Sri B.V.V. Sangha's

Basaveshwar Engineering College (Autonomous)

Bagalkot-587102

Department of Civil Engineering

SYLLABUS FOR POST GRADUATE PROGRAMME

M. Tech.

ENVIRONMENTAL ENGINEERING

2021-2022

VISION OF THE INSTITUTION

To be recognized as a premier technical institute committed to developing exemplary professionals offering research based innovative solutions and inspiring inventions for holistic socioeconomic developments.

MISSION OF THE INSTITUTION

- To pursue excellence through student centric dynamic teaching-learning processes, encouraging freedom of inquiry and openness to change.
- To carry out innovative cutting-edge research and transfer technology for industrial and societal needs.
- To imbibe moral and ethical values and develop compassionate, humane professionals.

VISION OF THE DEPARTMENT

To be a center of excellence of higher learning and research in civil engineering encompassing ethical, environmental and economical aspects of the society.

MISSION OF THE DEPARTMENT

- The department of Civil Engineering is committed to prepare globally competent engineers in response to rapid economic and technological growth, through a dynamic process of teaching-learning, research and sharing professional experiences for the betterment of the community.
- To provide knowledge base and consultancy services to the community in all the areas of Civil Engineering.

Programme Outcomes(POs)

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: Ability to write and present a substantial technical report/document

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

Programme Educational Objectives (PEOs)

PEO1: Graduates of the Programme will be effective and efficient environmental engineers to serve in various industry, academia and research organizations.

PEO2: Graduates will be able to apply appropriate concepts and modeling techniques for a sustainable environmental engineering system..

PEO3: Graduates are able to apply new emerging technologies and tools in solving complex real life environmental engineering problems and carry out interdisciplinary research to provide efficient, sustainable and ethical solutions.

Justification of consistency of the Department Vision and Mission with the Institute Vision and Mission

Vision

Institution Vision → / Department Vision ↓	To be recognized as the premier technical institute committed to developing exemplary professionals offering research based innovative solutions	Inspiring inventions for holistic socioeconomic developments
To be center of excellence of higher learning and research in civil engineering	*	*
To encompass the graduates ethical, environmental and economical aspect of the society		*

Mission

Institution Mission → / Department Mission ↓	To pursue excellence through student centric dynamic teaching-learning processes, encouraging freedom of inquiry and openness to change	To carry out innovative cutting edge research and transfer technology forindustrial and Societal needs.	To imbibe moral and ethical values and develop compassionate, humane professionals
To prepare globally competent engineers, in response to rapid economical and technological growth	*	*	
Dynamic process of teaching-learning, research and sharing professional experiences for the betterment of the community	*	*	*

BASAVESHWAR ENGINEERING COLLEGE, BAGALKOT (AUTONOMOUS)
SCMEME OF TEACHING AND EXAMINATION FOR
MASTER OF TECHNOLOGY (M.Tech.)
ENVIRONMENTAL ENGINEERING

I SEMESTER

Sl.No	Sub. Code	Name of the Subject	C	Hours/week			Marks for		
				L	T	P	CIE	SEE	Total
1	PEV121C	Environmental Chemistry and Microbiology	4	4	0	0	50	50	100
2	PEV122C	Water Treatment Technology	4	4	0	0	50	50	100
3	PEV123C	Wastewater Treatment	4	4	0	0	50	50	100
4	PEV00XE	Elective – A	4	4	0	0	50	50	100
5	PEV00XE	Elective – A	4	4	0	0	50	50	100
6	PEV00XE	Elective – B	3	3	0	0	50	50	100
7	PEV124S	Seminar	1	0	0	2	50	50	100
Total			**24**	**23**	**0**	**2**	**350**	**350**	**700**

II SEMESTER

Sl.No.	Sub. Code	Name of the Subject	C	Hours/week			Marks for		
				L	T	P	CIE	SEE	Total
1	PEV221C	Solid waste Management	4	4	0	0	50	50	100
2	PEV222C	Industrial Wastewater Management	4	4	0	0	50	50	100
3	PEV00XE	Elective – A	4	4	0	0	50	50	100
4	PEV00XE	Elective – A	4	4	0	0	50	50	100
5	PEV00XE	Elective – A	4	4	0	0	50	50	100
6	PEV00XE	Elective – B	3	3	0	0	50	50	100
7	PEV223T	Term paper	1	0	0	2	50	50	100
Total			**24**	**23**	**0**	**2**	**350**	**350**	**700**

III SEMESTER

Sl.No.	Sub. Code	Name of the Subject	C	Hours/week			Marks for		
				L	T	P	CIE	SEE	Total
1	PEV00XE	Elective – A	4	4	0	0	50	50	100
2	PEV321 I	Industrial Training	4	0	0	8	50	50	100
3	PEV301L	Environmental Engg. Lab	2	0	0	4	50	50	100
4	PEV312P	Project phase-I	10	0	0	20	50	50	100
Total			**20**	**4**	**0**	**32**	**200**	**200**	**400**

IV SEMESTER

Sl.No.	Sub. Code	Name of the Subject	C	Hours/week			Marks for		
				L	T	P	CIE	SEE	Total
1	PEV431P	Project phase-II	20	0	0	40	50	50	100
Total			**20**	**0**	**0**	**40**	**50**	**50**	**100**

LIST OF ELECTIVES

Credits-04

Sl. No	Sub. Code	Name of the subject
1	PEV002E	Water Resources Engineering and Applied Hydraulics
2	PEV003E	Transport process and Modeling in Aquatic Systems
3	PEV004E	Advanced Computation Methods and Optimization
4	PEV007E	Environmental Planning and Management
5	PEV008E	Hazardous Waste Management
6	PEV011E	Occupational Safety and Health
7	PEV012E	Ecology and environmental Impact Assessment
8	PEV015E	Applied Statistics and Probability
9	PEV019E	Air pollution and control
10	PEV013E	Energy and Environmental
11	PEV021E	Global warming and climate change
12	PEV022E	Advanced atmospheric environmental engineering

Credits-03

Sl. No	Sub. Code	Name of the subject
1	PEV006E	Operation and Maintenance of Environmental Facility
2	PEV209E	Reuse – Recycle Technology
3	PEV010E	Environmental Biochemistry and Biotechnology
4	PEV016E	Biological Treatment of Wastewater
5	PEV018E	Remote Sensing and GIS applications in geo-environmental Engineering
6.	PEV020E	Non – point sources of pollution and management

ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY
4 Credits

Sub Code: PEV121C **CIE Marks : 50**
Hrs/ Week: 04 **SEE Marks : 50**

Course Outcomes:
Students will be able to
1. Design the appropriate technology on applying basics of environmental chemistry and microbiology to solve the environmental problems.
2. Apply the principles of Physical, Electrochemistry and Analytical chemistry in Environmental Engineering process.
3. Conduct experiments to evaluate water quality parameters.

UNIT-I
Importance of Environmental Chemistry, types of reactions, redox reactions, reaction kinetics, Electrochemistry and its application.
Physical and equilibrium chemistry fundamentals and applications, Trace Contaminants and their analyses. pH- Principle, Measurement, Numerical Examples, Buffers and Buffer index.

12hr

UNIT-II
Colloidal Chemistry - Properties of colloids, colloidal dispersions, stability of colloids and applications. Applications of Organic Chemistry in Environmental Engineering.
Colourimetry-Principles and applications. Applications of Analytical Chemistry-emission and absorption techniques.

12hr

UNIT –III
Microbiology – Microorganisms of importance in air, water and soil environment. Principles and applications of microscopy, microscopic flora and fauna of importance. Metabolism and metabolic pathways, Bioconcentration, Biomagnifications and Bioaccumulation. 14hr

UNIT - IV
Bacteria - Morphology, typical growth curve and generation time, Measurement Techniques-APC, MPN (Probability and Thomas methods).MFT, Monod's equation and its applications. Algae-morphology,classification and their importance. Fungi- Protozoa- morphology, classification and their importance, enzymes- classification, kinetics- Michaelis- Menten equation, factors, influencing enzyme reaction. Virology -Types, characteristics andenumeration methodology. 14hr

REFERENCES :
1. McKinney R.E. (1962) "Microbiology for Sanitary Enginers", Newyork McGraw Hill.

2. Sawyer C.N. and McCharty P. L., (2003) "Chemistry for Environmental Engineering and Science. 5th Edition, Tata McGraw Hill Publishing Co.Ltd., New Delhi.

3. Pelczar M.J. Chan ECS, Krieg, NR (1998) "Textbook of Microbiology" 5th edition Tata

McGraw Hill Publishing Co.Ltd., New Delhi.

4. Gaudy and Gaudy (1980) “Microbiology for Environmental Scientists and Engineers” McGraw Hill.

COs	**ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY (PEV121C) (C101)**	PO1	PO2	PO3
CO1	Design the appropriate technology on applying basics of environmental chemistry and microbiology to solve the environmental problems	3	0	1
CO2	Apply the principles of Physical, Electrochemistry and Analytical chemistry in Environmental Engineering process.	2	0	3
CO3	Conduct experiments to evaluate water quality parameters	2	0	3
	Average	**2.33**	**0**	**2.33**

WATER TREATMENT TECHNOLOGY
4 Credits

Sub Code : PEV122C **CIE MARKS : 50**
Hrs/Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:
Students will be able to

1. Demonstrate the understanding of wholesomeness of water and design a appropriate treatment unit.
2. Create the efficient distribution system of drinking water depending upon the sources of water.
3. Optimize all the necessary parameters by thoroughly understanding the water quality standards and principles of treatment systems for supplying the wholesome water to the population residing in that area.

UNIT – I

Wholesomeness of water, Sources of water, Necessity of treatment, objective of various water uses, Water quality guidelines and standards for various water uses. Principles and design of aeration systems – two film theory, mass transfer coefficients with various units and dimensionless parameters for mass transfer with numerical. Water in air systems, Air in water systems. 14hr

UNIT – II

Principles of Sedimentation – Types of settling and settling equations, design criteria and design of settling tanks with emphasis on numerical examples. Principles of coagulation and flocculation – types of coagulants,coagulant aids, coagulation theory, effects of pH, alkalinity etc., optimum dosage of coagulant, design criteria and numerical examples. Filtration – theory, types, hydraulics of filter bed, design criteria and design of filters, filter backwash with numerical examples.Operational problems and trouble shooting. Adsorption process – types, factors affecting adsorption, kinetics and equilibrium with numerical examples and problem solving. 14hr

UNIT - III

Disinfection – different types, disinfectants, factors affecting disinfection, effect of pH, methods of disinfection, chemistry of chlorination and numerical. Water softening – ions causing hardness, Langelier index, various methods. Fluoridation and Defiuoriation, Principles and Design. 12hr

UNIT - IV

Water quality in distribution systems, Operation and Distribution of treatment system.Bench scale and Pilot plant studies in water treatment, Rural water supply systems. 12hr

REFERENCES:

1. Fair, G. M., Gayer J.C and Okum, (1966), Water and Waste Water Engineering, Vol. II, John Wiley Publications.
2. Webber, W. J., (1975), Physico – Chemical Processes for Water Quality Control
3. Peavy, H.S., Rowe and Tchobonoglous, G., (1985), Environmental Engineering, McGraw – Hill.
4. Raju, B.S.N., (1995), Water Supply and Waste Water Engineering, Tata McGraw Hill
5. Santosh kumar Garg, Water Supply Engineering, Khanna Publishers, New-Delhi

COs	**Water Treatment Technology (PEV122C) C102**	PO1	PO2	PO3
CO1	Design Appropriate treatment methods for municipal and certain industrial effluents	3	-	2
CO2	Critically think about the operational problems of chemical and biological treatment units..	2	-	3
CO3	Apply simple design equations for water and wastewater treatment plant.	2	-	1
	Average	**2.33**	**-**	**2.0**

WASTEWATER TREATMENT
4 Credits

Sub Code : PEV123C **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1. Design Appropriate treatment methods for municipal and certain industrial effluents.
2. Critically think about the operational problems of treatment units.
3. Apply simple design equations for water and wastewater treatment plant.

UNIT – I

Introduction to wastewater treatment with objectives.Types, composition, properties and analysis of wastewater. Effluent standards for disposal into water bodies and land.Fundamentals of process analysis, reaction kinetics, mass balance analysis. Types of reactors and analysis - batch, plug flow, completely mixed, packed and fluidized bed reactor. 14hr

UNIT – II

Unit operations – Screens, grit chamber, primary settling and oil & grease removal – Theory and design. Chemical unit processes – Coagulation and precipitation, oxidation and. Neutralization. 12hr

UNIT – III

Biological unit process – Aerobic processes: Theory and design of activated sludge process, trickling filter, rotating biological contactor, oxidation pond, oxidation ditch and lagoons. Anaerobic processes: Fundamentals, up flow anaerobic sludge blanket (UASB) reactor and anaerobic filter (AF). 14hr

UNIT – IV

Sludge characteristics and treatment – Thickening, digestion (detailed), conditioning, dewatering, drying and incineration. Nutrient removal: Nitrogen and phosphorous removal.
12hr

REFERENCES:

1. Metcalf and Eddy- Wastewater Engineering, Tata McGlaw Hill Publishing Company Ltd., New Delhi 2003
2. Eckenfelder and 0' Conner - Biological Waste treatment.
3. Gaudy – Advanced Waste Water treatment
4. Ramalho, R. S. 1983. Introduction to Wastewater Treatment Processes. New York: Academic Publishers
5. Karia G.L. and Christian R.A. "Wastewater Treatment Concepts and Design Approach" Prentice Hall of India Pvt., Ltd., New Delhi (2001)
6. Santoshkumar Garg. "Sewage Disposal and Air Pollution Engineering" Khanna Publishers New Delhi 2006
7. Punmia B. C. and Arunkumar Jain, "Environmental Engineering II", Laxmi Publishers Pvt. Ltd, New Delhi, 2000
8. Howard S. Peavy, Donald R. Rowe, George T, "Environmental Engineering", McGraw Hill, International editions, 1985.

COs	**Wastewater Treatment (PEV123C)C103**	PO1	PO2	PO3
CO1	Design Appropriate treatment methods for municipal and certain industrial effluents.	3	0	2
CO2	Critically think about the operational problems of treatment units..	2	0	3
CO3	Apply simple design equations for water and wastewater treatment plant	2	0	1
	Average	**2.33**	**0**	**2.0**

SOLID WASTE MANAGEMENT

4 Credits

Sub Code : PEV221C **CIE Marks : 50**

Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1. Apply the basic scientific and sustainability principles behind waste management, for solving practical waste management challenges
2. Evaluate the fundamental principles of existing and emerging technologies for the treatment of waste and recovery of value from waste.
3. Appreciate the increasing importance of waste and resource management in achieving environmental sustainability.

UNIT – I

Land pollution- Definition and scope, necessity and importance, solid waste - definition, sources, classification and characteristics, Generation and Quantification.

Collection & Transport-Collection equipments, systems of collection, transfer stations, bailing and compacting. 12hr

UNIT – II

Sanitary land filling- Definition, methodology, trench, area, ramp, pit method, site selection, basic steps involved, cell design, prevention of site pollution, Leachate treatment, gas collection and recirculation.

Disposal Methods-Types and suitability selection of site,Ocean disposal, feeding to hogs- merits and demerits. 14hr

UNIT – III

Composting-Aerobic and anaerobic. Composting, Factors affecting composting Indore and Bangalore processes of composting. Incineration- Processes 3Ts to control high temperature incinerators, design approach prevention of air pollution. Pyrolysis- Process, basic steps involved, end product, Pyrolysis of specific solid waste. 14hr

UNIT – IV

Recycle and reuse- material and energy recovery operation, pyrolysis of specific solid waste.

Management of toxic solid waste recent innovations. Biomedical waste and E-Waste Management. 12hr

REFERENCES:

1. J.L Pavoni, Hand Book of Solid Waste Disposal.New York .1975
2. Solid Waste Management, Van Nostrand Reinhold Co. 1975.
3. G. Tchobanoglous, H. Theisen and R. liliaissen, Solid waste Engineering, Principles and Management issues, McGraw Hill, New York 1977.
4. C.L. ell, Solid Waste Management, John Wiley, 1975.
5. P.W. Powers. How to dispose of toxic substances and industrial Waste, Noyes Data Corporation, England, 1976.
6. CPHEEO manual on solid waste management. 2010

COs	**Solid Waste Management (PEV221C) C202**	PO1	PO2	PO3
CO1	Apply the basic scientific and sustainability principles behind waste management, for solving practical waste management challenges	2	0	2
CO2	Evaluate the fundamental principles of existing and emerging technologies for the treatment of waste and recovery of value from waste.2	2	0	3
CO3	Appreciate the increasing importance of waste and resource management in achieving environmental sustainability	3	0	2
	Average	**2.33**	**0**	**2.33**

INDUSTRIAL WASTEWATER MANAGEMENT

4 Credits

Sub Code : PEV222C **CIE Marks : 50**

Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1. Assess the impact of industrial waste discharges on the water quality of stream and take the necessary measures to protect the water quality. Analyze the economics of industrial wastewater treatment vis -a- vis water quality of the stream for its best designated uses.
2. Implement the modern technical tools like waste minimization, strength reduction etc, in efficient and cost effective practice. Utilize the byproducts generated in these techniques to enhance the economics of the treatment process.
3. Demonstrate the understanding of green environment and practicing the environmental friendly processes for the manufacture of various industrial products like diary, Pharmaceuticals, petroleum etc, and also implementing the state-of-art technologies for wastewater treatment.

UNIT – I

Effects of industrial waste water on receiving water bodies, Effect of organic wastes on the DO profile of the stream, Streeter Phelps model, oxygen sag curve and numericals thereupon. Receiving water quality protection measures – receiving water quality standards and stream quality control, Sample-Grab, composite and integrated samples, stream sampling. Economics of industrial waste water treatment systems –primary/secondary benefits, intangible benefits, Quantification of benefits, Relationship of treatment cost to benefits. 14hr

UNIT – II

Waste minimizing techniques– Volume reduction, Strength reduction, Neutralization, Equalization and Proportioning, Removal of suspended, colloidal, inorganic and organic dissolved solids. Treatment and disposal of sludge solids, Sludge characteristics, Sludge volume and solids content relationship. 12hr

UNIT – III

Manufacturing process, waste water characteristics, treatment and disposal of waste water of following industries: Dairy, Distillery, Sugar, Textile, Paper and pulp, Pharmaceutical, Fertilizer.

12hr

UNIT – IV

Effects of industrial waste water on sewage treatment plants, Limiting values for discharge into municipal sewer systems, Joint treatment of industrial and domestic waste water, Membrane filter, electro dialysis and bioremediation techniques of waste water treatment. Radioactive waste treatment, Environmental auditing,Regulatory norms for waste water treatment, present scenario of waste water treatment in India.

14hr

REFERENCES

1. Nemerow N. N., Liquid waste of industry theories, practices and treatment, Addison Willey, New York, 1971.

2. Azad N. S., Industrial waste water management handbook, Mc Graw Hill book, co. New York.

3. Ross R. D., Industrial waste disposal, Reinhold environmental series, New York, 1968

4. Eckenfelder, W.W., "Industrial Water Pollution Control", McGraw-Hill, 1999.

COs	**Industrial Wastewater Management(PEV222C) C201**	PO1	PO2	PO3
CO1	Assess the impact of industrial waste discharges on the water quality of stream and take the necessary measures to protect the water quality. Analyze the economics of industrial wastewater treatment vis -a- vis water quality of the stream for its best designated uses.	3	0	2
CO2	Implement the modern technical tools like waste minimization, strength reduction etc, in efficient and cost effective practice. Utilize the byproducts generated in these techniques to enhance the economics of the treatment process	2	0	3
CO3	Demonstrate the understanding of green environment and practicing the environmental friendly processes for the manufacture of various industrial products like diary, Pharmaceuticals, petroleum etc, and also implementing the state-of-art technologies for wastewater treatment.	3	0	2
	Average	**2.66**	**0**	**2.33**

ENVIRONMENTAL ENGINEERING LAB

01 Credits

(0-0-4)

Sub Code : PEV301L **CIE MARKS : 50**

Hrs/Week: 4 **SEE Marks: 50**

LIST OF EXPERIMENTS

1. Testing of water and wastewater i) Physical characteristics ii) Chemical characteristics iii) Biological characteristics

2. Sampling and analysis of Ambient air

3. Solid waste and leachate analysis

4. Geoenvironmental parameters

i) Pollutant sorption capacity characterization ii) Soil permeability for contaminant flow

iii) Lime and cement stabilization of soil, leaching and compressive strength measurements

5. Demonstration of Arc-GIS and its applications in environmental Engineering

REFERENCES:

1. US EPA publication SW-846: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 1996.
2. BIS Compendium on Engineering Properties of Soil
3. AWWA and APHA new edition –standard procedures for analysis of water and wastewater samples.
4. CPHEEO manual on solid waste management. 2015

COs	**ENVIRONMENTAL ENGG LAB (PEV301L)**	PO1	PO2	PO3
CO1	Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems.	3	1	2
CO2	Statistically analyze and interpret laboratorial results	2	1	3
CO3	Apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions	1	3	2
	Average	**1.66**	**1.66**	**2.33**

ELECTIVES

WATER RESOURCES ENGINEERING AND APPLIED HYDRAULICS
4 Credits

Sub Code: PEV002E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:
Students will be able to

1. Evaluate and analyze hydrological systems and processes at a wide range of scales in both space and time for the purpose of water resources assessment, natural hazard assessment and mitigation, and environmental planning and management.
2. Estimate rainfall, optimum rain gauges and consistency with the concept hydrology, Analysis of hydrograph, low and high flows, Estimate discharge in rivers, streams and overland peak flows, design of storm drains and outfall sewer.
3. Apply the concepts of hydraulics to design water mains, steady state groundwater problems.

UNIT – I

Water resources of the world. Surface and ground water resources of India and Karnataka National Water Policy Act.Multiple uses of water resources.
Hydrology- Introduction, Hydrologic cycle including quantity and quality, estimation of precipitation and rain guage density. 12hr

UNIT – II

Hydrograph Theory- Unit hydrograph, assumptions, Derivation of unit hydrographs,S-hydrograph and synthetic hydrograph, Flow routing –Muskingham method, Low flow analysis.
Urban Hydrology- Run- off estimation, design of Storm water drains. Basics and applications of Remote Sensing in Water Resources. 14hr

UNIT – III

Unsteady Flow through Conduits-Water hammer analysis - Analytical and Graphical methods, Water hammer protection methods.
Flow Measurements-Stream gauging, weir method, End - Depth method, Chemical method, Tracer method, Ultrasonic method, Flumes etc. 14hr

UNIT – IV

Groundwater- Basic equations of flow. Flow into wells in unconfined and confined aquifers under steady and unsteady conditions, Sea water intrusion. Artificial recharge, Groundwater pollution. Bore wells - types and design principles. 12hr

REFERENCES:

1. Ven TE. Chow - Hand book of Applied hydrology.
2. Todd - Ground water hydrology, John Willey New York 2001
3. Ranganath .H.M. - Advanced hydrology.
4. Subramnya.K.S. - Advanced hydrology.
5. Ven .TE. Chow - Open channel hydraulics, Mc Graw Hill Book Co-Singapur 1973
6. Hammer M.J. and Mackichan .K.A. - Hydrology and quality of water resources.
7. Sabins - Remote Sensing.
8. Thomann and Muller - Principles of Water quality modeling, Estuary section 3.l.
9. Ram S. Gupta, Hydrology and Hydraulic System,
10. John Permankian, Water Hammer Analysis.

COs	**Water resources engineering and applied hydraulics (PEV002E)**	PO1	PO2	PO3
CO1	Evaluate and analyze hydrological systems and processes at a wide range of scales in both space and time for the purpose of water resources assessment, natural hazard assessment and mitigation, and environmental planning and management.	3	0	1
CO2	Estimate rainfall, optimum rain gauges and consistency with the concept hydrology, Analysis of hydrograph, low and high flows, Estimate discharge in rivers, streams and overland peak flows, design of storm drains and outfall sewer	2	0	3
CO3	Apply the concepts of hydraulics to design water mains, steady state groundwater problems	3	0	2
	Average	**2.66**	**0**	**2.0**

TRANSPORT PROCESSES AND MODELLING OF AQUATIC SYSTEMS

4 Credits

Sub Code : PEV003E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1. Develop the most appropriate comprehensive tools in environmental management for prediction and analysis about the water quality of the river bodies' vis-à-vis industrial waste discharge into the surface water.
2. Develop the state of art modeling for prediction and analysis by applying the techniques of I-D Oxygen balance models, steady state 2-D analysis etc.
3. Management of surface water bodies by application of various techniques like specialized water quality surveys, Parameter estimation etc.

UNIT – I

Models as Comprehensive tools in Environmental Management Advection, Diffusion and Dispersion - Definition, Molecular turbulent and shear diffusion, Derivation of Fick's laws of diffusion and convective - diffusion equations for turbulent and shear flow regimes. 12hr

UNIT – II

Steady state water quality modeling. Models for decaying pollutants (bacteria, phenol, ammonia) in rivers. I-D Oxygen balance models -Streeter- Phelps equation, critical point method. Calibration and verification of I-D Oxygen model. Mixing Zones in rivers- definition, steady state 2-D analysis with pipe and diffuser outfalls. 12hr

UNIT – III

Data collection specialized water quality surveys based on statistical average concepts. Estimation of parameters - decay and re-aeration rates. field study methodology. Parameter estimation - Lateral Mixing co- efficient - critical point method - derivation and examples.

Dissolved Oxygen models for lakes under completely mixed and stratified conditions, Ocean disposal of wastewater - siting and design of outfalls. Near field and far field mixing with simple examples. 14hr

UNIT – IV

Eutrophication Models - simplified nutrient loading models for rivers and lakes. Ground water quality modeling concepts - formulation of 1-D and 2-D models with decay and retardation for instantaneous sources, Non point sources of pollution, Analytical modeling for plume delineation studies from point sources. 14hr

REFERENCES:

1. RichLG. EnvironmentalSystemsEngineeringMcGrawHill-1972.
2. Thomas R.V. - Systems Approach to water quality management McGrawHill-1980.
3. Biswas A.K. – Models for water quality management- McGraw Hill 1980.
4. Rinaldi S.D.and Soncini, R- Modelling and Control of river water quality McGraw HilI-1979.
5. Gower A.M. - Water quality in catchment ecosystems john wiley - 1980.
6. Thomann and Mueller 1986., Principles of water quality management and control- Harper and Row pubs.
7. Hazen and Cherry, Ground Water Quality.
8. Velz LZ. Applied Stream Sanitation.

COs	**TRANSPORT PROCESSES AND MODELLING OF AQUATIC SYSTEMS (PEV003E)**	PO1	PO2	PO3
CO1	Develop the most appropriate comprehensive tools in environmental management for prediction and analysis about the water quality of the river bodies' vis-à-vis industrial waste discharge into the surface water	2	0	2
CO2	Develop the state of art modeling for prediction and analysis by applying the techniques of I-D Oxygen balance models, steady state 2-D analysis etc	2	0	3
CO3	Management of surface water bodies by application of various techniques like specializedwater quality surveys, Parameter estimation etc	2	0	2
	Average	**2.0**	**0**	**2.33**

ADVANCED COMPUTATIONAL METHODS AND OPTIMIZATION

4 Credits

Sub Code : PEV004E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1.Apply statistical techniques to examine data.

2.Solve engineering problems that involve constrained resource allocation.

3.Solve the governing equations of partial differential in nature applied to engineeringproblems.

UNIT – I

Numerical Methods-Newton-Raphson method for solution of simultaneous equations. Numerical solutions of partial differential equations.Finite difference, Finite element method and method of characteristics. Explicit and implicit methods to solve simple parabolic differential equations, convergence, Boundary value problems and successive over relaxation methods. 14hr

UNIT – II

Optimization-Definition and classification of optimization problems. Its importance in Environmental Studies.Single and multivariable optimization without and with constraints. Linear Programming - standard form of problems - pivotal reduction of equations. Single and Two phase simplex methods. Piece wise linear approximation of non - linear optimization. 14hr

UNIT – III

Statistics and Probability-Frequency Distribution - Characteristics of Distributions: Central Tendency and Dispersion, Concepts of Probability-Binomial, Poisson and Normal Distribution – Applications. 12hr

UNIT – IV

Method of Least Square and Regression - Multiple Regression - The Chi- squared test, F test, T-test. Analysis problems using Computer Programming.

12hr

REFERENCES:

1. Antony Raiston Philip Rabinowitz-A First Course in Numerical Analysis,Mc Graw Hill New Delhi 1984
2. Brice, Luther N.A. and James O. Wilkes - Applied Numerical Methods.
3. Stanton. R.G.- Numerical Methods for Science and Engineers.
4. Beveridge- Optimization techniques.
5. Rao. S.S. – Optimization New Age International (P) Ltd., New Delhi 2003
6. Desai C.S. and John FAbel - Introduction to the Finite Element Method, CBS, New Delhi 1987
7. Sienk iowics O.C.-The Finite Element Method, Zienkiewica,O.C. Butter Worth. Boston 2000 Statistical Hydrology
9. Ram S. Gupta ,Hydrology and Hydraulic Systems,"3rd"Edition.,Prentice-Hall. Taha, Optimization.

COs	**Advanced computational methods and optimization (PEV003E)**	PO1	PO2	PO3
CO1	Apply statistical techniques to examine data.	2	0	2
CO2	Solve engineering problems that involve constrained resource allocation.	3	0	3
CO3	Solve the governing equations of partial differential in nature applied to engineering problems.	1	0	2
	Average	**2.0**	**0**	**2.33**

ENVIRONMENTAL PLANNING AND MANAGEMENT
4 Credits

Sub Code : PEV007E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:
Students will be able to
1. Create the awareness in the concerned management about the significance of sustainable environment, resource utilization, regional planning etc, and make the environmental decisions about new projects keeping in view the above factors.
2. Develop the most appropriate policies and planning for environmental protection by making proper environmental cost benefit analysis.
3. Develop the skills and knowledge for the certification of industrial units from the reputed international certifying agencies like ISO14000 and also carry out the environmental auditing of air, water and soil.

UNIT – I

Environmental and Sustainable Development- Concept of Carrying capacity, Relation among quality of life, carrying capacity and resource utilization.
Engineering Methodology in Planning and its Limitations: Carrying capacity based short and long term regional planning. 14hr

UNIT – II

Environmental Protection - Economic development and social welfare consideration in socio economic developmental policies and planning. Total cost of development and environmental protection cost.Case studies on Regional carrying capacity -National Capital Region– Delhi area.

14hr

UNIT – III

Engineering Economics- Value Engineering, Time value of Money, Cash Flows. Budgeting and Accounting. Cleaner Technologies and their roles in Environmental Protection. 12hr

UNIT – IV

Total Quality Management in Environmental Management and Protection-ISO 14000 Series of Standards. Environmental Audit -Air, Water, Solid and its importance in Environmental Management.

12hr

REFERENCES:

1. Danoy G. E. and Warner R.F"Planning and Design of Engineering Systems". Unwin Hyman Publications. 1969.
2. Chanlett,"Environmental Protection" .McGraw Hill Publication, New Delhi 1975
3. Lohani B. N. "Environmental Quality Management", South Asian Publications
4. Heinke et aI., "A Text book of Environmental Engineering".
5. Journal of Indian Association for Environmental Management, 1995-1997.
6. MOEF. Government of India, Carrying Capacity Based Developmental Planning Studies for the National Capital Region,1995-96.
7. NEERI, Nagpur, Annual Reports 1995 and 1996.
8. Peurifoy R.L., Construction Planning Equipment and Methods, 1979.McGraw Hill.
9. Environmental Engineering and Management, Suresh. K.Dhaneja.2000 S.K. Kataria andSons.

COs	**ENVIRONMENTAL PLANNING AND MANAGEMENT (PEV007E)**	PO1	PO2	PO3
CO1	Create the awareness in the concerned management about the significance of sustainable environment, resource utilization, regional planning etc, and make the environmental decisions about new projects keeping in view the above factors.	2	0	1
CO2	Develop the most appropriate policies and planning for environmental protection by making proper environmental cost benefit analysis.	2	0	2
CO3	Develop the skills and knowledge for the certification of industrial units from the reputed international certifying agencies like ISO14000 and also carry out the environmental auditing of air, water and soil.	2	0	2
	Average	**2.0**	**0**	**1.66**

HAZARDOUS WASTE MANAGEMENT

4 Credits

Sub Code : PEV008E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks :50**

COURSE OUTCOMES:

Students will be able to

1. Assess the special characteristics of hazardous waste material generated from different industries. Understand the rules and regulations for management of hazardous wastes and take suitable steps for recover and rehabilitate abandoned the hazardous waste sites.
2. Reduce the risks of handling and managing the hazardous waste by scientifically understanding and practicing the treatment of hazardous waste by various physico-chemical treatment methods like air stripping, aerobic and anaerobic treatment etc.
3. Demonstrate the understanding of the various rules and regulations for safe transportation, handling and management of hazardous waste materials.

UNIT – I

Introduction- Definition, Sources and Classification , Land mark episodes (DDT, Mercury, PCB and PBB, Bhopal Gas Tragedy) Large and Small quantity Generators, Hazardous Waste Characterization, Corrosivity, Reactivity, Toxicity, EPA-designated hazardous wastes, Assessment of Hazardous Sites. Waste Minimization and Resource Recovery- Approaches to waste Reduction, Benefits of hazardous waste reduction, priorities in hazardous waste management, Regulations for Hazardous Waste Management - The superfund, CERCLA and SARA Acts, The Superfund process, NPL, Hazard Ranking system (HRS), Cleanup standards. 14hr

UNIT – II

Physico-Chemical treatment processes – Air stripping, Carbon adsorption, Steam stripping, chemical oxidation, Biological treatment. Biodegradation of Xenobiotics, Compound biodegradability, Aerobic Vs Anaerobic treatment, Microbial Growth requirements. Thermal methods, Chemistry of incineration, Thermodynamics of incineration, Design factors for incineration, Three T’s, Stochiometry and Combustion calculations, Incinerators-Merits and Demerits, TSCA and RCRA Incineration standards, Liquid Injection Incinerators, Atomizers, Design considerations, Solid waste Incinerators, Grate type and Hearth type, Rotary kiln incinerator with horizontal and vertical secondary combustion chambers, Fluidized Bed Incinerator. 14hr

UNIT – III

Transportation of Hazardous Waste - Regulations,Containers for Hazardous Materials, Bulk and Non-bulk Transport, Hazardous Substances Emergency Response. 12hr

UNIT – IV

Land-Fill Disposal-Landfill as disposal sites, Developing a new facility. Siting a Landfill, Design considerations, Operating a landfill.Site Remediation-Site Assessment and inspection, The hazardous system and the national priority list. Remedial Action, Monitoring of Disposal Sites. 12hr

REFERENCES:

1. Wentz CA., "Hazardous Waste Management", McGraw Hill, 1989.
2. LaGrega M.D., Mercer, "Hazardous Waste Management", 2ndEdition, McGraw Hill 2001.
3. Davis. Cornwell, "Introduction to Environmental Engineering" 3rd edition, McGraw Hill1998.

COs	**HAZARDOUS WASTE MANAGEMENT(PEV008E)**	PO1	PO2	PO3
CO1	Assess the special characteristics of hazardous waste material generated from different industries. Understand the rules and regulations for management of hazardous wastes and take suitable steps for recover and rehabilitate abandoned the hazardous waste sites.	2	0	2
CO2	Reduce the risks of handling and managing the hazardous waste by scientifically understanding and practicing the treatment of hazardous waste by various physico-chemical treatment methods like air stripping, aerobic and anaerobic treatment etc.	3	0	2
CO3	Demonstrate the understanding of the various rules and regulations for safe transportation, handling and management of hazardous waste materials.	3	0	2
	Average	**2.66**	**0**	**2.0**

OCCUPATIONAL SAFETY AND HEALTH

4 Credits

Sub Code : PEV011E **CIE Marks :50**
Hrs/ Week : 04 **SEE Marks :50**

COURSE OUTCOMES:

Students will be able to

1. Design policies and regulations **for** the development and maintenance of a healthy and safe work environment.
2. To interpret and apply legislative requirements, industry standards, and best practices in a variety of workplaces and apply risk management principles to Anticipate, identify, evaluate and control physical, chemical, biological and psychosocial hazards
3. To affect/manage change by advancing OH&S principles within management systems, cultures, practices, and priorities

UNIT – I

Introduction- History and Development, Occupational Safety and Health Act. Occupational Safety and Health Administration, Right to know Laws.

Accident Causation-Need for Accident Investigation, Accident investigation plan, Methods of acquiring Accident Facts, Correcting Missing Skills, Investigator Tendencies and Characteristics, Supervisory Role in Accident investigation. Human Error Model,Petersew's Model, Epidemiological Models.

Ergonomics- Ergonomics at work place, Ergonomic Task Analysis,Preventing Ergonomic Hazards, Setting up of Ergonomics Programme. 14hr

UNIT – II

Occupational Hazard and Control- Hazard Analysis, Human Error Analysis in Causation with Hazard Analysis, Fault Tree Analysis, Emergency Response. Decision for Action, Purpose and Considerations, Right Decision, Wrong Remedy, Hazard Control Measures, Hazards and their Control in Pharmaceutical, Construction, Textiles, Petroleum Refineries and LPG Bottling, Iron and Steel industries. 12hr

UNIT – III

Fire prevention and Protection-Fire Development and its Severity effects.Enclosure, need for early Detection of Fire, Extinguishing Fire Electrical Safety Product Safety, Technical

Requirements of Product Safety Programme.Environmental Safety and ISO 14000 ISO series of standards, ISO 14001 Standards, Environmental Management systems. (EMS) Total quality Management (TQM) and Total safety Management (TSM). 14hr

UNIT – IV

Occupational Health - Health and Safety Considerations, Personal Protective Equipments, Effects of Exposure and Treatment for Metal Working Trades, Municipal Solid Waste, Epoxy Resins, Foundries.Occupational Health and Safety Considerations in Wastewater Treatment Plants. 12hr

REFERENCES:

1. David L. Goetsch. "Occupational Safety and Health" for Technologists, Engineers and Managers, 3rd Edition. Prentice Hall.

2. David. A. Calling - Industrial Safety Management and Technology, Prentice Hall, New Delhi.

3. Della D. E. and Giustina, Safety and Environmental Management. Van Nostrand ReinholdInternational Thomson Publishing Inc, 1996.

4. Trevethick R. A. Environmental and Industrial Health Hazards,William Heinemann MedicalBooks Ltd., London (1973).

COs	**OCCUPATIONAL SAFETY AND HEALTH (PEV011E)**	PO1	PO2	PO3
CO1	Design policies and regulations for the development andmaintenance of a healthy and safe work environment.	1	0	2
CO2	To interpret and apply legislative requirements, industry standards, and best practices in a variety of workplaces and apply risk management principles to anticipate, identify, evaluate and control physical, chemical, biological and psychosocial hazards.	3	0	2
CO3	To affect/manage change by advancing OH&S principles within management systems, cultures, practices, and priorities.	2	0	2
	Average	**2.0**	**0**	**2.0**

ECOLOGY AND ENVIRONMENTAL IMPACT ASSESSMENT

4 Credits

Sub Code : PEV012E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1. Identify different Components of ecosystem and their interactions and interrelationships.
2. Outline the systematic process for environmental impact assessment along with different methodologies.
3. Identify and assess the impacts on environmental attributes from developmental projects, Explain importance of Public participation, EMP and DMP in EIA process.

UNIT – I

Ecology-Classification of Ecosystem,terminology concepts of Ecology.Sub-divisions in Ecology. Biotic and Abiotic components, Structure and functions of ecosystems. Energy flow in Ecosystems. Measurement of primary production. Ecological Niche and succession.Population Ecology community Ecology, Habitat Ecology. Biogeochemical cycles, Ecological pyramids. 12hr

UNIT – II

Aquatic and Terrestrial Ecosystems, Dominance and Diversity Indices Adaptations, Biogeography, Systems Ecology and Ecosystem modeling.Oligotrophy, Eutrophic status, Nutrient enrichment-Analysis of Eutrophication-Vollenweider and Dillon models of Phosphorous loading on lakes. Control of Eutrophication. 12hr

UNIT – III

Environmental Impact Assessment- Developmental Activity and Ecological factors. EIA, EIS, FONSI, Need for EIA Studies, Base line information, Step - by-step procedure for conducting EIA, limitations of EIA. Frame work of Impact Assessment, development projects in environmental setting.Objective and scope of EIA. Contents of EIA,Methodologies, techniques of EIA.

Assessment and Prediction of impacts on Attributes air, water, noise, land, ecology soil, cultural and socio-economic environment, IAA guidelines for development projects, REIA-CEIA.
14hr

UNIT – IV

Public participation in environmental decision making.Practical considerations in preparing Environmental Impact Assessment and Statements.

Salient features of the project activity - Environmental parameter - Activity relationships - matrices. EIA for water resource development projects, Nuclear power plant project, Mining project (Coal, Aluminium, iron ore, Bauxite) Thermal Power Plant (Coal-based) project, Pharmaceutical industries, etc. 14hr

REFERENCES:

1. Odum - Fundamentals of Ecology- Addition Co.2004

2. Kormondy - Concepts of Ecology - Printce hall publication PHI New Delhi 2005

3. AnantakrishnaanT. N- Bio-resources Ecology- Oxford and IBM.

4. Krebs J. - Ecology - The experimental analsis of distribution and abundance-II Edition Harper international.

5. Munn RE. (ed) Environmental Impact Assessment John Willey. 1975

6 Canter L - Environmental Impact Assessment McGraw Hill, Newyork 1977.

7. Clark B. c. Bisett and Tomlinsan P - Perspective on environmental Impact Assessment - Allied Publishers - 1985

COs	**ECOLOGY AND ENVIRONMENTAL IMPACT ASSESSMENT (PEV012E)**	PO1	PO2	PO3
CO1	Identify different Components of ecosystem and their interactionsand interrelationships.	1	0	1
CO2	Outline the systematic process for environmental impact assessmentalong with different methodologies.	3	0	2
CO3	Identify and assess the impacts on environmental attributes from developmental projects, Explain importance of Public participation,EMP and DMP in EIA process.	2	0	2
	Average	**2.0**	**0**	**1.66**

ENERGY AND ENVIRONMENT

4 Credits

Sub Code : PEV013E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1. Outline the need and application of various alternative fuels
2. Apply various methods/technologies to harness various renewable energy sources and non-renewable energy sources.
3. Collect data to understand the energy scenario of renewable and non-renewable energy sources.
4. Critically think about the global climatic changes-causes and effects

UNIT- I

Introduction-Global energy, Environmental resources, energy needs, energy crisis. Indian scenario- Energy consumption, needs and crisis. 12hr

UNIT-II

Energy production, utilization, Laws and Principles. Renewable sources of energy and Environmental aspects -- Bio gas, Bio- Mass. Wind Energy. Hydro power, ocean energy, solar energy, agricultural waste derived energy. 14hr

UNIT-III

Non renewable sources of energy and Environmental aspects – energy from coal, oil, natural gas, Nuclear energy, geothermal energy. 12hr

UNIT-IV

Global temperature, Green house effects, global warming. Acid rain - Causes, effects and control methods. Regional impacts of temperature change. 14hr

REFERENCES:

1. Wilber LC. "Hand book of Energy Systems" Engineering Wiley and Sons 1989

2. Master G.M. "Introduction to Environmental Engineering and Science" Gilber M Masters Publisher Pearson New Delhi 2006

3. Sincero and Sincero, Environmental Engineering - A design approach: Prentice Hall of India, (1999)

4. Rao and Parulekar RR Energy Technology- Non-conventional Renewable and Conventional, Second Edition Khanna Publication 1997.

COs	**ENERGY AND ENVIRONMENT (PEV013E)**	PO1	PO2	PO3
CO1	Outline the need and application of various alternative fuels	1	0	3
CO2	Apply various methods/technologies to harness various renewable energy sources and non-renewable energy sources	3	0	2
CO3	Collect data to understand the energy scenario and demonstrate the understanding the concept of climaticchanges.	1	0	2
	Average	**1.33**	**0**	**2.66**

APPLIED STATISTICS AND PROBABILITY

4 Credits

Sub Code : PEV015E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1. Understand systems, analysis, concepts and techniques applied to engineering problems.
2. Effectively communicate systems methods and modeling results
3. Solve challenging engineering problems that involve constrained resource allocation.

UNIT – I

Empirical statistics-Measures of central tendency, dispersion, Skewness and Kurtosis – Principle of least squares – correlation and regression – rank correlation. 12hr

UNIT – II

Sampling distributions and estimation-Sampling distributions – Point and interval estimates for population proportions, mean and variance- Maximum likelihood estimate method – Method of moments 12hr

UNIT – III

Testing of hypothesis -Basic definitions of statistical hypothesis – Tests based on Normal, t, Chi-square and F distributions – Analysis of variance – One way and Two way Classifications.

Design of experiments- Completely randomized design – Randomized block design – Latin square design – 22 factorial design. 14hr

UNIT – IV

Probability and random variables -Probability - Random Variables - Moments – Standard Distributions – Moment Generating Function – Functions of random variables – Two dimensional random variables – Multiple and partial correlation and Regression. 14hr

REFERENCES:

1. Brethouex, P.U., “Statistics for Environmental Engineers”, Lewis Publ., 1994.
2. Johnson, R.J. “Miller & Freund’s Probability and Statistical for Engineers“ 6th Edition, Prentice – Hall of India, Private Ltd., New Delhi, 2002.
3. Ang, A.H.S. and Tang W.H., “Probability concepts in Engineering Planning and Design” – Basic principles Vol. John Wiley and Sons, Inc. New Delhi, 1975.
4. Gupta, S.C. and Kapoor, V.K. “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 2001.
5. Taha, H.A., “Operations Research: An Introduction”, Seventh Edition, Pearson Education Edition, Asia, New Delhi, 2002.

COs	**APPLIED STATISTICS AND PROBABILITY (PEV015E)**	PO1	PO2	PO3
CO1	Understand systems, analysis, concepts and techniques applied to engineering problems.	3	0	2
CO2	Effectively communicate systems methods and modelingresults	1	0	2
CO3	Effectively communicate systems methods and modelingresults	3	0	2
	Average	**2.33**	**0**	**2.0**

AIR POLLUTION AND CONTROL

4 Credits

Sub Code : PEV019E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1.Identify anthropogenic sources and atmospheric effects to pollutions

2.Demonstrate the Understanding of Regional, global pollution transport mechanisms.

3.Develop the pollution control devices:

UNIT – I

Introduction- Definitions, Different Classification of air pollution sources, emission inventory classification Case histories of Air Pollution Episodes, Air Pollution Laws, Characterization and sampling of atmospheric pollutants (Sampling train).

Monitoring of particulates, Procedures, carbon monoxides, Hydrocarbons, Oxides of Sulphur and Oxides of Nitrogen as per CPCB.

Analytical methods for quantifying particulates, organic vapours and metals of environmental concern. Effects of Air Pollutants on materials and human health and injury to vegetation, National ambient Air quality standards, criteria and indices. 14hr

UNIT – II

Meteorology- Composition and structure of the atmosphere, wind circulation, solar radiation, Adiabatic Lapse Rate, ELR, Atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), Temperature inversions, Heat island effect, wind rose diagram,' General Characteristics of stack emission, plume behavior. 12hr

UNIT – III

Air Quality Modeling- Fixed box models, Gaussian Dispersion model, plume rise, stack design, Maximum Ground level Pollutant concentrations, Concentrations along plume line, calculation of effective stack height, Down wind pollutant concentrations under temperature inversion.

Particulates-Collection mechanism and efficiency, deposition of particulates from stacks, Hood and Duct design. Particulate Pollution Control equipment Design considerations of setting chambers, Cyclone separators, Wet collectors, Fabric filters, Electrostatic precipitators. 14hr

UNIT – IV

General Control-General Control of gases and vapors processes and their kinetics, Introduction to indoor air pollution Hydrocarbons in atmospheric photochemistry, Oxidants in Photochemical smog. Introduction to noise pollution and its control. 12hr

REFERENCES:

1. Perkins- Air Pollution.,McGraw Hill Higher Education (1 Jan 1974)
2. Kenneth Wark and Cecil F Warner - Air Pollution - its origin and control, Harper and Row, Publishers, New York.
3. Environmental Engineers Hand Book, Edition- Liptak Chilton Book Co. USA
4. Magill, Holden and Ackley - Air Pollution hand book, Mc Graw Hill New York 1956
5. Stern A.c. (ed) Vol. V- Air Quality Management.
6. Seinfeld N.J. - Air Pollution McGraw Hill 1975.
7. M N Rao and HVN Rao, Air Pollution" Tata Mc Graw Hill publication

COs	**AIR POLLUTION AND CONTROL (PEV019E)**	PO1	PO2	PO3
CO1	Identify anthropogenic sources and atmospheric effects to pollutions.	3	0	2
CO2	Demonstrate the Understanding of Regional, global pollution transport mechanisms.	3	0	2
CO3	Develop the pollution control devices:	3	0	2
	Average	**3.0**	**0**	**2.0**

GLOBAL WARMING AND CLIMATE CHANGE

4 Credits

Sub Code : PEV021E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1. Measure climate factors and how they change
2. Identify effects of climate change on biodiversity and ecosystems in different biomes and aquatic systems and the model possible scenarios for future climate change
3. Achieve possible ways to deal with climate change , energy Issues and Alternate Energy Sources.

UNIT-I

Green-House Effect as a Natural Phenomenon, Green House Gases GHGs) and their Emission Sources Quantification of CO_2 Emission, Global Warming Potential (GWP) of GHGs 12hr

UNIT-II

Modeling Climate change, Ozone layer depletion and its control, Impacts of climate change: Global and India, Temperature Rise, Sea Level rise, Coastal Erosion and landslides, Coastal Flooding, Wetlands and Estuaries loss Impact of ocean current on global climate, EL-NINO & LA-NINA effects. 14hr

UNIT-III

Kyoto Protocol: Importance, Significance and its role in Climate Change Carbon Trading – Mechanisms,Various Models (European, Indian) Global and Indian Scenario. 12hr

UNIT-IV

Cleaner Development Mechanisms: Various Projects related to CO_2 Emission Reduction Alternatives of Carbon Sequestration: Conventional and non-conventional techniques , Role of Countries and Citizens in Containing Global Warming. 14hr

REFERENCES

1. Barry R.G., and Chorley R.L., “Atmosphere, Weather and Climate”, 4th Edition, ELBS Publication.
2. Bolin B., (Ed.), “Carbon Cycle Modelling”, John Wiley and Sons Publications.
3. Corell R.W., and Anderson P.A., (Eds.), “Global Environmental Change”, Springler Verlog Publishers.
4. Francis D., “Global Warming: The Science and Climate Change”, Oxford University Press.
5. Frame B., Medury Y., and Joshi Y., (Eds.), “Global Climate Change: Science, Impact and Responses”.
6. Linden E.,, “The Winds of Change: Climate, Weather and the Destruction of Civilizations”, Simon and Schuster Publications.
7. Mintzer I.M., (Ed.), “Confronting Climate Change, Risks, Implications and Responses”,

COs	**GLOBAL WARMING AND CLIMATE CHANGE (PEV021E)**	PO1	PO2	PO3
CO1	Measure climate factors and how they change	3	0	2
CO2	Identify effects of climate change on biodiversity and ecosystems in different biomes and aquatic systems and the model possible scenarios for future climate change	3	0	2
CO3	Achieve possible ways to deal with climate change , energy Issues and Alternate Energy Sources.	3	0	3
	Average	**3.0**	**0**	**2.33**

ADVANCED ATMOSPHERIC ENVIRONMENTAL ENGINEERING

4 Credits

Sub Code : PEV022E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1. Understand Atmospheric Processes and Chemical Reactions.
2. Effectively utilize knowledge of design on Industrial Ventilation Systems
3. Learn Urban Air Quality Simulation Modeling

UNIT-I

Atmospheric Processes and Chemical Reactions: Definition of terms aerosols, particle, photolysis, gas to particle conversion, condensation, evaporation, dissolution, sublimation, specific heat, conduction, radiation. Mechanical turbulence, forced convection, advection, equation of state, first law of thermodynamics. Reaction Rates (Gas Phase Species) Atmospheric gases and their molecular structures, chemical reactions and photo processes, reaction rates, reaction rate coefficients, sets of reactions, stiff systems.

Atmospheric Boundary Layer: Characteristics of atmospheric boundary layer-boundary layer depth, mean velocity power-law profile, Log-Log velocity profile, spectral description of turbulence, turbulence intensity, Reynolds stress parameter, spectral density function, integral length scale, inertial subrange and small scales. Turbulent fluxes of momentum, turbulent fluxes of energy and water vapour, friction velocity, surface roughness lengths, bulk aerodynamic equations for eddy diffusion, monin-obukhov similarity theory, eddy diffusion above the surface layer, ground surface temperature and moisture. 14hr

UNIT-II

Urban Air Quality Simulation Modeling: General need, alternative approaches, basic model applications, general composition of models, Numerical modeling approaches-Gaussian diffusion models, physical basis of the mass conservation approach, mathematical foundation of the mass conservation approach.

Inherent problem in air quality simulation modeling: Boundary conditions, spatial resolution and compatibility with available data. Transportation related modeling-street canyon models, highway models, airport models. Air quality simulation models for Quasi-Inert pollutants-sulfur dioxide and particulate models, carbon monoxide models. Air quality simulation models for photochemical pollutants-background, features of photochemical air quality simulation models, model evaluation, model validation.

14hr

UNIT-III

Dispersion of Heavy Gases: Introduction, characteristics of heavy gas flow, introduction to numerical modeling of heavy gas dispersion, requirements for physical models (non-dimensional parameters, choice of scaling variables).

Mobile Sources of Pollution: Introduction, emission standards for automobiles, Gasoline, origin exhaust emissions from gasoline engines, crankcase and evaporative emissions, alternative fuels and their utilization. 12hr

UNIT-IV

Indoor Air Pollution: Introduction, the IAQ problem, diagnosis and remediation of IAQ problems, the interdisciplinary approaches.Industrial hygiene and its application to IAQ, industrial hygiene methodology. Indoor air quality and industrial hygiene, sampling, analysis and interpretation. Industrial hygiene methodology, architectural and construction aspects.

Design of Industrial Ventilation Systems: Introduction, ventilation by dilution, hood specifications, hoods of simple geometry, experimental velocity contours, complex hood design, duct design, fan selection and performance.

12hr

REFERENCES

1. Jacobson. Z. A., **Fundamental of Atmospheric modeling,** Cambridge University Press, Cambridge.
2. Warren B. Johnson et. al. , **Air Pollution**, Arthur C. Stern, third edition, Volume I, Academic Press, New York, .
3. Krogstad and Jacobsen, **Dispersion of heavy gases, in encyclopedia of environmental control technologies**, edited by Cheremioinoff, Volume-2, Rulf publishing company, Houston.
4. Crawford Martin**, "Air pollution control theory"**, Tata McGraw- Hill publishing company Ltd. New Delhi, .
5. Stull B. Roland, **Boundary Layer Meteorology**, Kluwer Academic Publishers.
6. Snyder H. William, "**Guideline for fluid modeling of atmospheric diffusion",** U.S. Environmental Protection Agency research Triangle Park, NC 27711.

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COs	**ADVANCED ATMOSPHERIC ENVIRONMENTAL ENGINEERING(PEV022E)**	PO1	PO2	PO3
CO1	Understand Atmospheric Processes and Chemical Reactions.	3	0	2
CO2	Effectively utilize knowledge of design on Industrial Ventilation Systems	3	0	2
CO3	Learn Urban Air Quality Simulation Modeling	3	0	3
	Average	**3.0**	**0**	**2.33**

REUSE AND RECYCLE TECHNOLOGY

4 Credits

Sub Code : PEV109E **CIE MARKS : 50**
Hrs/Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:
Students will be able to

1. Understand the different wastes as fuel and conversion devices to convert waste to energy.
2. Apply the existing technologies for the treatment of biomass and design the devices
3. Appreciate the increasing importance of waste and resource management in achieving environmental sustainability.

UNIT- I

Waste as a resource: Resource Economics, Disposed materials (Paper, plastic, metals, solvents), Collection and recycling of plastics, Potential for reuse.
Appropriate technologies for wastewater treatment and reuse: Reuse applications, appropriate technologies, types of systems (Centralised, Individual, and Community system), Performance expectations.

14hr

UNIT - II

Metals recovery: Ferrous metals, properties, principles of magnetic field-ferrous material interactions, magnetic separation, eddy-current separation- theory and types, Extraction of material from a bed.

12hr

UNIT- III

Reuse of industrial effluent, Urban effluent reuse for agriculture in arid and semiarid zones, Uses of Sewage in Pisciculture, Groundwater Recharge of sewage effluents, Reuse for Amenity.
Water Reuse: Direct and indirect Reuse, intentional reuse, Examples of water reuse, Close cycle and open cycle reuse, Recreational reuse.

14hr

UNIT- IV

Sludge as soil conditioner, vegetable oil as fuels, Biodiesel, Refuse derived fuel, Waste oil recycling, waste utilization in cement kilns.

12hr

REFERENCES:

1. Springer, "Recycling and Resource Recovery Engineering", Springer-Verlag Berlin Heidelberg(1996)
2. ICE:Reuse of Sewage Effluents, Proceedings of the International Symposium Thomas Felford London(1985)
3. Dean R.B and E., Water Reuse problems and solutions ,Academic Press(1981)
4. Kut D.,and Hase G Waste Recycling for Energy Conservation ,John Wiley and Sons Inc
5. John T.Aquino Waste Age/Recycling Times'Recycling Handbook
6. Jawad Al-Sulaimi Takashi Asano Wastewater Reclamation and Reuse

COs	REUSE AND RECYCLE TECHNOLOGY (PEV109E)	PO1	PO2	PO3
CO1	Understand the different wastes as fuel and conversion devices to convert waste to energy.	3	0	2
CO2	Apply the existing technologies for the treatment of biomass and design the devices	3	0	2
CO3	Appreciate the increasing importance of waste and resource management in achieving environmental sustainability.	1	0	2
	Average	**2.33**	**0**	**2.0**

ENVIRONMENTAL BIOCHEMISTRY AND BIOTECHNOLOGY

3 Credits

Sub Code : PEV010E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be ale to

1. Design the methods and techniques for analysis of environmental samples
2. Apply the technologies for bioremediation of soil, water and air.
3. Understand d- Metabolism - Stoichiometry arid Energetics, Thermodynamic Principles,Metabolic Reaction and Coupling, EMP Pathway.

UNIT – I

Introduction-Metabolism - Stoichiometry arid Energetics, Thermodynamic Principles, Metabolic Reaction and Coupling, EMP Pathway and other Carbohydrate Catabolic Pathways.

Respiration and Photosynthesis, Biosynthesis, Transport across Cell Membranes, End Products of Metabolism. Stoichiometry of Cell Growth and Product Formation,Medium Formulation and Yield Factors, Material Balances for Cell Growth, Product Formulation Stochiometry, Heat Generation, Yield Factor Estimate. 10hr

UNIT – II

Molecular Genetics and Control Systems -Molecular Genetics, Alteration of Cellular DNA, Recombinant DNA Technology, Growth and Reproduction of Single Cell.

Kinetics of Substrate Utilization, Product Utilization and Biomass Production in Cell Cultures, Ideal Reactors for Kinetics Measurement, Kinetics for Balanced Growth, Transient Growth Kinetics, Structured Kinetic Models. 10hr

UNIT – III

Biotechnology- Introduction to Microbial Biotechnology, Uses of Enzymes, Isolation and Purification of Enzyme Engineering, Protein Engineering, immune toxins, Metabolic Engineering for Over Production of Metabolites.

Uses of Microbes- Isolating and Culturing of Microorganisms, Production of Organic Compounds like Ethanol and Acetone by Microbial Fermentation, Production of Enzymes by Microorganism, Production of Antibiotics, Single Cell Protein, Sewage Treatment using Microbial Systems. 12hr

UNIT – IV

Biotechnology and Environment- Pollution Control, Restoration of degraded lands, biodiversity and its conservation, Biosensors, immobilized Cell Technology for Wastewater Treatment. 10hr

REFERENCES:

1. Bailey and Ollis, Biochemical Engineering and Fundamentals, McGraw Hill International,1986.
2. Smith, Principles of Biochemistry, 7th Edition, McGraw Hill international.
3. Agarwal's A Text book of Biochemistry, Goel Publishing House, Meerut2002
4. P.K. Guptha, Elements of Biotechnology, Restogi Publishers, Meerut,2003.

COs	**ENVIRONMENTAL BIOCHEMISTRY AND BIOTECHNOLOGY (PEV010E)**	PO1	PO2	PO3
CO1	Design the methods and techniques for analysisof environmental samples	3	0	2
CO2	Apply the technologies for bioremediation ofsoil, water and air.	3	0	3
CO3	Understand-Metabolism-Stoichiometry and Energetics, Thermodynamic Principles, Metabolic Reaction and Coupling, EMP Pathway.	3	0	1
	Average	**3.0**	**0**	**2.0**

BIOLOGICAL TREATMENT OF WASTEWATER

3 Credits

Sub Code : PEV016E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1. Identify various parameters of biological methods of analysis of waste water
2. Select and design the appropriate biological wastewater treatment processes and discuss pros and cons of each process
3. Critically analyze the various problems encountered in aerobic and anaerobic treatmentof waste water

UNIT – I

Introduction: Objectives of biological treatment – significance – aerobic and anaerobic treatment - Kinetics of biological growth – Factors affecting growth -attached and suspended growth – Determination of Kinetics coefficients for organics removal – Biodegradability assessment - selection of process. 10hr

UNIT – II

Aerobic treatment of wastewater: Design of sewage treatment plant units – screen chamber, Grit chamber with proportional flow weir, sedimentation tank - Trickling filters, Rotating Biological contactor, activated sludge process & variations, aerated lagoons, waste stabilization ponds – nutrient removal systems – natural treatment systems – Disinfected disposal options – reclamation and reuse - Flow charts, layout, hydraulic profile - Recent advances. 10hr

UNIT – III

Anaerobic treatment of wastewater: Attached and suspended growth, Design of units – UASB, up flow filters, Fluidised beds – septic tank and disposal – Nutrient removal systems – Layout and Hydraulic profile – Recent advances. 10hr

UNIT – IV

Sludge treatment and disposal: Design of Sludge management facilities, sludge thickening, sludge digestion, Biogas generation, sludge dewatering (mechanical and gravity) – upgrading existing plants – ultimate residue disposal – Recent Advances.

Operations, maintenance, management and case studies: Operational problems – Trouble shooting,Planning,Organising and Controlling of plant operations – capacity building, Case studies on sewage treatment plants – sludge management facilities. 12hr

REFERENCES:

1. Arceivala, S.J., Wastewater treatment for pollution control, TMH, New Delhi, 1998.
2. Manual on "Sewerage and Sewage Treatment" CPHEEO, Ministry of Urban Development, GoI, New Delhi, 1999.
3. METCALF & EDDY, INC. 'Wastewater Engineering, Treatment and Reuse. Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003.
4. Qasim, S.R, Wastewater Treatment Plant, Planning, Design & Operation Technomic Publications, New York, 1994.

COs	**BIOLOGICAL TREATMENT OF WASTEWATER (PEV016E)**	PO1	PO2	PO3
CO1	Identify various parameters of biological methods of analysis of waste water	3	0	2
CO2	Select and design the appropriate biological wastewater treatment processes and discusspros and cons of each process	3	0	2
CO3	Critically analyze the various problems encountered in aerobic and anaerobic treatmentof waste water	3	0	2
	Average	**3.0**	**0**	**2.0**

OPERATION AND MAINTENANCE OF ENVIRONMENTAL FACILITIES

3 Credits

Sub Code: PEV006E **CIE Marks : 50**
Hrs/ Week: 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1. Apply basic principles, organizational structure, work planning and scheduling and cost estimates of O&M
2. Prepare drawings, plans, record keeping, need for operational manual and SOP.
3. Solve operational problems in water treatment and supply facilities, wastewater collection and treatment facilities, air pollution control systems.

UNIT – I

Introduction- Importance of Operation and Maintenance, Basic Principles of Operation and Maintenance - Corrective and Preventive Maintenance, Data Base of Facilities for O and M - Detailed Plans, Drawings, Operation Manuals, Computer Applications in O and M. 10hr

UNIT – II

O and M of Water Supply Facilities-Intakes, Pumps, Rising Mains, Water Treatment Process Control, Water Quality and Water Quality Monitoring, Loss of Carrying Capacity of Pipes. Causes, Leak Detection, Projection of pipe Break Rates, Record Keeping,Appurtenances - Valves, Hydrants and Fittings. Use of Network Models in O and M. Safety aspects. 10hr

UNIT – III

O and M of Wastewater Facilities- Sewer Network: Inspection Methods for Sewers and Appurtenances -Manual and Television, cleaning. Rehabilitation - Sealing, Repair and Replacement. Safety in Sewer inspection. O and M of Wastewater Treatment plant. Monitoring, Operational Problems and Corrective Measures in Different Units of Treatment. 10hr

UNIT – IV

O and M of Air Pollution Control Facilities- Regular inspection of Devices, SPM Control Equipment, Gravity Settlers, Cyclone Separators, Bag Filters, Scrubbers, Electrostatic Precipitators, Gaseous Emission Control Devices - Absorption Beds and Adsorption Columns, Thermal Oxidisers, Incinerators and their Trouble Shooting. Safety measures during O and M. Operation and Maintenance Planning-Organizational Structure, work planning, Preparation and Scheduling Cost Estimates. 12hr

REFERENCES:

1. Water and Wastewater Technology, Hammer M.J. - 1985
2. Water Treatment Plants, Syed R. Quasim, Holt Rinchart and Winston - 1985
3. Neumann W.L. Industrial Air Pollution Control Systems, 1997, McGraw Hill
4. CPHEEO Manual on Water Supply and Treatment, GO! Publication, 1991.
5. CPHEEO Manual on Sewerage and Sewerage Treatment, GOI Publication. 1995
6. Training Manual on OandM for Municipal staff, Asian Development Bank Project, Government of Karnataka.
7. Walski T. M. Analysis of Water Distribution systems, CBS, Publications, New Delhi, 1987.

COs	**OPERATION AND MAINTENANCE OF ENVIRONMENTAL FACILITIES (PEV006E**	PO1	PO2	PO3
CO1	Apply basic principles, organizational structure, work planning and scheduling and cost estimates of O&M	2	0	2
CO2	Prepare drawings, plans, record keeping, needfor operational manual and SOP.	1	0	2
CO3	Solve operational problems in water treatment and supply facilities, wastewater collection andtreatment facilities, air pollution controlsystems.	3	0	2
	Average	**2.33**	**0**	**2.0**

REMOTE SENSING AND GIS APPLICATIONS IN GEO-ENVIRONMENTAL ENGINEERING

3 Credits

Sub Code : PEV017E **CIE Marks : 50**
Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:
Students will be able to

1. Develop a sound understanding of the nature, purpose and underlying principles of Remote Sensing.
2. Apply available Remote Sensing technologies and be able to match these to particular kinds of Geo environmental engineering problem.
3. Develop a critical awareness of the strengths and limitations of monitoring using Remote Sensing and the wider monitoring.

UNIT-1

Basics: Fundamentals of Remote Sensing, Electromagnetic Spectrum, Process of remote sensing, Black Body Radiation, Energy Interactions with earth atmosphere and surface features, spectral reflectance curves-For Vegetation, soil & water.

Sensors: Definition, Types (Typical Sensor used in optical remote sensing, Thermal sensor, Synthetic Aperture Radar) Classification Plat Forms: Definition & Types: Airborne & Space Borne platforms, Plat form characteristics. Indian Remote Sensing Programme: Definition, Objectives, Data Products of Launch Program Satellite Specifications for IRS-1C, 1D, P4, CARTOSAT-1 & CARTOSAT-2 10hr

UNIT-2

Visual Image Interpretation: Definition, Objectives, Keys & Elements of Visual Image interpretation. Digital Image Processing (DIP): Definition, Need, Stages of DIP-Image rectification & restoration, Image Enhancement-Contrast Mnipulation-Grey Level Thresholding, Classification-Brief discussion of classification procedure for Supervised & Unsupervised Classification Techniques.

GIS: Definition, Components, concept, Data acquisition for GIS input-Spatial (Vector, Raster & Surface data) & Non spatial data, rectification, processing, verification & Data Editing, Application. GIS functions. Brief Procedure of integrating Remote Sensing Data into GIS.

10hr

UNIT-3

GIS Advanced Concepts: Network Analysis &Virtual GIS.Modeling problems for demonstrating use of GIS functions for civil applications – Site selection for urban development, development of business center and wild life Sanctuary Park.

Computer Concepts of GIS: Coding of attribute data in computer (Binary system & Hexadecimal System), Coding of vector & Raster data in GIS, File Listing & Data Access, Raster data compression techniques, Data Base Structures. Basics of Photo grammetry : Acquisition of Arial photographs, Aerial Camera, Flight Planning, Photograph processing & feature extraction. (Brief Discussion Only)

Application of GIS in Geotechnical Engineering:-Introduction, Remote Sensing & GIS assisted geotechnical investigations, Determination of volumetric shrinkage of expansive soils, 3D mapping for sub surface stratum. 10hr

UNIT-4

Advanced Applications GIS assisted seismic hazard studies, study of soil drainage characteristics assisted with remote sensing, study of ground water prospects, soil mapping, and rock spectra for mineral identification- Relevant case studies

Applications In Environmental Engineering: Solid waste collection & transport, water quality assessment, water resource management, mapping of ground water potability status, GIS based master plan for water supply project, Ground water Vulnerability assessment, GIS based master plan for sewage collection & transport system. 10hr

REFERENCES:

I. Pater A Burraugh Rachal A Mc Donnas "Principle of GIS" (Oxford)

2. Christopher Jones "GIS and Computer Cartography"publication Prentice-Hall(2009)

3. Lilly Sand, "Remote sensing and Image interpretation, John Willey and Sons, New York 1999.

COs	**REMOTE SENSING AND GIS APPLICATIONS IN GEO-ENVIRONMENTAL ENGINEERING (PEV017E)**	PO1	PO2	PO3
CO1	Develop a sound understanding of the nature,purpose and underlying principles of Remote Sensing.	2	0	2
CO2	Apply available Remote Sensing technologies and be able to match these to particular kinds of Geo environmental engineering problem.	3	0	2
CO3	Develop a critical awareness of the strengths and limitations of monitoring using Remote Sensing andthe wider monitoring.	3	0	2
	Average	**2.66**	**0**	**2.0**

NON – POINT SOURCES OF POLLUTION AND MANAGEMENT

3Credits

Sub Code : PEV020E **CIE Marks : 50**

Hrs/ Week : 04 **SEE Marks : 50**

COURSE OUTCOMES:

Students will be able to

1. Utilize Simulation Models for tracing nonpoint source pollution
2. Develop management solutions for nonpoint source pollution control
3. Select best management solutions for nonpoint source pollution control

UNIT-I

Introduction: Non-point Pollution, Problem, definitions, magnitude of Non-point Pollution, Non-point Pollution Control Laws, Waste Assimilative Capacity and Stream Standards. 10hr

Pollution From the Atmosphere: Atmospheric Inputs – fall out, rainfall, Overland routing of the precipitation excess, interflow ground water flow. 10hr

UNIT-II

Groundwater Pollution: Sources of Groundwater Contamination, Groundwater Movement. **Pollution from impervious urban areas:** Introduction Deposition and Accumulation of Pollutants on Impervious Surfaces, Removal of Solids from street Surfaces, Porous Pavement.

10hr

UNIT-III

Non point Pollution Simulation Models: Basic Concepts Brief Description available Nonpoint Pollution Simulation Models.

Land use and non-point pollution: Effects , Comparative Assessment of Pollution Impact from land use, agricultural runoff, mining area runoff, Effect of hydrologic Modifications. 10hr

UNIT-IV

Management Practices of Non-point pollution control: Introduction, Source Control Measures Collection Control and Reduction of Delivery.

Planning for Nonpoint Pollution Control: Introduction, Water Quality Planning Process, Selection of Best Management Practices for Non Point Source Pollution Control – detention ponds, exfiltration and infiltration trenches, vegetative swales.

10hr

REFERENCES

1. Novotny V and Chesters G.,'**Hand Book of Non-point Pollution, Sources and Management",** Van Nostrand Reinhold Environmental Engineering Series, New York.

2. Pavoni J L, (Ed) "Hand Book of **Water Quality Management Planning"**, Van NostrandReinhold, Environmental Engineering Series.New York

3.Pluarg, Pollution from Land Use Activities Reference Group Novotny V and Chesters G "**Hand Book of Non-point Pollution, Sources and Management"**, Van Nostrand ReinholdCompany.

COs	**NON – POINT SOURCES OF POLLUTION AND MANAGEMENT (PEV020E)**	PO1	PO2	PO3
CO1	Utilize Simulation Models for tracingnonpoint source pollution	2	0	2
CO2	Develop management solutions for nonpointsource pollution control	3	0	2
CO3	Select best management solutions fornonpoint source pollution control	3	0	2
	Average	**2.66**	**0**	**2.0**