HKE'S PDA College of Engineering, KalaburagiSchemeofTeachingandExaminations2024
M.Tech. ENVIRONMENTAL ENGINEERING COURSE CIVIL ENGINEERING DEPARTMENT
Choice Based Credit System (CBCS) and Outcome-Based Education(OBE)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical/Seminar	Skill Development Activities (Hours are for Interaction between facultyandstudents)	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1.	BSC/PCC	24PEV11	Computational Methods	03	00	00	03	50	50	100	3
2.	IPCC/PCC/ PBCL	24PEV12	Applied Environmental Chemistry and Microbiology	03	02	00	03	50	50	100	4
3.	PCC	24PEV13	Water Treatment Technology	03	00	02	03	50	50	100	4
4.	PCC	24PEV14	Air pollution and control	02	00	02	03	50	50	100	3
5.	PCC	24PEV15	Water Resources Engineering & Applied Hydraulics	02	00	02	03	50	50	100	3
6.	PCCL	24PEVL16	Microbiology Lab	03	00	00	03	50	50	100	3
7.	PCCL	24PEVL17	Environmental Engineering Lab-I	01	02	00	03	50	50	100	2
8.	PCC	24SEM18	Technical seminar	00	01	01	03	100	--	100	1
9.	NCMC	24RMI19	Research Methodology and IPR	Online courses (online.vtu.ac.in)							PP
			TOTAL	**17**	**05**	**07**	**24**	**450**	**350**	**800**	**22**

Note: BSC-Basic Science Courses, PCC: Professional core. IPCC-Integrated Professional Core Courses, NCMC- none credit mandatory course, PCCL- Professional core course lab, AUD/AEC –Audit Course / Ability Enhancement Course, L-lecture, P- practical,T/sda-tutorial/skill development activity (hours are for interaction between faculty and students), PBLC-project based learning course.

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 questionpaper.

Project Based Learning Course (PBLC): Project Based Learning Course is a professional core course only students have to complete a project out of learning from the course and SEE will be viva voce on project work.

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

1. Interact with industry (small,medium,andlarge).
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/field work.
4. Accustom to the use of standards/codes etc., to narrow the gap between academic 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, analyse and authenticate the output to interpretand 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 be involved either individually or in groups to interact together to enhance the learning and application skills of thestudy they have undertaken. The students with the help of the course teacher can take up relevant technical–activities that will enhance their skills. The prepared report shall be evaluated for CIE marks.

24RMI19-Research Methodology and IPR – None Credit Mandatory Course (NCMC) if student have not studied this course in their under graduate program then he/she has to take this course at **http://online.vtu.ac.in**and qualifying in this course is compulsory before completion of the minimum duration of the program (Two Years), however, this course will not be considered for vertical progression.

Technical Seminar: Students has to finalize the technical topic for the seminar in consultation with a faculty mentor, Preparation of the seminar report, and presentation slides to be presented at the end of the semester.

Proposed Syllabus for I Semester M.Tech.

(Environmental Engineering)

COMPUTATIONAL METHODS

Subject Code: 24PEV11	**Credits = 03**	
CIE: 50 Marks	**SEE: 50 Marks**	**SEE: 03 Hrs**
Hours / Week: 4 Hrs (Theory)		**Total Hours: 42**

Course objectives: To enable the student to acquire the knowledge in the following topics.

1. Fundamentals of Numerical solutions based on examples of simple computer program.
2. Various optimization problems and their importance in environmental studies and learning Linear Programming using computer programming.
3. Quantitative and qualitative assessment of waste generated.
4. Solve Statistics and Concepts of Probability.
5. Analysis of problems using computer programming.

Module - I

Newton-Raphson method for solution of simultaneous equations. Numerical solutions of partial differential equations. Finite difference, Finite element method and method of characteristics. Explicit and implicit methods to solve simple parabolic differential equations, convergence, Boundary value problems and successive over relaxation methods. Numerical dispersion errors and their prevention, Comparison of solutions by analytical and finite difference techniques for one dimensional instantaneous discharge simple computer program based examples.**18 Hrs**

Module - II

Definition and classification of optimization problems, its importance in environmental studies. Single and multivariable optimization without and with constraints.

Linear Programming: Standard form of problems – pivotal reduction of equations. Single and two phase simplex methods. Piece wise linear approximation of non-linear optimization.**08Hrs**

Module - III

Numerical search methods for 1-D non-linear problems – Dichotomous, Fibonacci and Golden section methods. Quadratic and cubic interpolation methods, Solutions of linear programming problems using computer programming. **08Hrs**

Module - IV

Statistics and Probability: Frequency Distribution – Characteristics of Distribution: Central Tendency and Dispersion, Concepts of Probability – Binomial, Poisson and Normal distribution, and their applications.
04 Hrs

Module - V

Methods of Least Square and regression – Multiple Regression – The Chi Squared Test; F-test, t-test. Analysis of problems using computer programming.**04 Hrs**

COURSE OUTCOME: At the completion of this course the student should be able to

1.Evaluate the Fundamentals of Numerical solutions based on examples of simple computer program.(C1)

2.Analyse Various optimization problems and their importance in environmental studies and learning Linear Programming using computer programming.(C2)

3.Understand the Quantitative and qualitative assessment of waste generated.(C3)

4.Evaluate Statistics and Concepts of Probability .(C4)

5. Analysis of problems using computer programming.(C5)

Reference:

1. Antony Raiston Philip Rabinowitz – A First Course in Numerical Analysis.
2. Brice, Luther N.A. and James O. Wilkes – Applied Numerical Methods.
3. Stanton R.G. – Numerical Methods for Science and Engineers.
4. Bheveridge – Optimizaton Techniques.
5. Rao S.S. – Optimization
6. Desai C.S. and John F Abel – Introduction to the Finite Element Method
7. Sienkiowics O.C. – The Finite Element Method
8. Statistical Hydrology
9. Ram S. Gupta, Hydrology and Hydraulic Systems.
10. Taha, Optimization.

Note: 1) In the examination Ten questions will be set covering all the FIVE modules TWO questions will be set from each module, out of which students have to answer FIVE full questions selecting atleast one question from each module.

2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests, Quizzes, class attendance.

3) Extent of teaching: Clearly mentioned in the syllabus.

APPLIED ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

Subject Code: 24PEV12	**Credits = 04**	
CIE: 50 Marks	**SEE: 50 Marks**	**SEE: 03 Hrs**
Hours / Week: 3Hrs (Theory) +2Hrs(Practical/Seminar)		**Total Hours: 56**

Pre-requisites: 1.Engineering Chemistry, 2. Environmental Studies.

Course objectives: To enable the student to acquire the knowledge in the following topics.

1. Fundamentals of chemistry and microbiology, and Relevant problems
2. Various Components of atmosphere, Electro Chemistry, heavy metals and Minerals, chemistry of fluoride, Organic compounds and biochemistry, and Design problems.
3. Qualitative Assessment of water and wastewater generated. Solve BOD, pH, Electrochemistry problems using mass balance and equilibrium theory. Related problems
4. Micro-organisms of importance in Air, water and Soil environment, various types of microscopes, algae.
5. Fungi, Bacteria., rotifers and virus, classification, morphology and cell growth.

Module - I

Introduction to Environmental Chemistry, concept and scope of environmental chemistry: environmental segments-Atmosphere, hydrosphere, lithosphere and biosphere. Oxidation and Reduction reactions, and potentials, oxidation-reduction of water bodies,. **6Hrs**

Electro chemistry, conductivity, Electronic pH measurement, Calomel, Glass and other electrodes, Basic concepts from Equilibrium Chemistry, Acids and Bases, Buffers index. **6Hrs**

Module – II

Determination of Iron, Manganese and Lead, Mineral analysis of water, BOD, COD, DO and TOC determinations, interferences and modifications, Chemistry of aqueous chlorine. **5Hrs**

General Considerations, Chemistry of Fluoride and Fluoride Compounds, Determination methods. **2Hrs**

Classification of organic compounds, distinctions of organics and inorganic, major group of organic compounds encountered in industrial waste waters **3Hrs**

Module – III

Basic concepts from Biochemistry Introduction, enzymes, cofactors, temperature relationships, effect of pH, major and trace elements, Biochemistry of carbohydrates, proteins, fats and oils, general Biochemical pathways, energetic and bacterial growth, Biochemistry of man (carbohydrates, fats, proteins and vitamins) **6Hrs**

Colorimetric, Beer's and Lambert's Law, Photoelectric colorimeters, spectrophotometers, Nephelometry, Absorption methods, ultra violet spectrophotometry, infrared spectrophotometry, flame photometry, Atomic Absorption spectrophotometry, Emission spectrophotometry, Fluorimetry, Gas chromatography and mass spectrometry, X-ray analysis. **6Hrs**

Module - IV

Study of Microbiology in Environmental Protection, Classifications of living organisms with special emphasis on microorganisms Micro-organisms of importance in Air, water and soil environment.Fundamental and applied Microbiology **4Hrs**

Types of microscopes, Resolving power and their application, Microscopic flora and fauna of importance in Environmental studies. Culture of microorganisms, stains and staining Techniques, estimation of bacterial numbers. **3Hrs**

Algae-occurrence, biological economic importance, morphology, classification and metabolism with special reference to those forms that influence the environment.Culture media. **4Hrs**

Module - V

Fungi– morphology, characteristics, classification, detection, metabolism, Species of importance in Biodegradation of organic matter. **4Hrs**

Bacteria – Structure, Composition, classification, size, morphology, spore formation, Reproduction, Metabolism, Nutritional types, growth kinetics, detoxifying bacteria with special reference to phenols and heavy metals. Role of bacteria in bio-concentration of trace contaminants in food chain.

Rotifers and higher animals**:**Study of protozoa, rotifers, crustaceans, worms and larvae **5Hrs**

Viruses - Structure, Composition, types of viruses, growth, diseases **2Hrs**

COURSE OUTCOME: At the completion of this course the student will be able to

1. Understand the problems of Environmental Engineering using the fundamentals of chemistry and microbiology, and relevant problems. (C2)
2. Apply the knowledge of water and wastewater to study minerals like iron manganese, lead and fluoride and to classify the organic compounds.(C3)
3. Understand the biochemistry of Organic materials and evaluate pollutants concentration by colorimetric and instrumental methods. (C4)
4. Apply the general knowledge of the microbiology to study the types of microscopes and algae.(C4)
5. Understand The fungi, Bacteria., rotifers and virus, classification, morphology and cell growth(C2)

References:

1. Sawyer C.N. and McCarty P L ,G F Parkin , Chemistry for Environmental Engineers - New York. Mc Graw-**Hill** Book , 1978.
2. W **Stumm**, J J **Morgan** , "Aquatic Chemistry"New York,. Wiley-Interscience. 1970
3. McKinney R.E. "Microbiology for Sanitary Engineers", McGraw Hill., New York
4. Plichael J. Pellzar, J R et al. "Microbiology" Tata McGraw Hill.
5. **APHA**, **AWWA**, **WPCF**; **Standard Methods** for the **Examination of Water** and **Wastewater** (21st edition)American Public Health Association, American **Water**works Associations, Water Pollution Control Federation

Note: 1) In the examination Ten questions will be set covering all the FIVE modules TWO Questions will be set from each module, out of which students have to answer FIVE full Questions selecting at least one question from each module.

2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests, Quizzes, class attendance.

3) Extent of teaching: Clearly mentioned in the syllabus.

WATER TREATMENT TECHNOLOGY

Subject Code: 24PEV13	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 3Hrs (Theory) + 2(SDA)		Total Hours: 56

Pre-requisites- 1. Environmental Engineering, 2. Water Resources Engineering
Course objectives: To enable the student to acquire the knowledge in the following topics.

1. Fundamentals of water Engineering, design of intake structure rising main and Aeration.
2. Theory and design of sedimentation, tube settlers and coagulation .
3. Theory and design aspects of filters and Adsorption .
4. Water softening. Fluoridation, corrosion and design aspects
5. Industrial water quality, O&M, water supply components , design aspects of Distribution systems, and Rural water supply systems

Module - I

Wholesomeness of water, hygiene, aesthetic, and economic requirements(water demand), physical, chemical and bacteriological standards for raw and treated water, limnology, thermal stratification, lake over turns. Objectives of various water uses. **3Hrs**

Location of intake, site selection, types of intakes, Design of Intake and Raising main, and water treatment units and pipeline friction, Hazen William equation. **4Hrs**

Principles of aeration, solubility of gases, Henry's Law, Vapor pressure, gas transfer coefficient, Methods of aeration. **3Hrs**

Module – II

Principles of sedimentation, General equation for settling or rising of discrete particles. Hindered settling, Effect of temperature, viscosity, efficiency of an ideal settling basin. Reduction in efficiency by currents and other factors. Short circuiting, design of inlets and outlets, sludge and sedimentation zones. Tube settlers. Design of settling tank. **8Hrs**

Common coagulants used in water, Effects of pH, alkalinity etc. Determination of optimum coagulant dose, Theory and use of coagulant aids. Bentonites, clays, lime soda, silicates, Organic polyelectrolytes, dosing, hydraulic mixing and mixing devices. Design of coagulation and flocculation tanks. Design of mechanical flocculators. Mean velocity gradient 'G', power consumption **6Hrs**

Module - III

Theory of Filtration: Characteristics of filter material. Types of Filters, Preparation of filter material. Hydraulics of filteration, hydraulics of back washing. Estimation of loss of head through sand, gravel, under drains. Filtrability index, Design of filters. Filter backwash, design of wash water troughs, rate of flow controllers, loss of head gauges. Filter problems, Operation and maintenance of filters. **8Hrs**

Theory of adsorption, Adsorption processes for control of taste and odour, removal of colour. Equilibria and isotherms, kinetic factors affecting and mode of operation. **2Hrs**

Module -IV

Softening of water – various methods. Langelier and Ryzner indices, split treatment, recarbonation, use of poly phosphate, disposal of sludge, recalcination, water treatment for boilers and process water, sequestering agents. **2Hrs**

Theory and Principles of disinfection,Minor methods of disinfection (Chlorine, Iodine, Bromine), Chicks Law, Factors affecting disinfection-, Free and combined available chlorine, residual chlorine, Types of Chorination, Chlorine dioxide**,** destruction of virus, dosage control, safety measures, emergency chlorination, disinfection of new Pipes **4Hrs**

Effects of Fluoride, Fluoridation and defluoridation, Methods of defluoridation. **2Hrs**
Theory of corrosion, Principle of galvanic, electrolytic, stress and biochemical corrosions, Factors influencing corrosion such as oxygen concentration, over voltage, pH, temperature. Corrosion inhibition- use of non metallic pipes, lining, coatings, protective films, cathodic protection
4Hrs

Module - V

Special problems of industrial water supply like sugar, paper and pulp, Textile, Breweries, Petrochemical industries. **2Hrs**
Trace organic contaminants in water supplies and their removal. **2Hrs**
Distribution system, Water quality in distribution system. Design of distribution system, Hardy cross method, Newton raphson method, Computer method.Operation and maintenance of distribution system. Operation and maintenance of treatment systems. Scale-up Aspects **3Hrs**
Rural Water Supply Systems. Borewell Water supply system(BWSS), Municipal Water supply system(MWSS) and Piped water supply system(PWSS) **3Hrs**

COURSE OUTCOME: At the completion of this course the student should be able to

1. Understand the water supply scheme and estimate the quantities and analyses the quality of water for municipal use.(C2)
2. Understand the sedimentation and coagulation processes used to treat water for municipal purpose.(C2)
3. Design of filters, Evaluate the fundamentals of adsorption principles that are used to design and operate the processes used in water treatment systems. (C4)
4. Evaluate and design water softeners. Fluoridation, Corrosion control units.(C4)
5. Evaluate Industrial water quality, study the O&M water supply components, design aspects of Distribution systems, and discuss the Rural water supply systems (C5)

References:

AWWA,Water quality and treatment; a handbook of public water supplies
American Water Works Association - 1971.
Fair, G.M. Geyer J.C. and Okum – 'Water and Wastewater Engineering', Vol. II- John Wiley, 1969.
Weber, Walter J., Physicochemical processes for water quality control., New York; Wiley Interscience; 1972.
Water and Wastewater Technology, Mark J Hammer, Prentice Hall of India; 6th edition, June 15, 2007.
Basic Water Treatment, C. Binnie, M. Kimber, G. Smethurst, Royal Society of Chemistry; 3rd edition, March 15, 2002.
Water Supply, A. C. Twort, F. M. Law, F. W. Crowley, D. D. Ratnayaka, Wiley, 1994.
Environmental Engineering, Howard S. Peavy (Author), Donald R. Rowe (Author), George Tchobanoglous, McGraw Hill Education; First edition, 1 July 2017.
New Concepts in Water Purificattion (Von Nostrand Reinhold environmental engineering series), **Culp, Gordon L., Culp, Russell L, V**an Nostrand Reinhold Company, 1974.
Manual on Water Supply and Treatment by Ministry of Works and Housing.
Water Supply Engineering, S.K. Garg, Khanna Publishers, New Delhi 110002, 2016.

List of Journals:

- Journal of Water Research
- Journal of Indian Water Works Association
- Water Quality International
- ASCE Journal of Environmental Engineering

- Indian Journal of Environmental Health.
- Journal of Institution of Engineers (India), Environmental Division.

Note: 1) In the examination Ten questions will be set covering all the FIVE modules TWO questions will be set from each module, out of which students have to answer FIVE full questions selecting at least one question from each module.

2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests, Quizzes, class Attendance.

3) Extent of teaching: Clearly mentioned in the syllabus.

AIR POLLUTION AND CONTROL

Subject Code: 24PEV14	Credits = 03	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 2 Hrs (Theory) + 2 (SDA)		Total Hours: 42

Pre-requisites- 1. Air Pollution

Course objectives: To enable the student to acquire the knowledge in the following topics.

1. Classification of air pollutants, composition of atmosphere, stability condition, flume behavior, stack dispersion equations, Measurements of meteorological variables.
2. Dispersion model studies, heat island effect, effects of air pollutants on living beings and building materials.
3. Sampling of air pollutants, methods of sampling and analysis, photo chemical smog.
4. Theory and design of particulate and gaseous control equipment's,
5. General control methods of SO_2 and noise study, environmental legislations.

Module - I

Introduction – Definitions, Sources and Classifications of air pollutants, Primary and Secondary air pollutants, Stationary and mobile sources. **4Hrs**

Meteorology– Composition and structure of the atmosphere, Meteorological factors influencing air pollution, wind circulation, solar radiation, adiabatic lapse rate, ELR, Atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), Temperature inversions,

Effects of air pollution on human health, plants, animals, and building materials, air pollution episodes national ambient air quality standards, criteria and indices, **8Hrs**

Module –II

Measurements of meteorological variables, wind rose diagram, General characteristics of stack effluent, plume behavior, Stack effluent dispersion theories, dispersion equations,

Theory of Diffusion, Fick's Law of difussion and Limitation, dispersion models, fixed box model, Gaussian dispersion model, stack design, maximum ground level pollutants concentration, Concentrations along plume line, Calculation of effective stack height, down wind pollutant concentrations under temperature inversion. Heat island effect, Effect of terrain on plume behaviors. **4Hrs**

2Hrs

Module -III

Sampling procedures: Classification of sampling methods, difficulties encountered in sampling, instruments for sampling waste gases and for atmospheric sampling(sampling train), sampling sites, sampling methods, sampling suspended particulates by high volume filtration, stack sampling techniques **3Hrs**

Laboratory analytical methods used for analysis of atmospheric samples (chemical, instrumental and biological methods)

Photochemical air pollution: Theory of formation of PAN, factors effecting, measurement and effects of photochemical smog **2Hrs**

Particulates**:** Collection mechanism and efficiency, Deposition of particulates from stacks, Hood and Duct design. **4Hrs**

Module - IV

Particulate Pollution Control Equipment – Design considerations of setting chambers, Cyclone separators, Wet collectors, Fabric filters and Electrostatic precipitators. **4Hrs**

General Control of gases and vapours**:** Combustion, Adsorption and Absorption (and their kinetics), closed collection and recovery systems, masking and counter action, Basic design of packed bed absorption water. **4Hrs**

Module - V

General control methods to reduce sulphur dioxide emissions from fossil fuel. **3Hrs**

Noise:Definition, Measuremetns, Sources, Effects, Occupational hazards. Addition of noise levels, CPCB standards, LeqLd, Ln, Ldn, Noise mapping, Noise attenuation equations and methods, prediction equations, control measures, noise control at source, along its path and at receiver, Legal aspects of noise. **4Hrs**

COURSE OUTCOME: At the completion of this course the student should be able to

1. Understand the Classification of air pollutants, composition of atmosphere, stability condition, plume behavior, stack dispersion equations,Measurements of meteorological variables.(C1)
2. Study Dispersion models, heat island effect, effects of air pollutants on living beings and building materials.(C2)
3. Analyse Sampling of air pollutants, methods of sampling, photo chemical smog. (C3)
4. Theory and design of particulate and gaseous control equipments, (C4)
5. Evaluate General control methods of SO_2 and noise study, environmental legislations.(C5)

References:

Perkins – Air Pollution.

Stern – Air Pollution Vol. I, II, III

Kenneth Work and Cecil F Warner – Air Pollution ,its origin and control, Harper and Row, Publishers,NewYork. 1982

Environmental Engineer's Handbook, 2, Chilton Book Co., Radnor, PA (1974),U.S.A

PL **Magill**, FR **Holden**, AC **Ackley**(Eds.), **Air Pollution** Handbook McGraw-Hill, New York (1956).

Sterm A.C. (ed.) Vol. V – Air Quality Management.

RC Flagan, JH Seinfeld ,Fundamentals of air pollution engineering,2012

List of Journals:

1. Journal of Air Pollution Control Assoc., New York.
2. Asian Environment, Philippines.
3. Industrial Engineering Chemistry Journal
4. Canadian Journal of Chemical Engineering
5. American Institute of Chemical Engineering Journal.

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3) Extent of teaching: Clearly mentioned in the syllabus.

WATER RESOURCES ENGINEERING AND APPLIED HYDRAULICS

Subject Code: 24PEV15	**Credits = 03**	
CIE: 50 Marks	**SEE: 50 Marks**	**SEE: 03 Hrs**
Hours / Week: 2 Hrs (Theory) + 2(SDA)		**Total Hours: 42**

Pre-requisites- 1. Hydrology and Water Resource Engineering

Course objectives: To enable the student to acquire the knowledge in the following topics.

1. Introduction to Water resources of the world, and Hydrology.
2. Understanding Hydrograph Theory and applications of Remote Sensing.
3. Assessment of Distribution Network
4. Flow measurements.
5. Understanding Ground water flow, ground water recharging, and ground water pollution.

Module - I

Water resources of the world**.** Surface and ground water resources of India and Karnataka National Water Policy Act. Multiple uses of water resources. **4Hrs**

Hydrology Introduction, Hydrologic Cycle including quantity and quality, estimation of precipitation and rain gauge density.**4Hrs**

Module - II

Hydrograph theory – Unit hydrograph, assumptions, derivation of unit hydrographs,S-hydrograph and synthetic hydrograph, flow routing – Muskingam method, Low flow analysis. **5Hrs**

Urban Hydrology – Run-off estimation, design of storm water drains.Basics and applications of Remote Sensing in Water Resources. **5Hrs**

Module - III

Distribution Network – Hardy Cross Method and Newton Raphson method, Raising Main Design. **4Hrs**

Unsteady flow through conduits: Water hammer analysis – Analytical and graphical methods, Water hammer protection methods. **4Hrs**

Module - IV

Open Channel Hydraulics: Steady and Unsteady Flow.Numericals

Flow measurements: Stream gauging, weir method, end-depth method, chemical method, tracer method, ultrasonic method, flumes. Current Meter **8Hrs**

Module - V

Groundwater Basic equations of flow. Flow into wells in unconfined and confined aquifers for steady and unsteady conditions, Sea water intrusion. Artificial recharge, groundwater pollution. **4Hrs**

Bore wells– Types and design principles. **4Hrs**

COURSE OUTCOME: At the completion of this course the student should be able to

1. Understand Water resources of the world and Hydrology. (C2)
2. Understanding Hydrograph Theory and applications of Remote Sensing.(C2)
3. Analysis of Distribution Network. (C4)
4. Understand and apply of Flow measurement techniques. (C3)
5. Understand and apply Ground water flow, ground water recharging, and ground water pollution. (C3)

References:

1. Ven T. Chow – Handbook of Applied Hydrology.
2. Todd – Ground water hydrology
3. Ranganath H.M. – Advanced hydrology
4. Subramanya K.S. – Advanced hydrology
5. Ven T. Chow – Open Channel Hydraulics
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 3.1.
9. Ram S.Gupta – Hydrology and Hydraulic System, S.
10. John Permankian, Water Hammer Analysis.

Note: 1) In the examination Ten questions will be set covering all the FIVE modules TWO questions will be set from each module, out of which students have to answer FIVE full questions selecting atleast one question from each module.

2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests, Quizzes, class attendance.

3) Extent of teaching: Clearly mentioned in the syllabus.

MICROBIOLOGY LAB

Subject Code: 24PEVL16	**Credits = 02**	
CIE: 50 Marks	**SEE: 50 Marks**	**SEE: 03 Hrs**
Hours / Week: 1 Hr (Theory) + 2Hrs (Practical)		**Total Hours: 52**

Students should learn the sampling techniques, preservation of samples, knowledge of IS and other standards on drinking water & preparation of regents.

Following Experiments to be done on both water & wastewater samples:

1. **Study of microscopes.**
2. **Studies on Microorganisms in Air.**
3. **Studies on Microorganisms in water and waste water.**
4. **Studies on Microorganisms in Soil.**
5. **Sterilisation Technique.**
6. **Total count.**
7. **M.P.N.Test.**
8. **Isolation of Bacteria.**
9. **Performance of aerobic and anaerobic waste water treatment temperature, pH, antibiotics on microbes.**
10. **Studies on Virus (Structures composition).**

Note: - 1. A laboratory report has to be submitted at the end of the semester and Lab exam is Teacher optional.

2. A standard methods for examination of water & wastewater 20^{th} edition has to be followed for test procedures.

ENVIRONMENTAL ENGINEERING LAB-I

Subject Code: 24PEVL17	**Credits = 02**	
CIE: 50 Marks	**SEE: 50 Marks**	**SEE: 03 Hrs**
Hours / Week: 1Hr (Theory) + 2Hrs (Practical)		**Total Hours: 52**

Students should learn the sampling techniques, preservation of samples, knowledge of IS and other standards on drinking water & preparation of regents.

Following Experiments to be done on both water & wastewater samples:

- **Ph Test**
- **Hardness Test**
- **Calcium and Magnesium Test**
- **Chloride Test**
- **Alkalinity Test**
- **Acidity Test**
- **Solids Test**
- **D.O. (Dissolved oxygen test)**
- **B.O.D (Bio chemical Oxygen test)**
- **Fluoride Test**
- **Sulphate Test**
- **Nitrate Test**
- **COD Test**

Note: - 1. A laboratory report has to be submitted at the end of the semester and Lab exam is Teacher optional.

2. A standard methods for examination of water & wastewater 20^{th} edition has to be followed for test procedures.

Subject Code: 24RMI19	Online Courses (online.vtu.ac.in) PP

RESEARCH METHODOLOGY AND IPR

Module–1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

8hrs

Module–2

Reviewing the literature: Place of the literature review in research, bringing clarity and focus to research problem, improving research methodology, broadening knowledge base in research area, Enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

9hrs

Module–3

Design of Sample Surveys: Design of Sampling: Introduction,SampleDesign,Sampling and Non-Sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multi dimensional Scaling, Deciding the Scale. Data Collection: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, **9hrs**

Module–4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis TestingforMean, Proportion, Variance, for Differenceof Two Mean, forDifference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautionsin Using Chi-square Tests, Ztest, Ttest, Ftest, ANOVA, Factor Analysis and Report Writing;Bibliography.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. **9hrs**

Module–5

Intellectual Property: The Concept, Intellectual Property System in India, World Intellectual Property Organization (WIPO), Protection of Intellectual Property under TRIPS, Patents Act - Meaning of a Patent –

Characteristics/Features.Patentable and Non-Patentable Invention. Types of Patent applications in India.Procedure for obtaining Patent.The Designs Act- Introduction to Industrial Designs.Essential requirements of Registration. Designs which are not registrable, Procedure for Registration of Designs, Copyright Act,1957 and Related Rights - Meaning of Copy Right, Characteristics of Copyright, various rights of owner of Copyright.Procedure for registration, Publication and term of copyright Infringement ofCopyright and Its remedies.Trade Mark Act, 1999,The Geographical Indications of Goods (Registration and Protection) Act1999. **7hrs**

Question paper pattern:

Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.

1. Each full question can have a maximum of 4 sub questions.
2. There will be 2 full questions from each module covering all the topics of the module
3. Students will have to answer 5 full questions, selecting one full question from each module

The total marks will be proportionally reduced to 60 marks as SEE marks is 60

Textbooks

1. Research Methodology: Methods and Techniques C.R. Kothari, Gaurav Garg New Age International 4th Edition,2018.
2. Research Methodology a step-by- step guide for beginners. (For the topic Reviewing the literature under module 2) Ranjit Kumar SAGE Publications Ltd 3rd Edition, 2011.
3. Study Material(For the topic Intellectual Property under module 5) Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

Ability skill enhancement course	
24PEV281	Green building
24PEV282	Water treatment plant
24PEV283	See which treatment plant
24PEV284	Land fill operation

PROPOSED SYLLABUS FOR II SEMESTER M.TECH.

HKE'S PDA College of Engineering, KalaburgiSchemeofTeachingandExaminations2022
M.Tech. ENVIRONMENTAL ENGINEERING COURSE CIVIL ENGINEERING DEPARTMENT
Choice Based Credit System (CBCS) and Outcome-Based Education(OBE)

II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours			Examination				Credits
				Theory	Practical/Seminar	Tutorial / skill development activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	IPCC/ PCC	24PEV21	Industrial Wastewater Treatment	02	00	02	03	50	50	100	4
2	PCC/ PBLC	24PEV22	Wastewater treatment engineering	02	00	02	03	50	50	100	3
3	PCC	24PEV23	Solid waste management	03	02	00	03	50	50	100	3
4	PEC	24PEV24X	Professional Elective 1	02	00	02	03	50	50	100	3
5	PEC	24PEV25X	Professional Elective 2	02	04	02	--	100	--	100	3
6	MPS	24MPS26	Mini project/ technology based societal project	00	04	02	--	100	--	100	3
7	PCCL	24PEVL27	Laboratory session	01	02	--	03	50	50	100	2
8	AEC/ SEC	24PEV28X	Ability/ skill enhancement course (offline/ online)	00 01	02 00	-- --	02 01	50	50	100	1
TOTAL				**13**	**10**	**10**	**21**	**450**	**350**	**700**	**22**

Note: BSC-Basic Science Courses, PCC: Professional core. IPCC-Integrated Professional Core Courses, NCMC- none credit mandatory course, PCCL-Professional core course lab, AUD/AEC –Audit Course / Ability Enhancement Course, L-lecture, P-practical, T/sda-tutorial/skill development activity (hours are for interaction between faculty and students), PBLC-project based learning course, MPS- Mini Project with Seminar/ Societal Project with Seminar.

Professional Elective 1		**Professional Elective 2**	
Course Code under 22XXX23X	**COURSE TITLE**	**Course Code under 22XXX24X**	**Course title**
24PEV231	Ecology and Environmental impact assessment.	24PEV241	Environmental sanitation Systems
24PEV232	Non-point sources of pollutions and management	24PEV242	Advanced Atmospheric Environmental Engineering
24PEV233	Environmental disaster management and risk assessment	24PEV243	Recycle and Reuse Technology
24PEV234	Transport Process and Modeling in Aquatic Systems	24PEV244	Environmental Geo-technology

NOTE Integrated professional core course (IPCC): Refers to a professional theory core course integrated with praticles 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.

Project based learning course (PBLC): Project based learning course a professional core course only students have to complete a project out of learning from the course and SEE will be via VOCE on project work.

1MiniProjectwith

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. It may be techno societal project technical project work useful for the society.

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/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. **There is no SEE for this course.**

Audit course/ Ability Enhancement Courses suggested by BOS (online courses): Audit courses: There are prerequisite courses suggested by the concerned board of studies. Ability enhancement courses will be suggested by the BOS if prerequisite courses are not required for the programs. **Ability Enhancement Courses:**

- 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 course are imputers 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 of candidate fails to appear for the proctored examination or fails to pass the selected online course, he or she can register and appear for the same course if offered during the next session or registered 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.

PROPOSED SYLLABUS FOR II SEMESTER M.TECH

INDUSTRIAL WASTEWATER TREATMENT

Subject Code: 24PEV21	**Credits = 04**	
CIE: 50 Marks	**SEE: 50 Marks**	**SEE: 03 Hrs**
Hours / Week: 3Hrs (Theory) +SS-02 Hrs		**Total Hours: 56**

Pre-requisites- 1. Wastewater Treatment, 2. Water resource and Hydrology.

Course objectives: To enable the student to acquire the knowledge in the following topics.

1. Fundamentals of effects of Industrial wastewater and different approaches for treatment.
2. Understanding continuous monitoring processes for better results.
3. Understanding various Pretreatment process of Industrial Wastewater.
4. waste water treatment method of different Industries.
5. Effects of Waste additions on physical and chemical properties of soil, Design of Complete treatment system disposal for various industries, Environmental auditing,

Module - I

Effects of Industrial wastes on sewage, sewage treatment plants and receiving water bodies. Effluent standards and receiving water quality standards. Different aspects and choices of various alternatives.

- Joint treatment of raw industrial waste with domestic sewage.
- Joint treatment of partially treated industrial waste and domestic wastes.
- Ill effects of discharge of raw waste on soil, environmental auditing. .**10Hrs**

Module - II

Industrial Waste Survey – Process flow charts, condition of waste stream. Material balance, Sampling – Grab, Composite and integrated samples. Continuous monitoring – pH, conductivity, biomonitoring, computation of organic waste loads on streams,steeter-Phelps formulations,Thimas method for determingpollutiom-loads on capacity of streams, Churchill method of multiple linear correlations.

10Hrs

Module - III

Pretreatment of Industrial Wastewater – Volume reduction, Strength reduction, Neutralization, Equalization and Proportion, Removal of Organic and Inorganic dissolved solids.

8Hrs

Module - IV

Wastewater Treatment in Specific Industries**:** Distillery, Dairy, Sugar, Cannery, Pulp and Paper, Cement, Textile, Dairy, Fertilizer, oil refinery, Pesticides, Pharmaceutical, tannery. Radio Active Wastes Treatment – Low Activity and high activity wastewaters Ultimate disposal of Industrial Wastewater Sugar, Refinery and Diary Industries.

12Hrs

Module - V

Effects of Waste additions on physical and chemical properties of soil, Bio-Remediation ,Design of Complete treatment system disposal for industries: Distillery, Diary, Sugar, Refinery, Textile, Paper and Pulp mill to meet P.C.B. norms.

8Hrs

Environmental auditing- introduction, Cost of pollution, Environmental audit solutions, Financial and Managerial opportunities. Criminal and Regulatory liabilities, site selection-Evaluation of cost of product basis, Tangible and Intangible factors, Importance of long term planning, Waste disposal and water supply as a critical factor,.

8Hrs

COURSE OUTCOME: At the completion of this course the student should be able to

1. Study the effects of Industrial wastewater and different approaches for treatment.(C1)
2. Understanding continuous monitoring processes for better results.(C2)
3. Evaluating various Pretreatment process of Industrial Wastewater.(C3)
4. Analyse waste water treatment method of different Industries. (C4)
5. Understand the Effects of Waste additions on physical and chemical properties of soil, Design of Complete treatment system disposal for various industries, Environmental auditing,(C5)

References:

1. Nelson N Nemerow – Liquid waste of Industry theories, Practices and Treatment, Addison Willey New York.
2. Nardam S Azad – Industrial Wastewater Management Handbook, McGraw Hill Book Col., New York.
3. Ross R.D. – Industrial Waste Disposal, Reinhold Environmental Series – New York.
4. Dickinson – Practical Waste Treatment and Disposal Applied Science Publication, London.
5. Mahajan – Pollution Control in Process Industries, TMH, New Delhi.
6. Self N.J. – Industrial Pollution Control.
7. Eckenfelder – Industrial Water Pollution Control, McGraw Hill Company, New Delhi by American Chemical Society, Washington D.C. USA.
8. Gaynor W Dawson et al – Hazardous Waste Management, A Wiley-Interscience Publication, New York.
9. James f Parr et al – Land Treatment of Hazardous Wastes, Noyes Data Corporation, Parkridge, New Jersey, USA.

List of Journals:

- ASCE Journal of Environmental Engineering
- Journal of Water Research
- Indian Journal of Environmental Health
- Tata Energy Research Institute (Energy Environment Monitor)
- Journal of Institution of Engineers (India), Environmental Division.
- Journal of Water Environment Research (JWPCF).

Note: 1) In the examination Ten questions will be set covering all the FIVE modules TWO questions will be set from each module, out of which students have to answer FIVE full questions selecting atleast one question from each module.

2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests, Quizzes, class attendance. 3) Extent of teaching: Clearly mentioned in the syllabus

WASTEWATER TREATMENT ENGINEERING

Subject Code: 24PEV22	Credits = 03	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 2 Hrs (Theory) + 2(SDA)		Total Hours: 42

Pre-requisites- 1. Environmental Engineering-II, 2. Hydrology and Water Resource Engineering

Course objectives: To enable the student to acquire the knowledge in the following topics.

1. Fundamentals of wastewater engineering, treatment, & determination of kinetic coefficients.
2. Fundamentals of process analysis, mass balance analysis and hydraulic characteristics.
3. Design of Sewer Systems, Physical, Chemical Treatment.
4. Biological Treatment , Aerobic , Anaerobic Biological Treatments and Design Aspects.
5. Nitrification process, process analysis, and its applications, Nitrogen and Phosphorous Cycles, Waste Treatability studies and Design problems.

Module - I

Objectives of wastewater treatment. Composition, Properties and analysis of wastewater. **6Hrs**

Microbiology of waste treatment – Growth and inhibition of bacteria. Kinetics of Biological growth, Batch culture, substrate limited growth, Cell growth and substrate utilization, effects of endogenous metabolism. Monod's and Michaclismenton kinetics and their applications. Determination of kinetic coefficients. **8Hrs**

Module - II

Fundamentals of process analysis, reaction kinetics, mass balance analysis, reactors and their hydraulic characteristics, reaction kinetics and reactor selection. Batch, plug flow, completely stirred tank reactor and packed and fluidized bed reactor. **6Hrs**

Module – III

Design of sanitary sewers and storm water sewers. Physical treatment: reverse osmosis, Dialysis, Electro dialysis, Evaporation, multiple evaporation, Adsorption, sedimentation flocculation, Steam stripping, Screens, comminutors, Grit Chambers, Chemical Treatment : Ion exchange, Neutralization.**6Hrs**

Module - IV

Biological treatment process. Activated sludge process-Standard type and modifications. Aerators. Trickling filter, aerated lagoon, and stabilization ponds. Well injection, Brush aeration, subsurface disposal, biodisc system, Treatment disposal of sludge – Sludge characteristics, concentration. Anaerobic sludge digestion. Aerobic sludge digestion, sludge conditioning, Dewatering and drying. Incineration and wet oxidation, Anaerobic filters, UASB **8Hrs**

Module - V

Nitrogen conversion and removal. Forms, sources and operations and process for the control of nitrogen. Nitrification-process, process analysis and their applications. Nitrogen removal by physical and chemical process – Air stripping of ammonia and ion exchange. **3Hrs**

Phosphorous removal – Operations and process for phosphorous removal. **2Hrs**

Nitrogen sulfur and phosphorous cycles. Waste treatability studies – Bench scale and pilot scale, Effluent standards for discharge to water bodies and land applications – state and central norms & standards. **3Hrs**

COURSE OUTCOME: At the completion of this course the student should be able to

1. Understand the Fundamentals of wastewater engineering, treatment, & determination of kinetic coefficients.(C2)
2. Analyse Fundamentals of process analysis, mass balance and hydraulic characteristics. (C2)
3. Design of Sewer Systems, summerise Physical and Chemical Treatment.(C4)
4. Design aspects of Biological Treatment (Aerobic & Anaerobic).(C4)
5. Understand the Nitrification process and its applications, Nitrogen and Phosphorous Cycles, Waste treatability studies and Design problems. (C3)

Reference:

1. Metcalf and Eddy – Wastewater Engineering.
2. Webber W.J. Physico-chemical processes for water quality.
3. Fasir G.M., Geyer J.G. and Okun – Water Wastewater Engineering.
4. Eckenfelder and O'Connor – Biological Waste Treatment.
5. Gaudy and Gaudy – Microbiology for Environmental Scientist and Engineers. McGraw Hill – 1980.
6. Gaudy – Advanced Wastewater treatment.
7. Ramalho – Advanced Wastewater treatments.

List of Journals:

1. ASCE Journal of Environmental Engineering
2. Journal of Water Research
3. Indian Journal of Environmental Health
4. Energy Environment Monitor (Tata Energy Research Institute)
5. Journal of Institution of Engineers (India) Environmental Division
6. Journal of Water, Environment Research (JWPCF).

Note: 1) In the examination Ten questions will be set covering all the FIVE modules TWO questions will be set from each module, out of which students have to answer FIVE full questions selecting atleast one question from each module.

2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests, Quizzes, class attendance.

3) Extent of teaching: Clearly mentioned in the syllabus

SOLID WASTE MANAGEMENT

Subject Code: 24PEV23	**Credits = 03**	
CIE: 50 Marks	**SEE: 50 Marks**	**SEE: 03 Hrs**
Hours / Week: 2 Hrs (Theory) + 2 Hrs (SDA)		**Total Hours: 30**

Pre-requisites- 1. Environmental Studies,

Course objectives: To enable the student to acquire the knowledge in the following topics.

1. Fundamentals of solid waste management, collection transportation, and disposal methods.
2. Treatment methods, sanitary land filling and design.
3. Aerobic, Anaerobic Composting and Design.
4. Theory and design of incineration.
5. Pyrolysis process for specific solid waste. Reuse and recycle of solid waste, management of toxic solid waste.

Module - I

Definition and Scope, necessity and importance of solid waste, Sources, Types, Classification, and composition of MSW, Data Collection, collection and Reduction at source.
Collection equipment's, systems of collection, garbage, chutes, transfer stations, bailing and compacting, route optimization. Disposal methods- selection of site, open dumping, ocean disposal, feeding to hogs – merits and demerits. **5Hrs**

Module - II

Treatment Methods: Various methods of refuse processing, fertilizer, fuel and food values.**2Hrs**
Sanitary Land Filling: Definition, methodology, trench, area, ramp, pit method, site selection, basic steps involved, cell design, prevention of site pollution, leachate treatment, gas collection and recirculation. Control of land fill gases, design problems **4Hrs**

Module - III

Composting: Aerobic and anaerobic composting, factors affecting composting, Indore and Bangalore method processes of composting. And Design Problems**3Hrs**

Module - IV

Incineration Processes 3Ts to control high temperature incinerators, design approach, prevention of air pollution, gasification systems, combustion systems., closure of landfills, **4Hrs**

Module - V

Pyrolysis: Process, basic steps involved, end product, pyrolysis of specific solid waste. **5Hrs**

Recycle and Reuse: Material and energy recovery operation, reuse in other industries. Recovery of biological conversion products, recovery of thermal conversion products **4Hrs**

Managementof toxic solid waste, recent innovations. Management of E-waste. **3Hrs**

COURSE OUTCOME: At the completion of this course the student will learn to

1. Understand the basics of solid waste quantity and know its characteristics. (C2)
2. Understand and apply the different methods of treatment and disposal of municipal solid waste and their design aspects.(C3)
3. Evaluate Aerobic and Anaerobic composting and design. (C4)
4. Understand and apply the fundamentals of Incinerators and its design. (C4)
5. Apply the Process of reuse and recycle of solid waste and management of toxic waste. (C3).

Reference:

1. **JL Pavoni**, JE Heer Jr, DJ Hagerty , **Handbook** of **solid waste disposal** - 1975 - osti.gov,U.S.A
2. Solid waste Management, Van Nostrand Reinhold co., 1975.
3. G.Tchobanoglous, H. Theisen and R.Liliaissen, Solid Waste Engineering, Principles and Management Issues, McGraw Hill, New York, 1977.
4. CL Mantell Solid wastes: origin, collection, processing, and disposal , John Wiley and Sons, Inc.,New York, NY 1975
5. Powers,p.W. How to dispose of toxic substances and industrial waste, Noyes data corp,ParkRidge,NJ ,U.S.

Note: 1) In the examination Ten questions will be set covering all the FIVE modules TWO questions will be set from each module, out of which students have to answer FIVE full questions selecting atleast one question from each module.

2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests, Quizzes, class attendance.

3) Extent of teaching: Clearly mentioned in the syllabus.

PROPOSED SYLLABUS FOR II SEMESTER M.TECH

ECOLOGYANDENVIRONMENTALIMPACTASSESSMENT

SubjectCode:24PEV231	**Credits=03**	
CIE:50Marks	**SEE:50Marks**	**SEE:03Hrs**
Hours/Week:2Hrs(Theory)+2Hrs(SDA)		**TotalHours:30**

Course objectives: To enable the student to acquire the knowledge in the following

1)topics. Classification, structure and function of Ecosystem, Division of Ecology.

2)Energy flow in Ecosystems, Population, Community and Habitat.

3)Types of Ecosystems, Diversity Indices ,Ecosystem Modeling and Problems

4)Developmental Activity and Ecological Factors, EIA Framework.

5)Project activity, Environmental parameters and EIA for water resource development projects

Module-I

Classification of Ecosystem, Terminology, Concepts of Ecology, Sub-divisions in Ecology. Bioticand Abiotic Components, structure and functions of ecosystems. 4**Hrs**

Module-II

Energy flow in Ecosystems. Measurement of Primary productivity. Ecological Niche and succession. Population Ecology, Community Ecology, Habitat Ecology. Biogeochemical cycles, Ecological pyramids.

4Hrs

Module-III

Aquatic and Terrestrial Ecosystems, Dominance and Diversity Indices(problems) Adaptations, Biogeography, Systems Ecology and Ecosystem Modeling.

Oligotrophy, Eutrophicstatus, Nutrient Enrichment–Analysis of Eutrophication–Vollenweider and Dillon Models of Phosphorous loading on lakes. Control of Eutrophication. **6Hs**

Module-IV

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.

Framework of Impact Assessment, Developmental projects in environmental setting. Objectives 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, EIA guidelines for development projects, REIA-CEIA. **8Hrs**

Module-V

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

Salient features of the project activity – Environmental parameters – Activity relationships – matrices.

EIA for water resource development projects, Nuclear power plant project, mining project (coal, aluminum,iron ore, bauxite), Thermal Power Plant (coal based) project, pharmaceutical industries, etc. **8Hrs**

COURSEOUTCOME: Atthecompletionofthiscoursethestudentshouldbeableto

1. Classify and explain the structure and function of Ecosystem, list the Division of Ecology.(C1)
2. EvaluatetheEnergyflowinEcosystems,Population,CommunityandHabitat(C2)
3. List the Types ofEcosystems, explain Diversity Indices ,study of Ecosystem Modeling and related Problems(C3)
4. understandtheDevelopmentalActivityandEcologicalFactors,EIAFramework.(C4))
5. summerise project activity ,Environmental parameters and EIA for water resource development projects(C5)

References:

1. Odum–FundamentalsofEcology–AdditionCo.
2. Kormondy–ConceptsofEcology–PrenticeHallPublicaton.
3. AnantakrishnaanT.N.–Bio-resourcesEcology–OxfordandIBM.
4. KrebsJ–Ecology–Theexperimentalanalysisofdistributionandabundance-IIEditionHarperInternational.
5. **MommyREEd**EnvironmentalImpactAssessmentJohnwiley.
6. CanterL–EnvironmentalImpactAssessmentMcGrawHill,1977.
7. ClarkB.C.,BisettandTomlinsanP–Perspectiveonenvironmentalimpactassessment–AlliedPublishers – 1985.
8. Mall C.A.S. and Day J.W. – Ecosystem Modelingin Theory and Practice: An Introduction with Case NI Stories – John Wiley.
9. HeerandHagerty,EnvironmentalImpactAssessmentandStatements.VanNostrandandReinhold Co. 1977.
10. Jainetal–Environmental Impact Assessment, VanNostrand.

List of Journals:

1. Journal of Urban Planning and Development
2. Journal of Ecology–Bombay
3. Journal of Ecology.

Note: 1) In the examination Ten questions will be set covering all the FIVE modules TWO questions will be set from each module, out of which students have to answer FIVE full questions selecting atleast one question from each module.

2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests, Quizzes, class attendance.

Extent of teaching :Clearly mentioned in the syllabus.

PROFESSIONAL ELECTIVE-I
NON-POINT SOURCES OF POLLUTIONS AND MANAGEMENT

Subject Code: 24PEV232	Credits = 03	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 2 Hrs (Theory) + 2 Hrs (SDA)		Total Hours: 30

Course objectives: To enable the student to acquire the knowledge in the following topics.

1. Non point pollution problems, magnitude and control Laws, Surface Water Problems.
2. Atmospheric pollution and ground water pollution.
3. Pollution from impervious urban areas, deposition, accumulation and removal of solids.
4. Non point Pollution Simulation Models Land use andon point pollution Effect of Hydrologic Modifications.
5. Management Practices of Nonpoint pollution control.

Module - I

Introduction – Non point Pollution, Problem, definitions, magnitude of Nonpoint Pollution, Nonpoint Pollution Control Laws**.** **2Hrs**

Surface Water Problems – Introduction Waste Assimilative Capacity and Stream Standards. **2Hrs**

Module - II

Pollution From the Atmosphere – Atmospheric Inputs. **2Hrs**

Groundwater Pollution – Groundwater (Base Flow) and Nonpoint Pollution Groundwater Movement, Origin of Groundwater Quality Sources of Groundwater Contamination. **1Hr**

Module - III

Pollution from impervious urban areas – Introduction Deposition and Accumulation of Pollutants on Impervious Surfaces. Removal of Solids from street Surfaces, Porous Pavement. **6Hrs**

Module - IV

Non point Pollution Simulation Models – Basic Concepts Brief Description of available Nonpoint Pollution Simulation Models. **4Hrs**

Land use and non point pollution – use Effects on Nonpoint Pollution Comparative Assessment of Pollution Impact from land uses. Effect of Hydrologic Modifications. ``` **6Hrs**

Module - V

Management Practices of Nonpoint pollution control – Introduction Source Control Measures Collection Control and Reduction of delivery. **4Hrs**

Planning for Nonpoint Pollution Control – Introduction, Water Quality Planning Process, Selection of Best Management Practices for Non point Source Pollution Control. **3Hrs**

COURSE OUTCOME: At the completion of this course the student should be able to

1. Evaluate Non point pollution problems, magnitude and control Laws, Surface Water Problems.(C1)
2. Estimate Atmospheric pollution and ground water pollution.(C2)
3. Analyse the Pollution from impervious urban areas, deposition, accumulation and removal of solids.(C3)
4. Evaluate Non point Pollution Simulation Models Land use and non point pollution Effect of Hydrologic Modifications. (C4)
5. Understand the Management Practices of Nonpoint pollution control.(C5)

REFERENCES:

1. Hand Book of "Water Quality Management Planning", Edited by Pavoni J L, Van Non strand Reinhold Environmental Engineering Series.
2. Pluarg, Pollution from Land Use Activities Reference Group Novotny V and Chesters G, (1981), "Hand Book of Non-point Pollution, Sources and Management", Van No strand Reinhold company.

Note: 1) In the examination EIGHT questions shall be set covering all the chapters mentioned above, out of which students have to answer FIVE full questions

2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests or Quizzes/class, Attendance.

ENVIRONMENTAL DISASTER MANAGEMENT AND RISK ASSESSMENT

Subject Code: 24PEV233	**Credits = 03**	
CIE: 50 Marks	**SEE: 50 Marks**	**SEE: 03 Hrs**
Hours / Week: 2 Hrs (Theory) + 2 Hrs (SDA)		**Total Hours: 30**

Course objectives: To enable the student to acquire the knowledge in the following topics.

1. Natural Disasters,
2. Disaster Management.
3. Risk analysis and assessment.
4. Evaluation of the likelihood of major accidents in industrial processes.
5. Risk assessment in developing programmers', framework for sustainable development.

Module - I

Natural disasters – Floods, landslides, earthquakes, volcanism, avalanche, cyclones, drought and fire. Prediction, perception and adjustment to hazards. **6Hrs**

Module - II

Disaster Management – Environment risk due to project activities. Preparation of on-site and off site disaster management plans. Predisaster actual disaster-post disaster relief camp organization. Role of voluntary organization and armed forces. **5Hrs**

Module - III

Risk analysis and assessment: Basic concept, purpose of risk analysis; analytical techniques; tools of risk assessment-toxicology, epidemiology exposure modeling, and significance of risk, risk characterization, communication and management. **6Hrs**

Module - IV

Evaluation of the likelihood of major accidents in industrial processes, assessing risk to ecosystems and human health from genetically modified organizations, waste water treatment and disposal, epidemiology exposure modeling, assessing risk to human health from chemicals.

Psychology of risk, the economic and evaluation of risks. **8Hrs**

Module - V

Risk assessment in developing programs. Experience of world Bank-risk communication framework for sustainable development. **7Hrs**

COURSE OUTCOME: At the completion of this course the student should be able to

1.Categorise& Explain the Natural Disasters, (C1)

2.Analyse Disaster Management.(C2)

3.Evaluate Risk analysis and assessment.(C3)

4.Evaluation of the likelihood of major accidents in industrial processes. (C4)

5.Estimate the Risk assessment in developing programmers choose the framework for sustainable development.(C5)

REFERENCES:

1. John G Rau and David C Woosten (1980) Environmental Impact analysis Hand book, McGraw-Hill.
2. John Glasson, RikiTherivel, Andrew Chadwick (1994). Introduction to Environmental Impact Assessement, Research Press.
3. Girish K Mishra and G C Mathew (eds) (1993) Natural Disaster Reduction Reliance Publishing House, 302/74, Rangit Nagar, New Delhi.

Note: 1) In the examination EIGHT questions shall be set covering all the chapters mentioned above, out of which students have to answer FIVE full questions.

2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests or Quizzes/class attendance.

3) Extent of teaching: Clearly mentioned in the syllabus.

TRANSPORT PROCESSES AND MODELING OF AQUATIC SYSTEMS

Subject Code: 24PEV234	**Credits = 03**	
CIE: 50 Marks	**SEE: 50 Marks**	**SEE: 03 Hrs**
Hours / Week: 2 Hrs (Theory) + 2 Hrs (SDA)		**Total Hours: 30**

Course objectives: To enable the student to acquire the knowledge in the following topics.

1. Theory of molecular diffusion and dispersion, stream water quality modeling.
2. Calibration and verification of 1-D oxygen model,
3. Theory and design aspects of mixing zones in rivers.
4. Dissolved oxygen models for lakes under completely mixed and stratified conditions. Theory and design of ocean disposal methods of wastewater, eutrophication,
5. Ground water and ecosystem model studies.

Module- I

Models as Comprehensive tools in Environmental Management Diffusion and dispersion – Definition, Molecular turbulent and shear diffusion, derivation of Fick's laws of diffusion and convective – diffusion equations for turbulent and shear flow regimes.**6Hrs**

Module II

Steady state water quality modeling. Models for decaying pollutants (bacteria, phenol, ammonia) in rivers. 1-D oxygen balance models – Streeter – Phelps equation, critical point method. Data collection – specialized water quality surveys based on statistical average concepts. Estimation of parameters – decay and reareation rates. Calibration and verification of 1-D oxygen model. Error measures.**7Hrs**

Module - III

Mixing zones in rivers – definition, steady state 2-D analysis with pipe and diffuser outfalls using solutions based on method of images for conservative and decaying pollutants field study methodology. Parameter estimation – Lateral Mixing coefficient – critical point method – derivation and examples. **6Hrs**

Module - IV

Dissolved oxygen models for lakes under completely mixed and stratified conditions,
Ocean disposal of wastewater – Silting and design of outfalls. Near field and far field mixing with simple examples.**3Hrs**
Eutrophication models – simplified nutrient loading models for rivers and lakes.**3Hrs**

Module - V

Ground water quality modeling concepts – formulation of 1-D and 2-d models with decay and retardation for instantaneous sources, Non-point sources of pollution, Analytical modeling for plume delineation studies from point sources. Field data gathering and parameter estimation.**3Hrs**
Ecosystem model – Description, Schematization and formulation.**2Hrs**

COURSE OUTCOME: At the completion of this course the student should be able to

1. EvaluatetheTheory of molecular diffusion and dispersion, stream water quality modeling.(C1)
2. Analyse Calibration and verification of 1-D oxygen model, (C2)
3. UnderstandtheTheory and design aspects of mixing zones in rivers.(C3)
4. Evaluate the Dissolved oxygen models for lakes under completely mixed and stratified conditions. Theory and design of ocean disposal methods of wastewater, eutrophication,(C4)
5. Understand the Ground water and ecosystem model studies.(C5)

References:

1. Rich L.G. Environmental Systems Engineering. McGraw Hill – 1972.
2. Thomas R.V. – Systems Approach to Water Quality Management. McGraw Hill – 1980.
3. Biswas A.K. – Models for water quality management – McGraw Hill, 1980.
4. Rinaldi S.D. and Soncini R., - Modeling and Control of River Water Quality. McGraw Hill – 1979.
5. Gower A.M. – Water quality in catchment ecosystems. John Wiley – 1980.
6. Thomann and Mueller 1986. Principles of water quality management and control – Harper and Two Pubs.
7. Hazen and Cherry, Ground Water Quality.
8. Velz L.Z. Applied Stream Sanitation.

Note: 1) In the examination Ten questions will be set covering all the FIVE modules TWO questions will be set from each module, out of which students have to answer FIVE full questions selecting atleast one question from each module.

2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests, Quizzes, class attendance.

3) Extent of teaching: Clearly mentioned in the syllabus.

PROFESSIONAL ELECTIVE - II

ENVIRONMENTAL SANITATION SYSTMES

Subject Code: 24PEV241	**Credits = 03**	
CIE: 50 Marks	**SEE: 50 Marks**	**SEE: 03 Hrs**
Hours / Week: 2 Hrs (Theory) + 2 Hrs (SDA)		**Total Hours: 30**

Pre-requisites: Applied Environmental Chemistry and Microbiology

Course objectives: To enable the student to acquire the knowledge in the following topics.

1. Understanding Communicable Diseases.
2. Various components of Food Sanitation,
3. Milk Sanitation,
4. Rural Sanitation, and Industrial Hygiene.
5. Institutional Sanitation.

Module - I

COMMUNICABLE DISEASES: -

Definitions, Microorganisms, disease communicated, General methods of communicable disease control, control of epidemics. **3Hrs**

Module - II

FOOD SANITAION:-

Food born disease, food and drug laws, food and bacteria, legal control of food safety, dried foods, frozen foods. Sanitation of eating and drinking establishment. **3Hrs**

MILK SANITATION: -

Essentials of Milk Sanitation, Milk and Bacteria, Milk borne diseases, sanitation, pasteurization, bacteriological standards. **4Hrs**

Module - III

SWIMMING POOLS & BATHING BEACHES- Introduction, Pool Operation, Pool Maintenance, Wading Pools, Bathing Beaches.

INSECTS, RODENTS, NOXIOUS WEEDS- The Housefly, Mosquito Control, Bed Bug, Rat and Mice, Ragweed & Noxious Weed Control.

3Hrs

Module - IV

RURAL SANITATION:

Rural water supplies and different methods of sewage disposal in rural areas.

Cleaning and Disinfection, Emergency Water Supply and Treatment **3Hrs**

INDUSTRIAL HYGIENE:

Occupational hazards sources, effects and control measures, sanitation programmes. **2Hrs**

Module - V

INSTITUTIONAL SANITATION:

Schools, Hospitals-Location planning- Lighting and ventilation, disposal of wastes. **6Hrs**

Radioactive wastes – Sources – effects – disposal methods. **2Hrs**

COURSE OUTCOME: At the completion of this course the student should be able to

1. Understand the Communicable Diseases. (C2)
2. Apply various components of Food Sanitation. (C2)
3. Evaluate Milk Sanitation. (C3)
4. Understand Rural Sanitation, and Industrial Hygiene. (C2)
5. Suggest for Institutional Sanitation. (C3)

REFERENCES:

1). Environmental engineering & Sanitation – Joseph A Salvato, Willey – Interscience.

2). Municipal and Rural Sanitation – Ehlers and steel, McGraw – Hill.

Note: 1) In the examination Ten questions will be set covering all the FIVE modules TWO questions will be set from each module, out of which students have to answer FIVE full questions selecting atleast one question from each module.

2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests, Quizzes, class attendance.

3) Extent of teaching: Clearly mentioned in the syllabus.

ADVANCED ATMOSPHERIC ENVIRONMENTAL ENGINEERING

13072022/V1

Subject Code: 24PEV242	Credits = 03	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 2 Hrs (Theory) + 2 Hrs (SDA)		Total Hours: 30

Course objectives: To enable the student to acquire the knowledge in the following topics.

1 Atmospheric Processes and Chemical Reactions, laws of thermodynamics, Reaction Rates, Atmospheric Boundary Layer eddy diffusion above the surface layer, ground surface temperature and moisture..
2 Urban Air Quality Simulation Modeling, problems, model evaluation, model validation.
3 Dispersion of Heavy Gases, Mobile Sources of Pollution.
4 Indoor Air Pollution
5 Design of Industrial Ventilation Systems.

Module - 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.**3Hrs**

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 streets parameter, spectral density function, integral length scale, inertial sub range and small scales. Turbulent fluxes of momentum, turbulent fluxes of energy and water vapor, 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.

3Hrs

Module - II

Urban Air Quality Simulation Modeling: General need, alternative approaches, basic model applications, general composition of models,. Numerical modeling approaches-Guassian diffusion models, physical basis of the mass conservation approach, mathematical foundation of the mass conservation approach. **4Hrs**

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. **4Hrs**

Module - 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). **4Hrs**

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. **3Hrs**

Module - 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.**6Hrs**

Module - V

Design of Industrial Ventilation Systems: Introduction, ventilation by dilution, hood specification, hoods of simple geometry, experimental velocity contours, complex hood design, duct design, fan selection and performance. **3Hrs**

COURSE OUTCOME: At the completion of this course the student should be able to

1. Evaluate the Atmospheric Processes and Chemical Reactions, laws of thermodynamics, Reaction Rates, Atmospheric Boundary Layer eddy diffusion above the surface layer, ground surface temperature and moisture..(C1)
2. Understand the Urban Air Quality Simulation Model, model evaluation, model validation. related problems(C2)
3. Study Dispersion of Heavy Gases, Mobile Sources of Pollution.(C3)
4. Understand Indoor Air Pollution.(C4)
5. Design of Industrial Ventilation Systems.(C5)

REFERENCES:

1. Jacobson. Z A., Fundamental of Atmospheric modeling, Cambridge University press, Cambridge, 1999.
2. Warren B Johnson et. Al. Air Pollution, Arthur C Stern, third edition, Volume I, Academic Press, New York, 1976.
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, 1980.

5. Stull B Roland, Boundary Layer Meteorology, Kluwer Academic Publishers, 1988.
6. Snyder H William, “Guideline for fluid modeling of atmospheric diffusion”, U S Environmental Protection Agency research Triangle Park, NC 2711.
7. Wark K Warner C F and Davis. W T., Air Pollution, “its origion and control” third edition, Harper and Row Publication, 1998.
8. Steve M Hays, Ronald V Gobbell 7 Nicholas R Ganick, “Indoor Air Quality” – Tata McGraw-hill, 1995.

Note: 1) In the examination Ten questions will be set covering all the FIVE modules TWO questions will be set from each module, out of which students have to answer FIVE full questions selecting atleast one question from each module.
2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests, Quizzes, class attendance.
3) Extent of teaching: Clearly mentioned in the syllabus.

RECYCLE AND REUSE TECHNOLOGY

Subject Code: 24PEV243	Credits = 03	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 2 Hrs (Theory) + 2 Hrs (SDA)		Total Hours: 30

Course objectives: To enable the student to acquire the knowledge in the following topics.

1. Fundamentals of Waste as a Resource reuse and recycle of disposable materials.
2. Sampling, characterization, energy content, collection, transportation, recycling design aspects.
3. Water reuse, ground water recharge, energy recovery, emission control, refuse derived fuels.
4. Metals of metals recovery, extraction of metals,
5. Reuse of industrial effluents, health aspects of reuse.

Module - I

Waste as a Resource**:** Resource economics, Disposable materials, Recycling Collection, Processing, Governmental Role in Waste Management, and Potential for Reuse. **3Hrs**

Waste Analysis: Sampling, Composition, Categorization, Determination of Waste Properties, Ash and Fines Analysis, Energy Content. **2Hrs**

Module - II

System Design: Design of Recycling Systems, Collection System, Process Train Design and Complexity, Product Design of Recycling, Conveyance, Transport Safety, Efficiency of Operation Systems. **5Hrs**

Module - III

Water Reuse**:** Direct and Indirect Reuse, Intentional Reuse, Groundwater Recharge, Examples of Water Reuse, Close Cycle and Open Cycle Reuse Recreational Reuse. **3Hrs**

Energy Recovery**:** Combustion, Energy Losses, Energy Recovery Analysis Emission Control, Residue Control, In-plant Operations, Refuse Derived Fuel. **3Hrs**

Module - IV

Metals Recovery**:** Ferrous metals, Properties, Principles of Magnetic Field – Ferrous Material Interactions, Magnetic Separation Equipment, Non-ferrous metal separation, Eddy-Current Separation – Theory and Types, Extraction of Material from a bed. **6Hrs**

Module - V

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. **4Hrs**

Health Aspects of Water Reuse, Guidelines for Evaluating Recreational Water Reuse, Resource Conservation and Recovery Act. **4Hrs**

COURSE OUTCOME: At the completion of this course the student should be able to

1. Understand the Fundamentals of Waste as a Resource reuse and recycle of disposable materials.(C1)
2. Study the Sampling, characterization, energy content, collection, transportation, recycling of product design aspects.(C2)
3. Understand Water reuse, ground water recharge, energy recovery, emission control, refuse derived fuels. (C3)
4. Evaluate Metals recovery, extraction of metals,(C4)
5. Study the Reuse of industrial effluents, health aspects of reuse.(C5)

References:

Springer, Recycling and Resource Recovery Engineering, Springer-Verlag Berlin Heidelberg (1996).
ICE: Reuse of Sewage Effluent, Proceedings of the International Symposium, Thomas Felford London (1985). Dean R.B. and E., Water Reuse Problems and Solutions, Academic Press (1981).
Kut D., and Hase G., Waste Recycling for Energy Conservation, John Wiley & Sons Inc.

Note: 1) In the examination Ten questions will be set covering all the FIVE modules TWO questions will be set from each module, out of which students have to answer FIVE full questions selecting atleast one question from each module.
2) CIE covers 2 Major tests, Assignments/ Class Seminar, slip tests, Quizzes, class attendance.
3) Extent of teaching: Clearly mentioned in the syllabus.

ENVIRONMENTAL GEO-TECHNOLOGY

Subject Code: 24PEV244	**Credits = 03**	
CIE: 50 Marks	**SEE: 50 Marks**	**SEE: 03 Hrs**
Hours / Week: 2 Hrs (Theory) + 2 Hrs (SDA)		**Total Hours: 30**

Module-1

Soil- Pollutant Interaction:

Introduction to geo environmental engineering – environmental cycle – sources, production and classification of waste – causes of soil pollution – factors governing soil-pollutant interaction Physicochemical behavior and modelling -failures of foundations due to pollutants **5Hrs**

Module-2

Characterization, Stabilization and DisposalSafe disposal of waste – site selection for land fills – characterization of land fill sites – waste characterization –stability of land fills – current practice of waste disposal- passive contaminant system - Hazardous waste control and storage system – mechanism of stabilization - solidification of wastes – micro and macro encapsulation – absorption, adsorption, precipitation- detoxification — organic and inorganic stabilization

6Hrs

Module-3

Transport of Contaminants:

Contaminant transport in sub surface – advection – diffusion – dispersion – governing equations – contaminant transformation – sorption – biodegradation – ion exchange – precipitation – hydrological consideration in land fill design – ground water pollution – bearing capacity of compacted fills – pollution of aquifers by mixing of liquid waste – protecting aquifers. **6Hrs**

Module-4

Detection and Testing Methods

Methodology- review of current soil testing concepts – Proposed approach for characterization and identification of contaminated ground soil for engineering purposes **5Hrs**

Module-5

Remediation of Contaminated Soils:

Rational approach to evaluate and remediate contaminated sites – monitored natural attenuation – exsitu and insitu remediation – solidification, bio – remediation, incineration, soil washing, electro kinetics, soil heating, verification, bio venting – Ground water remediation – pump and treat, air sparging, reactive well-application of geo synthetics in solid waste management – rigid or flexible liners. **8Hrs**

Course outcomes:

At the end of the course the student will be able to:

- On completion of this course, students are able to understand causes for soil pollution and behavior of the pollutants.
- Contaminants transport, detection and testing methods.
- Application of geo synthetics in solid waste management.

Textbook/ Textbooks

(1) Daniel, B.E., Geotechnical practice for waste disposal, Chapman and Hall, London, 1993.
(2) Fang, H.Y. Introduction to environmental Geotechnology, CRC press New York, 1997.
Reference Books
(1) Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
(2) Lagrega, M.d., Bukingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.

MINI PROJECT WITH SEMINAR

Course Code	24MPS25	CIE Marks	100
Number of contact Hours/Week	04 Hrs	Credits	03

Course objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Mini-Project: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

At the end of the course the student will be able to:

- Present the mini-project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

CIE procedure for Mini - Project:

The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.The marks awarded for Mini - Project report shall be the same for all the batch mates.

ENVIRONMENTAL ENGINEERING LAB-II

Subject Code: 24PEVL26	**Credits = 02**	
CIE: 50 Marks	**SEE: 50 Marks**	**SEE: 03 Hrs**
Hours / Week: 1 Hr (Theory) + 2Hrs (Practical)		**Total Hours: 52**

Pre-requisites- 1. UG Environmental Lab.

Course objectives: To enable the student to acquire the knowledge in the following topics.

1 Mineral and heavy metal analysis, suitability of sand for filtration.
2 Demonstration on GC, HPLC, and AAS.
3 Determination of Ambient air quality.
4 Experiment on Auto Exhaust analyzer.

- Determination of Sulphate, Phosphate, Jar Test (optimum pH and dosages), Total Nitrogen, Amonical nitrogen, Nitrite, Nitrate, Kjaldhal Nitrogen, Heavy Metals(As,Cr,Cu,Pb,Hgetc), and Mineral analysis (Sodium, Potassium, Magnesium, calcium,, and Fluoride) .Uniformity coefficient, Effective size ,silt content, Organic content, Acid solubility test of filter sand.
- Demonstration on GC, HPLC, AAS.
- Determination of Ambient air quality.
- Experiment on Auto Exhaust analyzer.

Note: - 1. A laboratory report has to be submitted at the end of each experiment and Lab exam will be conducted at the end of semester for evaluation of CIE

2. A standard methods for examination of water & wastewater 21st Edition has to be Followed for test procedures.

COURSE OUTCOME: At the completion of this course the student should be able to

1.Analysis of Mineral and heavy metal , suitability of sand for filtration.(C1)
2.Demonstration on GC, HPLC, and AAS.(C2)
3.Determination of Ambient air quality. (C3)
4. Analysis of Auto Exhaust analyzer(C4)

Proposed Scheme for III Semester M.Tech.

(Environmental Engineering)

HKE'S PDA College of Engineering, Kalaburagi Scheme of Teaching and Examinations2024
M.Tech ENVIRONMENTAL ENGINEERING COURSE CIVIL ENGINEERING DEPARTMENT
Choice Based Credit System (CBCS) and Outcome-Based Education(OBE)

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	PEC	24PEV31x	Professional elective -3 (Online Courses)	03	00	00	03	50	50	100	3
2	PEC	24PEV32x	Professional elective -4 (Online Courses)	03	00	00	03	50	50	100	3
3	INT	24INT33	Research internship/ industry internship leading to project work/ startup	Two semester duration, SEE in the IV semester which leads to project work/ startup			03	100	--	100	4
4	PROJ	24PROJ34	Project Work phase -1				03	100	--	100	2
TOTAL				**09**	**12**	**03**	**12**	**300**	**100**	**400**	**12**

Note: PEC: Professional Elective Courses., L-lecture, P-practical, T/sda-tutorial/skill development activity (hours are for interaction between faculty and students), INT-Internship: Research internship /industry internship leading to the project work startup, PROJ- Project Phase-I: Problem statement out of undergone internship (Industry/ research) report submission only CIE

For completion of professional elective courses (3 & 4) students should choose subjects related to advanced environmental engineering from NPTEL or MOOCS.

Research internship/ industry internship leading to project work/ startup

Subject Code: 24INT33	**Credits = 04**
CIE: 100 Marks	**SEE: ---**

INT: STUDENT HAS TO VISIT AT LEAST ONE INDUSTRY FOR STIPULATIED PERIOD OF FOUR TO SIX MONTHS AND SUBMIT A REPORT OF THEIR EXPOSURE IN RESPECTIVE FIELD & PRESENT TWO SEMINARS (MID AND END) BEFORE **THE EXPERT COMMITTEE**FOR EVALUATION OF **CIE** MARKS**.**

PROJECT PHASE-I

Subject Code: 24PROJ34	Credits = 02
CIE: 100 Marks	SEE: ---

PROJECT PHASE-I:

PROJECT WORK WILL BE FOR A PERIOD OF 8 MONTHS OUT OF WHICH 3 MONTHS WILL BE DURING THIRD SEMESTER (PHASE-I). DURING THIS SEMESTER STUDENT HAS TO CARRY OUT LITERATURE SURVEY AND FINALISE THE OBJECTIVES OF THE PROJECT WORK .

CIE WILL BE EVALUATED BY CONCERNED GUIDE ALONG WITH THE EXPERT COMMITTEE ON THE BASIS OF THE LITERATURE COLLECTION (15-20 JOURNAL PAPERS) & TWO SEMINARS (MID & END) DELIVERED BY THE CANDIDATE**.**

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PROPOSED SCHEME FOR IV SEMESTER M.TECH

HKE'S PDA College of Engineering, Kalaburagi Scheme of Teaching and Examinations 2024
M.Tech. ENVIRONMENTAL ENGINEERING COURSE CIVIL ENGINEERING DEPARTMENT
Choice Based Credit System (CBCS) and Outcome-Based Education(OBE)

IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
				L	P					
1	INT	24INT41	Research internship/industry internship leading to project work/ startup	Two semester Duration		03	100	100	200	12
2	PROJ	24PRO42	Project Phase-2			03	100	100	200	12
			TOTAL	**--**	**--**	**06**	**200**	**200**	**400**	**24**