of Sludge Analysis - VSS, VFA, N & Phosphate, pH-Buchner Funnel Tests, Capillary Suction Time Test.

Experiments on Municipal Solid Waste - Moisture Content, Density, Calorific Value.

### REFERENCES :

1. APHA, Standard Methods for Examination of Water and Wastewater.
2. Adams and Eckenfelder Jr. W. W. Environmental, Process Design Techniques for Industrial Waste Treatment, Nashville (USA), 1974.
3. Metcalf and Eddy, Wastewater Engineering, Tata McGraw Hill, 1995.
4. Relevant IS Codes.