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

2022-2023

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 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.

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.

PO4: Apply mathematical and computer based tools to formulate and analyse the real life problems in environmental engineering.

PO5: Adopt changing environmental technologies and innovative methods to meet the challenges emanating out of climate change and environmental issues.

PO6: Exhibit professional and intellectual integrity and ethics for socially responsible and competent environment engineer.

Justification of consistency of the Department Vision and Mission with theInstitute 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

Basaveshwar Engineering College(A), Bagalkote
Scheme of Teaching and Examinations–2022
M.Tech. Environmental Engineering (CEE)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credit
				Theory	Practical/Seminar	Tutorial / Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	BSC	22PEV11	Advanced Computational Methods	03	00	00	03	50	50	100	3
2	IPCC	22 PEV12	Environmental Chemistry and Microbiology	03	02	00	03	50	50	100	4
3	PCC	22 PEV13	Advanced Wastewater	03	00	02	03	50	50	100	4

			Treatment								
4	PCC	22 PEV14	Advanced Solid Waste Management	02	00	02	03	50	50	100	3
5	PCC	22 PEV15	Hazardous Waste Management	02	00	02	03	50	50	100	3
6	MCC	22RMI16	Research Methodology and IPR	03	00	00	03	50	50	100	3
7	PCCL	22 PEVL17	Environmental Engineering Lab	00	03	00	03	50	50	100	2
8	AUD/ AEC	22AUD18/ 22AEC18	BOS recommended ONLINE courses	Classes and evaluation procedures are as per the policy of the online course providers.							PP
			TOTAL	**17**	**04**	**06**	**21**	**350**	**350**	**700**	**22**

Note:

BSC-Basic Science Courses, **PCC –** Professional core. **IPCC**– Integrated Professional Core Courses, **MCC** – Mandatory Credit Course.

Audit Course / Ability Enhancement Course (AUD/AEC):): A pass in AUD/AEC is mandatory for the award of the degree:

PCCL-Professional Core Course lab.

L-Lecture, P-Practical, T/SDA-Tutorial/ Skill Development Activities (Hours are for Interaction between faculty and students)

Integrated Professional Core Course (IPCC):

Refers to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

Audit Courses /Ability Enhancement Courses Suggested by BOS (ONLINE courses):

Audit Courses: These are prerequisite courses suggested by the concerned Board of Studies.

Ability Enhancement Courses: These will be suggested by the BoS if prerequisite courses are not required for the programs.

•These courses are prescribed to help students to enhance their skills in fields connected to the field of specialization as well allied fields that leads to employable skills. Involving in learning such courses are impetus to lifelong learning.

•The courses under this category are online courses published in advance and approved by the concerned Board of Studies.

•Registration to Audit /Ability Enhancement Course shall be done in consultation with the mentor and is compulsory during the concerned semester.

•In case a candidate fails to appear for the proctored examination or fails to pass the selected online course, he/she can register and appear for the same course if offered during the next session or register for a new course offered during that session, in consultation with the mentor.

•The Audit Ability Enhancement Course carries no credit and is not counted for vertical progression. However, a pass in such a course is mandatory for the award of the degree.

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modeling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s(tools) to simulate, analyze and authenticate the out putt interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared reports hall be evaluated for CIE marks.

Basaveshwar Engineering College(A), Bagalkot
Scheme of Teaching and Examinations–2022
M.Tech. Environmental Engineering (CEE)

II SEMESTER

Sl.No	Course	Course Code	Course Title	Teaching Hours/Week			Examination				Credits
				Theory	Practical/Seminar	Tutorial/Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	PCC	22 PEV21	Industrial Effluent Treatment	04	00	00	03	50	50	100	4
2	IPCC	22 PEV22	Air Pollution and Control	03	02	00	03	50	50	100	4
3	PEC	22 PEV23E	Professional Elective -1	02	00	02	03	50	50	100	3
4	PEC	22 PEV24E	Professional Elective- 2	02	00	02	03	50	50	100	3

5	OEC	22 PEV25N	Open Elective	03	02	00	03	50	50	100	3
6	MPS	22 PEV26P	Mini Project	00	04	02	--	100	--	100	3
7	PCCL	22 PEVL27	Computer Application in Environmental Engineering Lab	00	03	00	03	50	50	100	02
8	AUD / AEC	22AUD28	Suggested ONLINE Courses	Classes and evaluation procedures are as per the Policy of the online course providers.							PP
TOTAL				**13**	**08**	**08**	**15**	**350**	**250**	**600**	**22**

Note: PCC: Professional core courses, PEC: Professional Elective Courses, IPCC-Integrated Professional Core Courses. MPS-Mini Project with Seminar; AUD/AEC; Audit Courses/ Ability Enhancement Courses (Mandatory), PCCL-Professional Core Course lab,

L-Lecture, P-Practical, T/SDA-Tutorial/Skill Development Activities (Hours are for Interaction between faculty and students).

Professional Elective 1		Professional Elective 2	
Course Codeunder 22CEE24E	**Course title**	**Course Code under 22 PEV 25E**	**Course title**
22 PEV241	Remote Sensing and GIS applications in Environmental Engineering	22 PEV251	Non -Point sources of pollution and management
22 PEV242	Energy and Environmental Engineering	22 PEV252	Water Resources Engineering
22 PEV243	Biological Process for Wastewater Treatment	22 PEV253	Waste to Energy
22 PEV244	Project management	22 PEV254	Plastic waste management
22 PEV245	Occupational Safety and Health	22 PEV255	Green Technology

Note:

1 Mini Project with Seminar: This may be hands-on practice**,** survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modeling of system, simulation, analyzing and authenticating, case studies, etc.

CIE marks shall be awarded by a committee comprising of HOD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project. Participation in the seminar by all post graduate students of the program shall be mandatory.

The CIE marks awarded for Mini-Project work and Seminar, shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question-and-Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical

progression as well as for the award of degree. Those, who do not take-up/completetheMiniProjectandSeminarshallbedeclaredasfailinthatcourseandhavetocompletethesameduringthe subsequentsemester. There is no SEE for this course.

3. Internship: All the students shall have to undergo a mandatory internship of **06 weeks** during the vacation of II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. The internship shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the internship shall be declared as f ail in the internship course and have to Complete the same during the subsequent University examination after satisfying the internship requirements.

Basaveshwar Engineering College(A), Bagalkot
Scheme of Teaching and Examinations–2022
M.Tech. Environmental Engineering (CEE)

III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours/Week			Examination				Credits
				Theory	Practical/Mini–Project/ Internship	Tutorial/Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	22 PEV31	Design of water and wastewater treatment plants	03	00	02	03	50	50	100	3
2	PEC	22 PEV32E	Professional Elective- 3	03	00	00	03	50	50	100	3
3	PROJ	22 PEV33P	Project Work Phase-1	00	06	00	--	100	100	200	3
4	SP	22 PEV35	Societal Project	00	06	00	--	100	--	100	3
5	INT	22 PEVI36	Internship	(06 weeks Internship Completed during the intervening vacation of I and III semesters.)			03	50	50	100	6
Total				**09**	**12**	**03**	**12**	**400**	**200**	**600**	**18**

Note: PCC: Professional core courses, **PEC**: Professional Elective Courses, **IPCC**-Integrated Professional Core Courses. **MPS**-Mini Project with Seminar; **AUD/AEC**; **Audit Courses / Ability Enhancement Courses (Mandatory)**, **PCCL**-Professional Core Course lab, **L-Lecture, P-Practical, T/SDA-Tutorial/ Skill Development Activities** (Hours are for Interaction between faculty and students).

Professional Elective 3		Open Elective 1	
Course Code under 22 PEV 31E	**Course title**	**Course Code under 22 PEV32N**	**Course title**
22 PEV321	Reuse-Recycle Technology	22 PEV331	Ecology and environmental Impact Assessment
22 PEV322	Global warming and climate change	22 PEV332	Advanced atmospheric Environmental Engineering
22 PEV323	Environmental Planning and Management	22 PEV333	Environmental Biochemistry and Biotechnology
22 PE 324	Water Reclamation and Reuse	22 PEV334	Environmental Disaster Management
22 PEV325	Operation and maintenance of Environmental Facility	22 PEV335	Environmental Geo-technology

Note:

1. **Project Work Phase-1:** The project work shall be carried out individually. However, in case a disciplinary or interdisciplinary project requires more participants, then a group consisting of not more than three shall be permitted.

Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall pursue a literature survey and complete the preliminary requirements of the selected Project work. Each student shall prepare a relevant introductory project document, and present a seminar.

CIE marks shall be awarded by a committee comprising of HOD as Chairman, all Guide/s and co-guide/s(if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question-and-Answer session in the ratio of 50:25:25.

2. Societal Project: Students in consultation with the internal guide as well as with external guide (much preferable) shall involve in applying technology to workout/proposing viable solutions for societal problems.

CIE marks shall be awarded by a committee comprising of HOD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question-and-Answer session integration of 50:25:25.

Those, who have not pursued /completed the Societal Project, shall be declared as fail in the course and have to complete the same during subsequent semester/s after satisfying the Societal Project requirements. There is no SEE (University examination) for this course.

3. Internship: Those, who have not pursued /completed the internship, shall be declared as fail in the internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.

CIE marks shall be awarded by a committee comprising of HOD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase - I, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question-and-Answer session in the ratio of 50:25:25.

Basaveshwar Engineering College(A), Bagalkot
Scheme of Teaching and Examinations–2022
M.Tech. Environmental Engineering (CEE)

IVSEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Fieldwork	Duration in hours	CIE Marks	SEE Marks Viva-	Total Marks	
				L	P					
1	Project	22 PEV 41P	Project work phase-2	--	08	03	100	100	200	18
			TOTAL	--	**08**	**03**	**100**	**100**	**200**	**18**

Note:

1.ProjectWorkPhase-2:

Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall continue to work of Project Work phase -1to complete the Project work. Each student / batch of students shall prepare project document, and present a seminar.

CIE marks shall be awarded by a committee comprising of HOD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -2, shall be based on the evaluation of the Project Report, Project Presentation skill, and performance in the Question-and-Answer session in the ratio of50:25:25.

SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

Total Credits22+22+18+18=**80**

ADVANCED COMPUTATIONAL METHODS
Code: 22PSE011/ 22PGT011/ 22PEV011
Credits :03 (3-0-0)
(2-2-0)

Subject Code: PSE 122C **CIE Marks: 50**
Duration of Exam: 3 Hrs **SEE marks: 100**

Unit-I

Statistics: Frequency Distribution – Characteristics of Distributions: Central tendency and dispersion. Methods of least square and regression, multiple regression, Solutions of regression analysis problems Analysis of Variance.

Probability: Concept of probability, Random Variables, Binomial, Poisson and Normal distribution – applications, Chi- squared test, F test, t-test. Applications to respective fields in Civil Engineering.

Unit-II

Matrix operation: Matrix operation Eigen value and Eigen vector by iterative methods. Diagonalisation and square matrix. Applications to respective fields in Civil Engineering.

Unit-III

Ordinary Differential Equation: Second order homogeneous equation, Euler-Cauchy's equation, non-homogeneous linear equation. Partial differential equation: wave equation – one and two dimensions. Applications to respective fields in Civil Engineering

Unit-IV

Numerical methods: Development of simultaneous using Gaussian elimination method, Gauss- Jordan matrix inversion method, Gauss- Siedel method, Cholesky decomposition method. Applications to respective fields in Civil Engineering.

BOOKS FOR REFERENCE

1. Rao, S.S. (1996), "Optimization: Theory and applications", Wiley Eastern Ltd. Publications
2. Grewal. B.S., and Grewal. J.S., "Numerical methods in Engineering and Science", Khanna Publishers, 9th Edition, New Delhi.
3. S S Sastry- Introductory Methods of Numerical Analysis, 5th edition, PHI, New Delhi, 2012.
4. E Balagurusamy- Numerical Methods, Tata Mc Graw Hill,2017.
5. H C Saxena- Examples in Finite Differences and Numerical Analysis, S Chand & Co. New Delhi,1975.

ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

4 Credits

(4-0-0)

Sub Code : 22PEV12 **CIE Marks : 50**

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

Course Outcomes:

Students will be able to

1. Analyse the chemical reactions, trace contaminants and applications of electrochemistry.
2. Apply the principles of physical, electrochemistry and analytical chemistry in Environmental Engineering process.
3. Identify the importance of microbiology in the environment and micrology to solve the environmental problems.
4. Demonstrate the microbial experiments to evaluate water quality parameters and study the morphology of the bacterial, fungi, protozoa and virus.

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.

12 hr

UNIT-II

Colloidal Chemistry - Properties of colloids, colloidal dispersions, stability of colloids and applications. Applications of Organic Chemistry in Environmental Engineering.

Colorimetry- Principles and applications. Applications of Analytical Chemistry- emission and absorption techniques.

14 hr

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, Biomagnification and Bioaccumulation.

12 hr

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 and enumeration methodology.

14 hr

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.

5. APHA, (2002) “Standard Methods for Examination of Water and Wastewater” 21st Edition.

6. Stumn and Morgan (1970), “Aquatic Chemistry”, John Willey & Sons New York.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Design the appropriate technology on applying basics of environmental chemistry and micrology to solve the environmentalproblems.	3	1		2		1
2	Apply the principles of Physical, Electrochemistry and Analytical chemistry in Environmental Engineering process.	2	1		2	1	
3	Conduct experiments to evaluate water quality parameters.	2	1	2		2	
4	Demonstrate the microbial experiments to evaluate water quality parameters and study the morphology of the bacterial, fungi, protozoa and virus.	1		2		2	2
Average		2.00	0.75	1.00	1.00	1.25	0.75

ADVANCED WASTEWATER TREATMENT

4 Credits

(3-2-0)

Sub Code : 22 PEV13 **CIE Marks : 50**

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

COURSE OUTCOMES

Students will be able to

1. Design Appropriate treatment component for municipal and certain industrial effluents.
2. Evaluate the operational problems of treatment units and apply the solutions in water and wastewater treatment plant.
3. Construct appropriate treatment schemes to remove certain pollutants present in water or wastewater.
4. Construct the alternative sludge processing techniques apply the knowledge in nutrient removal from the wastewater.

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.

14 hr

UNIT – II

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

12 hr

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)

14 hr

UNIT – IV

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

12hrs

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.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Design Appropriate treatment component for municipal and certain industrial effluents.	2		2	3		
2	Evaluate the operational problems of treatment units and apply the solutions in water and wastewater treatment plant.	1		3	2	1	2
3	Construct appropriate treatment schemes to remove certain pollutants present in water or wastewater.	2		1		2	1
4	Construct the alternative sludge processing techniques apply the knowledge in nutrient removal from the wastewater.	3			1		2
Average		2.00		1.50	1.50	0.75	1.25

ADVANCED SOLID WASTE MANAGEMENT

3 Credits (3-0-0)

Sub Code : 22 PEV14 **CIE Marks : 50**

Hrs/ Week : 03 **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 collection and treatment of waste and recovery of value from waste.
3. Select the different disposal methods and prevention measures.
4. Construct the waste and resource management importance in achieving environmental sustainability.

UNIT – I

Solid Waste: Definition and scope, Necessity and importance, Sources, Classification, Integrated Solid Waste Management (ISWM), Hierarchy of waste management options, 4 R's - reduce, recover, recycle and reuse, Physical, Chemical and Biological characteristics of municipal solid waste (MSW), Generation rates and methods, Chemical composition, Numerical problems.

Functional elements: Flow chart, Waste generation, Storage, Collection, Transfer and transport, Processing and recovery, Disposal.

Collection, Transfer and Transport: Collection equipment, systems of collection - hauled container system, stationary container system, numerical problems; Transfer stations, Bailing and Compacting.

10 hr

UNIT – II

Separation and Processing Technologies: Size reduction, Size separation, Density separation, Magnetic & Electric Field separation, Densification (Compaction), Design of Material Recovery Facilities (MRFs), Numerical problems.

Thermal Treatment Processes: Combustion Systems (Mass-Fired Combustion Systems, RDF-Fired Combustion Systems, Fluidized Combustion Systems, Hear recovery systems, Waterwall Combustion Systems, Waste heat boiler) Pyrolysis Systems, Gasification Systems, Environmental Control Systems, Energy Recovery Systems

Biological and Chemical Conversion Processes: Aerobic Composting (Aerated static pile composting, In-vessel composting, Windrow composting, Vermicomposting), Indore and Bangalore processes of composting, Anaerobic Digestion (low solids & high solids), Other Biological Transformation processes, Chemical Transformation processes, Energy production from biological conversion products.

14 hr

UNIT – III

Disposal methods: Types, Selection of suitable site, Ocean disposal, Feeding to hogs, Merits and demerits of various disposal methods.

Open dumping: Environmental implications of open dumping, Construction debris - management & handling, Rag pickers and their role

Sanitary land filling: Definition, methodology, Types - trench, area, ramp, pit methods, Basic steps involved, Site selection, Prevention of site pollution, Landfill remediation, Geo-technical considerations, Densification - earthen, Geo-membrane, Geo-synthetics and Geo-textiles.

8 hr

UNIT – IV

Operational aspects of Landfills: Daily cover, Final cover, Leachate disposal, Ground water monitoring, Leachate and its treatment, Gas collection and re-circulation systems, Post-closure environmental monitoring.

Treatment of other wastes: E-Waste Management, Hazardous waste management and Bio-medical waste.

Recent Developments in Solid Wastes Reuse and Disposal: Power Generation, Blending with construction materials and Best Management Practices (BMP), Community based waste management, Waste as a Resource concept, Public Private Partnership (PPP), Role of various organizations in Solid Waste Management: Governmental, Non-Governmental Citizen Forums.

8 hr

REFERENCES:

1. George Tchobanoglous, Hilary Theisen, Samuel A. Vigil, Integrated Solid Waste Management-Engineering Principles and Management Issues, McGraw-Hill, International Editions, 1993.
2. Ramachandra T. V., Management of Municipal Solid Waste, The Energy and Resources Institute, TERI, ISBN: 9788179931875, 9788179931875, 2006
3. Peavy and Tchobanoglous, Environmental Engineering, McGraw-Hill International Editions, 1985.

Reference Books:

1. A. D. Bhide and B. B. Sunderashan, Solid Waste Management in developing countries Bhide and Sunderashan, 14, Satsang vihar marg, Sansanwal marg special institutional area, New Delhi 110067, 1983
2. Stephen Burnley, Solid Waste Management, ISBN: 978-1-118-86393-0, Wiley publications, 2014
3. C.L. ell, Solid Waste Management, John Wiley, 1975.
4. P.W. Powers. How to dispose of toxic substances and industrial Waste, Noyes Data Corporation, England, 1976.
5. CPHEEO manual on solid waste management. 2010
6. J.L Pavoni, Hand Book of Solid Waste Disposal. New York .1975
7. Biomedical waste handling rules - 2000.

Scheme of Examination:

1. The question paper consists of two parts; Part-A and Part-B. Part-A is compulsory and Part-B has internal choice.
2. Part-A consists of one compulsory question with 20 sub question of 01 mark each/ 10 questions of 02 marks each, covering the entire syllabus (all units)/ (50% of the questions must be L3 and L4 level).
3. Part-B consists of one question from each unit with internal choice. Each question carries 20 marks. Any Four Full questions are to be answered from Part-B, choosing at least one question from each unit.
4. Each Question should not have more than four sub divisions.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Apply the basic scientific and sustainability principles behind waste management, for solving practical waste management challenges	2		1	1	2	
2	Evaluate the fundamental principles of existing and emerging technologies for collection and treatment of waste and recovery of value from waste.	2		3	1		1
3	Select the different disposal methods and prevention measures.	1		3		1	
4	Construct the waste and resource management importance in achieving environmental sustainability.			2		2	1
	Average	1.25		2.25	0.5	1.25	0.5

HAZARDOUS WASTE MANAGEMENT

3 Credits
(2-2-0)

Sub Code : 22 PEV15 **CIE Marks : 50**
Hrs/ Week : 03 **SEE Marks :50**

COURSE OUTCOMES

Students will be able to

1. Assess the special characteristics of hazardous waste material generated from different industries and understand rules and regulations for management of hazardous waste.
2. Evaluate 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.
3. Construct the various rules and regulations for safe transportation, handling and management of hazardous waste materials.
4. Apply the solid waste management systems of waste reduction at source, collection techniques and disposal techniques.

UNIT – I

Introduction- Definition, Sources and Classification, Land mark episodes (DDT, Mercury, PCB and PBB, Bhopal Gas Tragedy) Large and Small quantity Generators, Hazardous WasteCharacterization, 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,

10 hr

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.

10 hr

UNIT – III

Types of Incinerators- 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.

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

10 hr

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, Monitoringof Disposal Sites.

10 hr

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 Hill 1998.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Assess the special characteristics of hazardous waste material generated from different industries and understand rules and regulations for management of hazardous waste.	1		2		3	1
2	Evaluate 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.	2	1		2	2	
3	Construct the various rules and regulations for safe transportation, handling and management of hazardous waste materials.		2	1		2	2
4	Apply the solid waste management systems of waste reduction at source, collection techniques and disposal techniques.1			1	2	2	
Average		0.75	0.75	1.00	1.00	2.25	0.75

ENVIRONMENTAL ENGINEERING LAB

Credits

(0-0-2)

Sub Code : 22 PEVL17 **CIE Marks : 50**

Hrs/Week: 3 **SEE Marks : 50**

Course Outcome:

Students will be able to

1. Perform experiments relating to water and wastewater quality and know which tests are appropriate for given environmental problems.
2. Apply the laboratorial results to problem identification, quantification and basic environmental design and technical solutions.
3. Analyze and interpret experimental results and recommend the areas of air quality monitoring and wastewater for its safe disposal.
4. Demonstrate the ability to lead and work in groups and to write clear technical laboratorial reports.

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. 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.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Perform experiments relating to water and wastewater quality and know which tests are appropriate for given environmental problems.	2		1			2
2	Apply the laboratorial results to problem identification, quantification and basic environmental design and technical solutions.		3		2	1	
3	Analyze and interpret experimental results and recommend the areas of air quality monitoring and wastewater for its safe disposal.	2		2		2	
4	Demonstrate the ability to lead and work in groups and to write clear technical laboratorial reports.		3		1	1	1
Average		1.00	1.5	0.75	0.75	1.00	0.75

RESEARCH METHODOLOGY AND IPR

3 Credits

(3-0-0)

Subject Code: 22PSE017 **CIE Marks: 50**

Duration of Exam: 3 Hrs **SEE marks: 100**

On completion of the course, students should be able to:

1. Describe the value, scope, relevance and mandatory steps of research as well as principles of effective research.
2. Demonstrate the application and utility of the Systematic approach and out of the box thinking concepts for research to be effective.
3. Demonstrate the procedures outlined for a systematic Literature Review.
4. Analyze and prepare well structured research proposal and research paper invoking clearly outlined principles.
5. Describe and distinguish between different intellectual property rights.

UNIT 1:

Foundations of Research – Definitions of Research, Mandatory Steps in Research, Types of Research, Relevance of Research for Innovation and Technology Development, Effective Research and Self Discipline.

Out of the Box Thinking and Systematic approach in Research – Transformation to Impossible Thinking, Convergent and Divergent Thinking, Generation, Evaluation and Selection of Ideas.

10 hr

UNIT 2:

Literature Review – Importance of Literature Review, Constituents of Good Literature Review, Strategies for Literature Search, Referencing, Paraphrasing, and Summarizing, Academic Standards and Ethics.

Statistical methods and data analysis. Data Collection, Analysis and Interpretation, Ethics in Business Research, Research Design and Approaches: Descriptive, Exploratory, Causal, Qualitative Research, Observation Studies, Surveys, Experiments, Measurements and Scales, Questionnaires, Data Analysis: Presentation, Exploring and Examining.

10 hr

UNIT 3:

Research Proposal – Structure of a Good Research Proposal, Getting Started, Tips for Compilation of Good Research Proposal.

Technical communication – Research paper for publication – significance of problem statement and its scope, formulation of hypothesis, adequacy of methodology, significant of presentation and discussion of results, relevance and importance of references.

Effective presentation – Preparation, templates, balance between good design and good content, planning and sequencing, pampers, (projection, articulation, modulation, punctuation, enunciation, repetition and speed) rule, people (position and gestures, eye contact, orientation, proximation, looks and appearance, and expressions and emotion) rule, 4P's rule (plan, prepare, practice and present), essentials of effectiveness, effective pausing and inclusive answering.

10 hr

UNIT 4:

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999, The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

10 hr

CO	Statement	PO1	PO2	PO3
	On completion of the course, students should be able to:			
1	Describe the value, scope, relevance and mandatory steps of research as well as principles of effective research	2	1	3
2	Demonstrate the application and utility of the Systematic approach and out of the box thinking concepts for research to be effective	3	1	3
3	Demonstrate the procedures outlined for a systematic Literature Review	2	3	2
4	Analyze and prepare well structured research proposal and research paper invoking clearly outlined principles	2	3	2

INDUSTRIAL WASTEWATER MANAGEMENT
4 Credits
(3-2-0)

Sub Code : 22PEV21 **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.
2. Analyze the economics of industrial wastewater treatment vis -a- vis water quality of the stream for its best designated uses.
3. Implement the modern technical tools like waste minimization, strength reduction etc, in efficient and cost-effective practice.
4. Demonstrate the understanding of green environment and practicing the environmental friendly processes for the manufacture of various industrial products 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.

12 hr

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.

13 hr

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.

14 hr

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.

13 hr

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.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Assess the impact of industrial waste discharges on the water quality of stream and take the necessary measures to protect the water quality.	3		2		2	
2	Analyze the economics of industrial wastewater treatment vis -a- vis water quality of the stream for its best designated uses.	2			3	1	1
3	Implement the modern technical tools like waste minimization, strength reduction etc, in efficient and cost-effective practice.			2		2	2
4	Demonstrate the understanding of green environment and practicing the environmental friendly processes for the manufacture of various industrial products and also implementing the state-of-art technologies for wastewater treatment.			2	1	2	2
	Average	1.25		1.50	1.00	1.75	1.25

AIR POLLUTION AND CONTROL

4 Credits

(3-2-0)

Sub Code : 22 PEV22 **CIE Marks : 50**

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

COURSE OUTCOMES

Students will be able to

1. Understand the science of air pollution, air pollution episodes and its monitoring.
2. Design the hoods and ducts including stacks for ventilation and interpret the meteorology **c**omposition and structure of the atmosphere.
3. Identify the control technologies and design the air quality models.
4. Identify anthropogenic sources and atmospheric effects to pollutions.

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.

13 hr

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 is land effect, wind rose diagram,' General Characteristics of stack emission, plume behavior.

13 hr

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.

14 hr

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.

12 hr

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.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Understand the science of air pollution, air pollution episodes and its monitoring.	3		2			2
2	Design the hoods and ducts including stacks for ventilation and interpret the meteorology composition and structure of the atmosphere.	1			3	3	1
3	Identify the control technologies and design the air quality models.		1	2	3	1	
4	Identify anthropogenic sources and atmospheric effects to pollutions.		2		1	2	1
	Average	1.00	0.75	1.00	1.75	1.50	1.0

COMPUTER APPLICATIONS IN ENVIRONMENTAL ENGINEERING
(Credit-02)

Sub Code : 22PEVL27 **CIE Marks : 50**
Hrs/ Week : 03 **SEE Marks : 50**

COURSE OUTCOMES
Students will be able to

1. Outlines and writes programmers related to population forecasting and water supply and treatment system design.
2. Develop skill of writing programmers for water supply and treatment unit design.
3. Construct the C-programme related to wastewater collection and primary treatment units
4. Design and write the C-Programme on wastewater secondary treatment system.

LIST OF EXPERIMENTS
C- Programming on

1. Population Forecast Programs: Arithmetic Increase Method, Geometric Increase Method and Incremental Increase Method.

2. Water Supply and Treatment Programs: Rising main design, pumping unit, Water treatment units design -Cascade aerator, plain sedimentation tank, clariflocculator tank, filters (rapid and slow) and disinfection.

3. Wastewater Collection and Treatment Units Programs: wastewater treatment units – Screen and Grit chamber, Primary settling tank, Aeration tank.

4. Secondary treatment units: Secondary settling tank of ASP, Trickling filter unit, Sludge drying beds and Septic tank.

REFERENCES:

1. Thomann, R. V., and Mueller, J.A., (1987), "Principles of Surface Water Quality Modeling and Control" – Harper Int. Edition.
2. Krishna Murthy, C.S., and Rajeev, S., (1998), "Computer Aided Design software and Analytical Tools"– Norosa Publishing House.
3. Wark K. Warner, G.F., and Davis, W.T., (1998), "Air Pollution its Origin and Control" – Addison- Wesley.
4. Sincero, A.P., and Sincero, G.A., (1999), "Environmental Engineering – A Design Approach" Prentice Hall of India.
5. Water Supply and Treatment – CPHEEO Manual (Latest version), New Delhi.
6. Wastewater Collection, Treatment & Disposal – CPHEEO Manual (Latest version), New Delhi.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Outlines and writes programmers related to population forecasting and water supply and treatment system design.	3	3		2		2
2	Develop skill of writing programmers for water supply and treatment unit design.	1	2		3	2	
3	Construct the C-programme related to wastewater collection and primary treatment units.	3	1		1		
4	Dsign and write the C-Programme on wastewater secondary treatment system.		2		2	3	1
	Average	1.75	2.00		2.00	1.25	0.75

REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL ENGINEERING

3 Credits

(2-2-0)

Sub Code : 22 PEV241 **CIE Marks : 50**

Hrs/ Week : 03 **SEE Marks : 50**

COURSE OUTCOMES

1. Develop a sound understanding of the nature, purpose and underlying principles ofRemote Sensing.
2. Apply available Remote Sensing technologies and be able to match these to particularkinds of Geoenvironmental engineering problem.
3. Develop a critical awareness of the strengths and limitations of monitoring using Remote Sensing and the wider monitoring.
4. Capacity to extrapolate GIS data of ground water mapping, erosion studies, watershed management and drainage.

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.

10 hr

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.

10 hr

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 Photogrammetry: 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.

10 hr

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 Vulneribility assessment, GIS based master plan for sewage collection & transport system.

10 hr

REFERENCES:

1. Energy 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.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Develop a sound understanding of the nature, purpose and underlying principles ofRemote Sensing.	2		3		2	1
2	Apply available Remote Sensing technologies and be able to match these to particular kinds of Geoenvironmental engineering problem.		1		2	2	
3	Develop a critical awareness of the strengths and limitations of monitoring using Remote Sensing and the wider monitoring.	3	1	2			2
4	Capacity to extrapolate GIS data of ground water mapping, erosion studies, watershed management and drainage.		1			2	2
	Average	1.25	0.75	1.25	0.5	1.50	1.25

ENERGY AND ENVIRONMENTAL ENGINEERING

3 Credits

(2-2-0)

Sub Code : 22 PEV242 **CIE Marks : 50**

Hrs/ Week : 03 **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. Understand the energy scenario of renewable and non-renewable energysources.
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.

10 hr

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.

10 hr

UNIT-III

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

10 hr

UNIT-IV

Global temperature, Green house effects, global warming. Acid rain - Causes, effects and control methods. Regional impacts of temperature change. 10 hr

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.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Outline the need and application of various alternative fuels.	2	2		1		2
2	Apply various methods/technologies to harness various renewable energy sources and non-renewable energy sources.			2	3	1	1
3	Understand the energy scenario of renewable and non-renewable energysources.	2		3		3	1
4	Critically think about the global climatic changes-causes and effects.	1	2			3	2
	Average	1.25	1.00	1.25	1.00	1.75	1.50

BIOLOGICAL PROCESS FOR WASTEWATER TREATMENT

3 Credits (2-2-0)

Sub Code : 22PEV243 **CIE Marks : 50**

Hrs/ Week : 03 **SEE Marks : 50**

COURSE OUTCOMES

Students will be able to

1. Identify various parameters of biological methods of analysis of waste water.
2. Design the appropriate biological wastewater treatment processes and discuss pros and cons of each process.
3. Analyze the various problems encountered in aerobic and anaerobic treatment of waste water.
4. Construct the treatment methods for sludge obtained during the water and wastewater treatment.

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.

10 hr

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.

10 hr

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.

10 hr

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.

10 hr

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.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Identify various parameters of biological methods of analysis of waste water.	2		2		2	
2	Design the appropriate biological wastewater treatment processes and discuss pros and cons of each process.		2	3	2		2
3	Analyze the various problems encountered in aerobic and anaerobic treatment of waste water.	2		1	3	2	
4	Construct the treatment methods for sludge obtained during the water and wastewater treatment.			2	1	2	1
	Average	1.00	0.5	1.75	1.50	1.50	0.75

PROJECT MANAGEMENT

(03 Credits)

Sub Code : 22 PEV244 **CIE Marks :50**
Hrs/ Week : 03 **SEE Marks :50**

COURSE OUTCOMES:
Students will be able to

1. Identify the potential project and understand the strategic planning and analysis of the project.
2. Analyse the project scope, WBS and scheduling projects.
3. Perform the project on time and acquire the knowledge management, perform administrative work.
4. Construct the network analysis in project and MS Project to perform CPM /PERT analysis.

UNIT-1

Introduction: Definition of project, characteristics of projects, understand projects, types of projects, scalability of project tools, project roles Project Selection and Prioritization – Strategic planning process, Strategic analysis, strategic objectives, portfolio alignment – identifying potential projects, methods of selecting projects, financial mode / scoring models to select projects, prioritizing projects, securing and negotiating projects. 10 hr

UNIT-II

Planning Projects: Defining the project scope, Project scope checklist, Project priorities, Work Breakdown Structure (WBS), Integrating WBS with organisation, coding the WBS for the information system. Scheduling Projects: Purpose of a project schedule, historical development, how project schedules are limited and created, develop project schedules, uncertainty in project schedules, Gantt chart. 10 hr

UNIT-III

Performing Projects: Project supply chain management: – Plan purchasing and acquisitions, plan contracting, contact types, project partnering and collaborations, project supply chain management. 28 Project Progress and Results: Project Balanced Scorecard Approach, Internal project, customer, financial issues, Finishing the project: Terminate project early, finish projects on time, secure customer feedback and approval, knowledge management, perform administrative and contract closure. 10 hr

UNIT-IV

Network Analysis: Introduction, network construction – rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method (CPM) to find the expected completion time of a project, floats; PERTfor finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects. 10 hr

Text Books:

1. Project Management Timothy J Kloppenborg Cengage Learning Edition 2009.
2. Project Management -A systems approach to planning scheduling and controlling Harold kerzner CBS publication.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Identify the potential project and understand the strategic planning and analysis of the project.	2		3			1
2	Analyse the project scope, WBS and scheduling projects.		3	2	1	2	1
3	Perform the project on time and acquire the knowledge management, perform administrative work.	1	1			1	2
4	Construct the network analysis in project and MS Project to perform CPM /PERT analysis.			2	2	1	
	Average	0.75	1.00	1.75	0.75	1.00	1.00

OCCUPATIONAL SAFETY AND HEALTH

3 Credits

(3-2-0)

Sub Code : 22PEV245 **CIE Marks :50**

Hrs/ Week : 03 **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. 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. Analyse the change by advancing OH&S principles within management systems, cultures, practices, and priorities.
4. Construct the Cccupational Health and Safety Considerations in Wastewater Treatment Plants.

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. 10 hr

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. 10 hr

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). 10 hr

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.

10 hr

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 Reinhold International Thomson Publishing Inc, 1996.
4. Trevethick R. A. Environmental and Industrial Health Hazards,William Heinemann Medical Books Ltd., London (1973).

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Design policies and regulations for the development and maintenance of a healthy and safe work environment.		2		1	2	1
2	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.	2	1			2	1
3	Analyse the change by advancing OH&S principles within management systems, cultures, practices, and priorities.	1			2	1	1
4	Construct the Cccupational Health and Safety Considerations in Wastewater Treatment Plants.		2			3	2
	Average	0.75	1.25		0.75	2.00	1.25

NON – POINT SOURCES OF POLLUTION AND MANAGEMENT

3 Credits

(2-2-0)

Sub Code : 22 PEV251 **CIE Marks : 50**
Hrs/ Week : 03 **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. Construct the non-point source Pollution Simulation Models.
4. 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

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

10 hr

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.

10 hr

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.

10 hr

UNIT-IV

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

Planning for Nonpoint Pullution 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.

10 hr

REFERENCES

1. Novotny V., and Chesters G., “Hand Book of No n-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 Nostrand Reinhold, 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 Reinhold Company.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Utilize Simulation Models for tracing nonpoint source pollution.	1		3	1		2
2	Develop management solutions for nonpoint source pollution control.			1	3	3	
3	Construct the non-point source Pollution Simulation Models.	2		1	1		2
4	Select best management solutions for nonpoint source pollution control.	1		2		2	1
	Average	1.00		1.75	1.25	1.25	1.25

WATER RESOURCES ENGINEERING
3 Credits
(2-2-0)

Sub Code : 22 PEV252 **CIE Marks : 50**
Hrs/ Week : 03 **SEE Marks : 50**

COURSE OUTCOMES

Students will be able to

1. Evaluate the hydrological systems and processes at a wide range of scales in both spaceand time for the purpose of water resources assessment.
2. Estimate rainfall, optimum rain gauges and consistency with the concept hydrology.
3. Analyse the water hammer effects and flow measurement using different methods.
4. 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.

10 hr

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.

10 hr

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.

10 hr

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.

10 hr

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.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Evaluate the hydrological systems and processes at a wide range of scales in both spaceand time for the purpose of water resources assessment.	2		2		2	1
2	Estimate rainfall, optimum rain gauges and consistency with the concept hydrology.			3	2	1	
3	Analyse the water hammer effects and flow measurement using different methods.	2	2			1	2
4	Apply the concepts of hydraulics to design water mains, steady state groundwater problems.		1		1		1
	Average	1.00	0.75	1.25	0.75	1.00	1.00

WASTE TO ENERGY

3 Credits
(2-2-0)

Sub Code : 22 PEV253 **CIE Marks : 50**
Hrs/ Week : 03 **SEE Marks : 50**

Course Outcomes:

Students will be able to

1. Understand of the concept of Waste to Energy.
2. Analyse the technical and management principles for production of energy form waste.
3. Discuss about the best available technologies for waste to energy.
4. Develop the skills in the decision-making process.

UNIT I

The Principles of Waste Management and Waste Utilization. Waste Management, Hierarchy and 3R, Principle of Reduce, Reuse and Recycle. Waste as a Resource and Alternate Energy source.

Waste Sources & Characterization

Waste production in different sectors such as domestic, industrial, agriculture, postconsumer, waste etc. Classification of waste – agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous). Characterization of waste for energy utilization. Waste Selection criteria.

10 hr

UNIT II

Biomass Pyrolysis Types, slow fast, Manufacture of charcoal, Methods, Yields and application, Manufacture of pyrolytic oils and gases, yields and applications.

10 hr

UNIT III

Biomass Gasification, Gasifiers, Fixed bed system, Downdraft and updraft gasifiers, Fluidized bed gasifiers, Design, construction and operation, Gasifier burner arrangement for thermal heating, Gasifier engine arrangement and electrical power, Equilibrium and kinetic consideration in gasifier operation. 10 hr

UNIT IV

Biomass Combustion, Biomass stoves, Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation, Operation of all the above biomass combustors. Biogas, Properties of biogas (Calorific value and composition), Biogas plant technology and status, Bio energy system, Design and constructional features, Biomass resources and their classification, Biomass conversion processes, Thermo-chemical conversion, Direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, Types of biogas Plants, Applications, Alcohol production from biomass, Bio diesel production, Urban waste to energy conversion, Biomass energy programme in India. 10 hr

Reference Books:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd.,1990.

2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I &II, Tata McGraw Hill Publishing Co. Ltd., 1983.

3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd.,1991.

4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Understand of the concept of Waste to Energy.	2		2		1	
12	Analyse the technical and management principles for production of energy form waste.			2	3	1	2
3	Discuss about the best available technologies for waste to energy.			3	1	1	
4	Develop the skills in the decision-making process.	1	2	1			1
	Average	0.75	0.5	2.00	1.00	0.75	0.75

PLASTIC WASTE MANAGEMENT AND RECYCLING
(Credits-03)

Sub Code : 22 PEV254 **CIE Marks : 50**
Hrs/ Week : 03 **SEE Marks : 50**

OBJECTIVES:

Students will be able to
1. Analyse the various sources of plastics waste generation and the segregation methods for recycling the plastics and recycling codes of commodity and engineering plastics.
2. Demonstrate the waste treatment of various plastic plants.
3. To learn about primary recycling techniques with examples/case studies.
4. To understand the recycling of various commodity and engineering plastics.

Unit -I
Plastic & environment value additions, global policy, regulations, waste energy management. Recycling & recovery of various plastic items/materials their effect on environment. 10 hr

Unit -II
Waste treatment of various plastic plants, estimations of power requirement & efficiency of size reduction operation of plastics, environment pollution aspects. Need for recycling – Sorting and segregation of waste – Plastics identification- Plastics Production and composition– Plastics waste – Composition, quantities and disposal alternatives. 10 hr

Unit -III
Primary recycling – Equipments for primary recycling. Specific recycling techniques – PE films, PP battery case – Crushing and separation – PET films. 10 hr

Unit -IV
Recycling of plastics from urban waste – rheology, density, mechanical behavior. Secondary recycling Plastics wastes containing paper – hydrolytic treatment – processing methods – processing of mixed plastics waste – household waste – industrial sector – TPO based materials.

Use of recyclable plastics in motor vehicles – recoverable materials – disposal of residuals – recyclable plastic components – virgin and recycled HDPE – Fluorinated and unfluorinated HDPE – fuel tanks. Tertiary recycling – Reactors used – Advantages – Dry method wet method - use of recyclable plastics in automobiles. 10 hr

REFERENCES

1. “Plastic Waste Management" Nabil Mustafa, Marcel Dekker, New York, 1995.
2. John Schiles, Polymer Recycling.
3. Recycling & Plastics Waste Management, Edited by Dr. J.S. Anand, CIPET, 1997.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Analyse the various sources of plastics waste generation and the segregation methods for recycling the plastics.	2		1		3	1
2	Demonstrate the waste treatment of various plastic plants.		2	1	2	1	
3	Demonstrate the primary recycling techniques with case studies.	2		2	2		
4	Understand the recycling of various commodity and engineering plastics.			2		1	3
	Average	1.00	0.5	1.50	1.00	1.25	1.00

GREEN TECHNOLOGY

3 Credits

(3-0-0)

Sub Code : 22PEV253 **CIE Marks : 50**

Hrs/ Week : 03 **SEE Marks : 50**

Course Outcomes:

Students will be able to

1. Understand the principles of green chemistry and engineering.
2. Design processes those are benign and environmentally viable.
3. Design processes and products those are safe and hazard free.
4. Learn to modify chemical processes making hazardous products and make them green safe and economically acceptable by using biotechnology.

UNIT I

Fundamentals of Green Chemistry and Technology- Principles of Green Chemistry and technology, green chemistry metrics (atom economy, atom efficiency, E-factor, and other green chemistry metrics, Green processes- Microwave assisted reactions, ultra-sonication assisted reactions, ionic liquids as solvent, water as a reaction medium, solvent free reactions, supercritical solvents, safe product and process design, case studies.

10 hr

UNIT II

Industrial Safety and Hazard analysis- Introduction to ISO standards, hazard identification, life cycle analysis, and safety aspects related to transport, handling and storage of hazardous chemicals. green technologies for addressing the problems of Water, Energy, Health, Agriculture and Biodiversity- WEHAB (eco-restoration/ phyto-remediation, ecological sanitation, renewable energy technologies, industrial ecology, agro ecology and other appropriate green technologies, global warming; greenhouse gas emissions, impacts, mitigation and adaptation

10 hr

UNIT III

Green Nanotechnology – Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste Management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

10 hr

UNIT IV

Advances in separation process- Adsorption, Distillation, 04 filtration, membrane separation, precipitation, crystallization.

10 hr

REFERENCES:

1. Khan B.H, Non-conventional energy resources, Tata McGraw-Hill, New Delhi 2006.
2. Rashmi Sanghi and M.M. Srivastava, Green Chemistry-Environment Friendly Alternatives, Narosa Publishing House, New Delhi 2009.
3. Paul L. Bishop, Pollution prevention –Fundamentals and Practices, McGraw-Hill- international 2000.
4. N. Vinutha bai, R. Ravindra, Energy efficient and green technology concepts, International Journal of Research in Engineering and Technology p 253-258, Volume: 03, Special Issue: 06, 2014, ISSN: 2319-1163 pISSN: 2321-7308.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Understand the principles of green chemistry and engineering.			3	2	1	
2	Design processes those are benign and environmentally viable.			2		2	2
3	Design processes and products those are safe and hazard free.	1		2		2	1
4	Learn to modify chemical processes making hazardous products and make them green safe and economically acceptable by using biotechnology.	1		1		1	
	Average	0.5		2.00	0.5	1.50	0.75

DESIGN OF WATER AND WASTEWATER TREATMENT PLANTS

3 Credits (3-0-0)

Sub Code : 22 PEV31 **CIE Marks : 50**

Hrs/ Week : 03 **SEE Marks : 50**

Course Outcomes

Students will be able to

1. Understand the different unit operations involved in water and wastewater treatment.
2. Know about the design criteria and suitability of unit operations involved.
3. Analyse the suitability of treatment schemes for a variety of input parameters.
4. Apply the knowledge of design principles in the design of water and wastewater treatment Plants.

UNIT I

Water Treatment flowsheets, Treatment Plant Hydraulics, Head Loss Types and Calculations, Manifold Hydraulics, Intake Facilities, Design of Aeration Systems, Design of Chemical Mixing, Chemical Precipitation. 10 hr

UNIT II

Flocculation Process Design, Sedimentation Tank Design, Filter Design, Ion Exchange Process and Equipment Design, Membrane Unit Design, Disinfection and Sludge Handling. 10 hr

UNIT III

Wastewater treatment flowsheets, Screens- Design and Hydraulics, Grit Chamber, Proportional Weir, Sedimentation Tanks- Inlet and Outlet Design. 10 hr

UNIT IV

Biological Waste Treatment- Activated Sludge Process, Extended Aeration, Biofilter, UASB Reactor, Fluidised/Expanded Bed System, Ponds and Lagoon Design, Sludge Digestion and Drying Beds. 10 hr

Text Books and/or Reference Materials

1. Metcalf and Eddy “Wastewater Engineering: Treatment and Reuse, Tata McGraw Hill Edition. 2. Ronald L Droste, “Theory and Practice of water and Wastewater Treatment”, Wiley Publications.

3. Syed R Qasim, “Wastewater Treatment Plants – Planning, Design and Operations, CRC Press.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Understand the different unit operations involved in water and wastewater treatment.	2		2	1		2
2	Know about the design criteria and suitability of unit operations involved.		2	3		1	2
3	Analyse the suitability of treatment schemes for a variety of input parameters.			1		2	3
4	Apply the knowledge of design principles in the design of water and wastewater treatment Plants.	1			3	1	1
	Average	0.75	0.5	1.50	1.00	1.00	2.00

REUSE – RECYCLE TECHNOLOGY
3 Credit (3-0-0)

Sub Code : 22 PEV321 **CIE Marks : 50**
Hrs/ Week : 03 **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 metal recovery in various fields.
3. Apply the existing technologies for the treatment of biomass and design the devices.
4. 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. 10 hr

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.

10 hr

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. 10 hr

UNIT- IV

Sludge as soil conditioner, vegetable oil as fuels, Biodiesel, Refuse derived fuel, Waste oil recycling, waste utilization in cement kilns. 10 hr

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.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Understand the different wastes as fuel and conversion devices to convert waste to energy.			2		3	2
2	Apply the metal recovery in various fields.	2		1	3	1	
3	Apply the existing technologies for the treatment of biomass and design the devices.	1		2		2	2
24	Appreciate the increasing importance of waste and resource management in achieving environmental sustainability.			2		1	2
	Average	0..75		1.75	0.75	1.75	1.50

GLOBAL WARMING AND CLIMATE CHANGE

3 Credits

(3-0-0)

Sub Code : 22 PEV322 **CIE Marks : 50**

Hrs/ Week : 03 **SEE Marks : 50**

COURSE OUTCOMES

Students will be able to

1. Analyse the climate factors with their changes in the environment.
2. Demonstrate the effects of climate change models for future climate change.
3. Identify the effects of climate change on ecosystem.
4. Construct the possible ways to deal with 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 CO2 Emission, Global Warming Potential (GWP) of GHGs

10 hr

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.

10 hr

UNIT-III

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

10 hr

UNIT-IV

Cleaner Development Mechanisms: Various Projects related to CO2 Emission Reduction Alternatives of Carbon Sequestration: Conventional and non-conventional techniques, Role of Countries and Citizens in Containing Global Warming.

10 hr

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", Cambridge University Press.
8. Srivatsava A.K., "Global Warming", APH Publications.
9. Wyman R.L., (Ed.), "Global Climate Change and Life on Earth", Chapman and Hall Publications.
10. Yadav, Chander and Bhan, "Global Warming: India's Response and Strategy", RPH Publications.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Analyse the climate factors with their changes in the environment.	2	2		2	3	1
2	Demonstrate the effects of climate change models for future climate change.	1				2	2
3	Identify the effects of climate change on ecosystem.		1	2		1	2
24	Construct the possible ways to deal with energy issues and alternate energy sources.			3	1	2	2
	Average	0.75	0.75	1.25	0.75	2.00	1.75

ENVIRONMENTAL PLANNING AND MANAGEMENT

3 Credits

(3-0-0)

Sub Code : 22 PEV323 **CIE Marks : 50**

Hrs/ Week : 03 **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. Demonstrate the engineering economics and apply the cleaner technologies and their roles in environmental protection.
4. 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.

10 hr

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.

10 hr

UNIT – III

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

10 hr

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.

10 hr

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 and Sons.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
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.	2	2			3	1
2	Develop the most appropriate policies and planning for environmental protection by making proper environmental cost benefit analysis.		1	1		2	
3	Demonstrate the engineering economics and apply the cleaner technologies and their roles in environmental protection.	2		1	2	3	1
24	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.	1			2	2	
	Average	1.25	0.75	0.5	1.00	2.50	0.5

WATER RECLAMATION AND REUSE

3 Credits

(3-0-0)

Sub Code : 22 PEV324 **CIE Marks : 50**

Hrs/ Week : 03 **SEE Marks : 50**

COURSE OBJECTIVES

Students will be able to

1. Understand the wastewater reuse applications for various processes.
2. Apply the concepts of advanced wastewater treatment processes for different reuse purposes.
3. Analyse the suitability and management of advanced filtration systems for reuse applications of wastewater.
4. Evaluate the feasibility of different treatment flow sheets for waste water management in zero effluent discharge.

UNIT I

Overview of wastewater treatment processes. Wastewater reuse applications in irrigation, groundwater recharge and recreational purposes. Effluent standards for different reuse applications. 10 hr

UNIT II

Advanced Wastewater Treatment Processes: Adsorption, Ion Exchange, Advanced Oxidation Processes – Fenton's, Photo Fenton, UV and O zonation. 10 hr

UNIT III

Advanced Filtration Processes, Ultrafiltration, Microfiltration, Nanofiltration and Reverse Osmosis Processes, Design of Reverse Osmosis processes, Reject Management, Thermal Evaporators. 10 hr

UNIT IV

Concept of Zero Effluent Discharge, Karnal Technology, Impact of discharge of treated wastewater on land and groundwater. Effluent Treatment Plant for an Industry with zero effluent discharge. 10 hr

REFERENCES:

1.Syed R Qasim, Edward M Motley and Guang Zhu, Water Works Engineering: Planning Design and Operation, Prentice Hall.

2.Metcalf and Eddy "Wastewater Engineering: Treatment and Reuse, Tata McGraw Hill Edition.

3. Rittman Bruce "Environmental Biotechnology", McGraw Hill Publications.

4. Syed R Qasim, "Wastewater Treatment Plants – Planning, Design and Operations, CRC Press.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Understand the wastewater reuse applications for various processes.	2		2	1		2
2	Apply the concepts of advanced wastewater treatment processes for different reuse purposes.		1	2		2	
3	Analyse the suitability and management of advanced filtration systems for reuse applications of wastewater.	1			1	2	
4	Ealuate the feasibility of different treatment flow sheets for waste water management in zero effluent discharge.		1	1	3	1	1
	Average	0.75	0.50	1.25	1.25	1.25	0.75

OPERATION AND MAINTENANCE OF ENVIRONMENTAL FACILITIES

3 Credits

(3-0-0)

Sub Code : 22 PEV325 **CIE Marks : 50**

Hrs/ Week : 03 **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.
4. construct the Air Pollution Control Facilities- Regular inspection of Devices.

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.

10 hr

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.

10 hr

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.

10 hr

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.

10 hr

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 O and M for Municipal staff, Asian Development Bank Project, Government of Karnataka.
7. Walski T. M. Analysis of Water Distribution systems, CBS, Publications, New Delhi, 1987.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Apply basic principles, organizational structure, work planning and scheduling and cost estimates of O&M.			3	1		1
2	Prepare drawings, plans, record keeping, need for operational manual and SOP.	2	2			2 1	
3	Solve operational problems in water treatment and supply facilities, wastewater collection and treatment facilities, air pollution control systems.			1	1		2
2 4	construct the Air Pollution Control Facilities- Regular inspection of Devices.	1	1		1	2	1
	Average	0.75	0.75	1.00	0.75	1.25	1.00

ECOLOGY AND ENVIRONMENTAL IMPACT ASSESSMENT

3 Credits

(3-0-0)

Sub Code : 22 PEV331 **CIE Marks : 50**

Hrs/ Week : 03 **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.
4. Understand the practical considerations in preparing Environmental Impact Assessment and salient features of the project activity.

UNIT – I

Ecology-Classification of Ecosystem, terminology concepts of Ecology. Sub-divisons 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.

10 hr

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.

10 hr

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.

10 hr

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. 10 hr

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

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Identify different Components of ecosystem and their interactions and interrelationships.		1			2	2
2	Outline the systematic process for environmental impact assessment along with different methodologies.	3		2	2		3
3	Identify and assess the impacts on environmental attributes from developmental projects, Explain importance of public participation, EMP and DMP in EIA process.	1	2		2	1	
24	Understand the practical considerations in preparing Environmental Impact Assessment and salient features of the project activity.			2		3	1
	Average	0.75	0.75	1.00	1.00	1.50	1.50

ADVANCED ATMOSPHERIC ENVIRONMENTAL ENGINEERING

3 Credits

(3-0-0)

Sub Code : 22 PEV332 **CIE Marks : 50**

Hrs/ Week : 03 **SEE Marks : 50**

COURSE OUTCOMES

Students will be able to

1. Discuss the atmospheric processes and chemical reactions.
2. Asses the urban air quality simulation modeling.
3. Interpret the mobile sources of pollution and design the models for dispersion of heavy gases.
4. Investigate the indoor air pollution and effectively utilize knowledge of design on industrial ventilation systems.

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. 10 hr

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. 10 hr

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.

10 hr

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.

10 hr

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.

7. Wark K., Warner C.F., and Davis. W.T., "**Air Pollution, its origin and control**", Third Edition, Harper and Row Publication.

8. Steve M. Hays, Ronald V. Gobbell & Nicholas R. Ganick, "**Indoor Air Quality"-** Tata McGraw-Hill.

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	1. Discuss the atmospheric processes and chemical reactions.	1		2		2	1
2	Asses the urban air quality simulation modeling.	2			3	1	
3	Interpret the mobile sources of pollution and design the models for dispersion of heavy gases.			2	1		2
4	Investigate the indoor air pollution and effectively utilize knowledge of design on industrial ventilation systems.	2		1		1	1
	Average	1.25		1.25	1.00	1.00	1.00

ENVIRONMENTAL BIOCHEMISTRY AND BIOTECHNOLOGY
3 Credits
(3-0-0)

Sub Code : 22 PEV333 **CIE Marks : 50**
Hrs/ Week : 03 **SEE Marks : 50**

COURSE OUTCOMES
Students will be able to

1. Discuss the metabolism - stoichiometry arid energetics, thermodynamic principles, metabolic reaction and coupling, EMP pathway.
2. Infer the molecular genetics and its control system.
3. Use the biotechnology in the field of environmental and apply the microbes in sewage treatment system.
4. Apply the technologies for bioremediation of soil, water and air.

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. 10 hr

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. 10 hr

UNIT – III

Biotechnology- Introduction to Microbial Biotechnology, Uses of Enzymes, Isolation and Purification of Enzyme Engineering, Protein Engineering, Immuno 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. 10 hr

UNIT – IV

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

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, Meerut, 2002.
4. P.K. Guptha, Elements of Biotechnology, Restogi Publishers, Meerut, 2003.

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Discuss the metabolism - stoichiometry arid energetics, thermodynamic principles, metabolic reaction and coupling, EMP pathway.	2		2	1	2	
2	Infer the molecular genetics and its control system.			2	3		1
3	Use the biotechnology in the field of environmental and apply the microbes in sewage treatment system.	1		1		3	
4	Apply the technologies for bioremediation of soil, water and air.	1		1			2
	Average	1.00		1.50	1.00	1.50	0.75

ENVIRONMENTAL DISASTER MANAGEMENT

3 Credits

(3-0-0)

Sub Code : 22 PEV334 **CIE Marks : 50**

Hrs/ Week : 03 **SEE Marks : 50**

Course Objectives

1. Find out solution for a sustainable earth for future generation.
2. Make the stakeholder aware of their rights, responsibilities, consequence of their conduct towards nature and build resilience.
3. Develop a sense of equitable use of resources and their preservation for the future generation.
4. Sensitize the stakeholders on disaster and pandemic preparedness.

UNIT-I

The Environment: The Atmosphere, Lithosphere, Hydrosphere, Biosphere.

Ecosystem: Energy flow in the ecosystem, Biogeochemical Cycle: Water Cycle, Carbon Cycle, Nitrogen Cycle.

Pollution: Water Pollution, Air Pollution, Soil Pollution, Radiation Pollution, Industrial Pollution, Light Pollution, Sound Pollution.

Environmental Laws: (Water Act 1974, Air act 1981, The Wildlife Protection Act 1972, The Environment Protection Act 1986), The Forest Conservation Act 1980.

10 hr

UNIT-II

Climate Change & Sustainable Development:

Population Ecology: Individuals, Species, Population, Community, Human Population Growth, Population Control Methods, Urbanization and its effect on society.

Climate Change: Cause, Effect, Global Warming, Carbon Footprint and environmental protection Step taken towards Sustainable Development: Ban of single-use plastic automobile Scrapping Policy, Promotion of Electrical Vehicles, Brief idea on Sustainable Development Goals (SDGs), Agenda 21 of Rio Earth Summit.

10 hr

UNIT-III

Disaster Management: Types of Disasters (Natural and Man-made and their cause and effect) Vulnerability Assessment and Risk Analysis: Vulnerability to various disasters (Flood, Cyclone, Earthquake, Heat waves and Lightning)

Institutional Framework: Institutional arrangements for disaster management (National Disaster Management Authority (NDMA), State Disaster Management Authority (SDMA), District Disaster Management Authority (DDMA), National Disaster Response Force (NDRF) and Odisha Disaster Rapid Action Force (ODRAF).

Preparedness Measure: Disaster Management Cycle, Early Warning System, Pre-Disaster and Post Disaster Preparedness, Strengthening of SDMA and DDMA, Community Preparedness,

Stakeholder Participation, Corporate Social Responsibility (CSR).

Survival Skills: Survival skills adopted during and after disaster Flood, Cyclone, Earthquake, Heat waves and Lightning.

10 hr

UNIT-IV

Public Health Management:

Brief idea on Epidemics and Pandemics Non-Communicable Diseases with special reference to cardiovascular diseases, Cancer, Hypertension and Obesity and their prevention. Communicable Diseases with special reference to Covid-19, Flu, Hepatitis, AIDS and Tuberculosis and their transmission.

Dynamics of Disease Transmission: Mode of transmission (Direct/Indirect), Events after infection:

Immunity (Active vrs Passive, Innate vrs Acquired, Herd Immunity), Incubation Period.

Prevention of Epidemics/Pandemics Disease: Preventing Measures (Quarantine, Sanitization, Personal Protective measures such as Hand Washing and use of protective devices, Vaccination); Control Measures (Surveillance, Isolation, Contact Tracing), Life Style Management (Diet, Physical Exercise, Yoga and sleeping habit, Role of Different Sectors in managing Health Disaster: Role of Government (Centre and State), Community, Civil Society, Student mass, NGOs.

10 hr

Course outcome	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Select the solution for a sustainable earth for future generation.			1		3	2
2	Apprise the stakeholder aware of their rights, responsibilities, consequence of their conduct towards nature and build resilience.	2		1	2		
3	Develop a sense of equitable use of resources and their preservation for the future generation.	2	2		1		2
4	Sensitize the stakeholders on disaster and pandemic preparedness.			2		1	1
	Average	1.00	0.50	1.00	0.75	1.00	1.25

ENVIRONMENTAL GEO-TECHNOLOGY

3 Credits

(3-0-0)

Sub Code : 22 PEV335 **CIE Marks : 50**

Hrs/ Week : 03 **SEE Marks : 50**

COURSE OBJECTIVE

Students will be able to

1. Create awareness about subsurface contamination and its sources.
2. Infer the geotechnical aspects of planning and design of facilities for disposal of different solid waste.
3. Discuss about detection & monitoring of subsurface contamination and its remediation.
4. Evaluate the rehabilitation of waste dumps and geotechnical re-use of waste.

UNIT-1

Sources and effects of subsurface contamination; Physical, Chemical and biological characteristics of solid wastes; Soil-waste interaction; Contaminant transport, Concepts of Integrated SWM & Geoenvironmental Engineering. 10 hr

UNIT-2

Waste disposal on land, Types of landfills: Sitting criteria; waste containment principles; Types of barrier materials; Planning and design aspects relating to waste disposal in landfills, in ash ponds and tailing ponds, and in rocks Principles and Planning of Landfills, Liners for Landfills, Landfill Covers. 10 hr

UNIT-3

Generation and Control of Leachate and Gas from Landfills, Stability of Slopes and Settlement of Landfills. Environmental monitoring around landfills; Detection, control and remediation of subsurface Contamination. 10 hr

UNIT-4

Engineering properties and geotechnical reuse of waste, demolition waste dumps; Regulations; Planning & Design, Incremental Raisings and Failures of Slurry Ponds, Environmental Control Measures at Slurry Ponds, Geotechnical Reuse of Waste Case studies. 10 hr

REFERENCES:

1. Sharma, H. and Reddy, K.R., 2004. Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies. Wiley.
2. Daniel, D.E., 1993. Geotechnical Practice for waste disposal. Chapman and Hall, London.
3. Koerner, R.M., 2005. Designing with Geosynthetics. Prentice Hall, New Jersey.
4. Reddi, L.N. and Inyang H.I., 2000. Geoenvironmental Engineering: Principles and Applications, Marcel Dekker Inc Publication.

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Create awareness about subsurface contamination and its sources.	2		1	1	2	1
2	Infer the geotechnical aspects of planning and design of facilities for disposal of different solid waste.			2	1	1	
3	Discuss about detection & monitoring of subsurface contamination and its remediation.	1				3	2
4	Evaluate the rehabilitation of waste dumps and geotechnical re-use of waste.	1		2	1		
	Average	1.00		1.25	0.75	1.50	0.75

PROJECT WORK PHASE - I

3 Credits

(3-0-0)

Sub Code : 22 PEV33P **CIE Marks : 100**

Hrs/ Week : 03 **SEE Marks : 100**

COURSE OBJECTIVE

Students will be able to

1. Identify a current problem through literature/field/case studies.
2. Analyse the background objectives and methodology for solving the same study.
3. Infer and design the technologies developed through literature for the solving the same study.
4. Apply and develop a technology/process to address the problem.

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Identify a current problem through literature/field/case studies.	2	3			2	1
2	Analyse the background objectives and methodology for solving the same study.	1		3	1		1
3	Infer and design the technologies developed through literature for the solving the same study.	1	3	1		2	
4	Apply and develop a technology/process to address the problem.		1		2	1	1
	Average	1.00	1.75	1.00	0.75	1.25	0.75

Societal Project

3 Credits

(3-0-0)

Sub Code : 22 PEV35 **CIE Marks : 100**

Hrs/ Week : 03

COURSE OBJECTIVE

Students will be able to

1. Collect, assimilate, analyze and interpret the technical information/data.
2. Analyse the technical information/data pertaining to the recent environmental engineering related topics.
3. Infer and design the technologies developed through literature for the solving the same study.
4. Demonstrate writing and Communication skills effectively.

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Collect, assimilate, analyze and interpret the technical information/data.	1	3			1	
2	Analyse the technical information/data pertaining to the recent environmental engineering related topics.	2		2	3		1
3	Infer and design the technologies developed through literature for the solving the same study.				1		2
4	Demonstrate writing and Communication skills effectively.		3			2	1
	Average	0.75	1.50	0.50	1.00	0.75	1.00

PROJECT WORK PHASE - II

18 Credits

(3-0-0)

Sub Code : 22 PEV 41P
Hrs/ Week : 03

CIE Marks : 100
SEE Marks : 100

COURSE OBJECTIVE

Students will be able to

1. Identify a current problem through literature/field/case studies and define the background objectives and methodology for solving the same.
2. Analyse the background objectives and methodology to address the problem.
3. Infer, design and implement and evaluate the technologies developed through literature for the solving the same study.
4. Demonstrate the writing and communication skills effectively.

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6
1	Identify a current problem through literature/field/case studies and define the background objectives and methodology for solving the same.	2	3			2	1
2	Analyse the background objectives and methodology for solving the same study.	1		3	1		1
3	Infer and design the technologies developed through literature for the solving the same study.	1	3	1		2	
4	Demonstrate the writing and communication skills effectively.		1		2	1	1
	Average	1.00	1.75	1.00	0.75	1.25	0.75