Semester- I

Numerical Analysis and Advanced Computational Methods

Course Code	22CWH11	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to;

- Study various concepts on mathematical models and applications in Environmental Engg. field.
- Gain the knowledge on Optimization techniques and application.
- Concepts on Statistical operational system using mathematical models.

Module-1

Approximations and round off errors: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors.

Mathematical modelling and engineering problem solving: Simple mathematical model, Conservation Laws of

Engineering.

Teaching-Learning Process	Class room teaching

Module-2

Numerical Methods: Partial Differential equation, Newton Raphson method, Finite Difference, Finite Element, method of Characteristics, Different methods, S O R method.

Optimization: Classification and Importance in Environmental Studies, single and multivariate optimization without and with constraints.

Teaching-Learning Process	Class room teaching

Module-3

Applied Partial Differential Equations: Classification of second order PDE's, Canonical forms-Hyperbolic, parabolic and Elliptic Equations.

Laplace Transformation method: Transforms of Derivatives, Differential equations and simultaneous equations, Transform of Dirac Delta function, Inverse Transform examples.

Fourier Transform Method: Properties, sine and cosine of Fourier Transforms.

Teaching-Learning Process	Class room teaching

Module-4

Probability Theory: Review of basic probability theory,Definition of random variables and probability distribution, Probability mass and density function, expaction, moments, central moments, characteristic functions, probability generating and moment generating functions– illustrations,Binomial, Poisson, Exponential,Gaussian and Rayleigh distribution examples.

Teaching-Learning Process	Class room teaching

Module-5

Joint Probability Distribution: Definition and properties of CDF, PDF, PMF, conditional distributions. Expection, covariance and Correlation. Independent Random variables, statement of central limit theorem - illustrative examples.

Random Process: Classification, stationary and ergodic random process. Auto correlation function properties,Gaussian random process.

Teaching-Learning Process	Class room teaching

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**
   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Ross S.M.,(1987) "**Introduction to Probability and Statistics for Engineers and Scientists**", John Wiley Publications.3rd Edition,Academicpress.
2. KreyszigErwin(2006),9th Edition" **Advanced Engineering Mathematics**", Wiley Eastern Publications.
3. Berthouex P M.,and Brown L. C.(1994), "**Statistics for Environmental Engineers**", Lishe publication, 2nd Edition.

Web links and Video Lectures (e-Resources):

•

Skill Development Activities Suggested

•

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the role and importance of mathematical modelling.	1,2.3.4
CO2	Knowledge about applications of evaluated results from projects.	1,2,3,4
CO3	Significance of Statistical and Numerical analysis.	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO10
11.	Project Management and Finance	PO11
12.	Life-long Learning	PO12

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-

Semester - I

Environmental Chemistry			
Course Code	22CWH12	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

- The course introduces both ecology and transport modelling of aquaticsystems for students.
- It explains different ecosystems and their interactions through symbioticand synergic relationships, reviews ecological indices and modes.
- It describes tropic levels of lakes, influence of nutrient loading and control measures for Eutrophication.
- Know the Importance of modelling in wastewater engineering.

MODULE-1

Atmospheric Chemistry- Environmental Segments; Lithosphere, Hydrosphere, Biosphere and Atmosphere. Composition of Atmospheric air, radiation balance of earth, Chemical species and particulates present in atmosphere, photochemical reactions in atmosphere (ozone, nitrogen and Sulphur)

Global warming: Greenhouse concept and its environmental effects, Impacts of Global warming and ozone depletion. Effects of air pollutants on health and property issues. Absorption and adsorption techniques used for the control of gaseous pollutants.

Teaching-Learning Process	Class room

MODULE-2

Water Chemistry; Water resources and classification of water pollutants. Physico-chemical and Biological characteristics of water and wastewater. Significance of bacteriological test in water quality. Water quality standards.

Hydrology; Hydrological cycle (Hortons cycle), Global water distribution, Rain water harvesting methods and recharging of ground water.

Teaching-Learning Process	Class room

MODULE-3

Soil Chemistry; Layers of Earth, Types of rocks, Formation of soil, Composition of soil and weathering process, Types of soil textures, Accumulation of salts in soil.

Soil Pollution; Sources of soil pollution, Effects of soil pollutants, Control measures of soil pollution, Agricultural and urban waste on soil. Marine pollution, sources, effects and control of marine pollution.

Teaching-Learning Process	Class room

MODULE-4

Chemistry for Wastewater; Concept of coagulation, Coagulants determination of optimum dosage. Types of Oxygen demands and importance of dissolved oxygen in water and wastewater. Methods of determination of BOD and COD.

Organic and Inorganic Wates; Sources of Organic and Inorganic wastes, Characteristics, various types of Organic and Inorganic wastes from industries. Total Solids and their determination from water and wastewater.

Teaching-Learning Process	Class room

MODULE 5

Eutrophication; Eutrophication process. Effects of eutrophication, Oligotrophic and eutrophic water bodies, various sources of nutrients-natural and manmade sources causing eutrophication, Preventive measures.

Pesticidal pollution; Introduction, types of pesticides and persistence of pesticides in soil and water. Pesticides kinetics in environment. Pesticidal impacts on environment.

Teaching-Learning Process	Class room

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Determination of Optimum Coagulant Dosage.
2	Determination of Do and Five day BOD.
3	Determination of Ultimate BOD.
4	Determination of solids from wastewater samples
5	Determination of Aero soles.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

1. Two Tests each of **20 Marks**
2. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.

- The laboratory test at the end /after completion of all the experimentsshall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.
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SEE for IPCC
Theory SEE will be conducted by University as per the scheduled timetable, with common question

papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:
Books
1. Odum E.P. & Barret G.W., (2005), "**Fundamentals of Ecology**", 5thEdition, Cengage Learning.
2. Schnoor J.L., "**Environmental Modelling – Fate and Transport of Pollutants in Water, Air and Soil**",
3. John Wiley and Sons.Thomann R.V., and Mueller J.A., "**Principles of Water QualityManagement and Control**", Harper & Row Publications.

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Student will be able to Classify and discuss the structure and function ofecosystems.	1,2,3,4
CO2	Describe symbiotic and synergic relationships.	1,2,3,4
CO3	Illustrate the need for bio- geo- cycles. Apply ecosystem models.	1,2,3,4
CO4	Describe the importance of modelling and its applications.	1,2,3,4
CO5	To evaluate the data collection and analysis. Achieve knowledge mixing zones in rivers, Eutrophication.	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO10
11.	Project Management and Finance	PO11
12.	Life-long Learning	PO12

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	1	-	-	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-
CO4	2	1	2	-	-	-	-	-	-	-
CO5	1	2	1	-	-	-	-	-	-	-

Semester- I

<table>
<tr><td colspan="4" align="center">Water Treatment Technology</td></tr>
<tr><td>Course Code</td><td align="center">22CWH13</td><td>CIE Marks</td><td align="center">50</td></tr>
<tr><td>Teaching Hours/Week (L:P:SDA)</td><td align="center">03:00:02</td><td>SEE Marks</td><td align="center">50</td></tr>
<tr><td>Total Hours of Pedagogy</td><td align="center">50</td><td>Total Marks</td><td align="center">100</td></tr>
<tr><td>Credits</td><td align="center">04</td><td>Exam Hours</td><td align="center">03</td></tr>
</table>

Course Learning objectives:

This course will enable students to;

- Gain the Knowledge on significance of water, quality and standards for usage.
- Understand the objectives of water treatment.
- Understand the Design and operation of Water Treatment Process.
- Understand about the Purification process like, Sedimentation, Coagulation,
- Filtration, Disinfection, Fluoridation & De-fluoridation and softeningmethodologies involved before supplying to Public.

Module-1	

Introduction: Necessity and objectives for Treatment of water. Water pollution, Sources of water pollution and control methods. Point and non-point sources of water pollution. Difference between Ground water and Surface water characteristics. Water Borne and water in du c e d diseases and control.

Quality of water and Analysis: Drinking water quality standards asper BIS & WHO guide lines. Importance of Bacteriological examination of water, Plate Count Test and MPN Test. Problems ondetermination of E-coli using MPN equation.

Teaching-Learning Process	Class room teaching

Module-2	

Water treatment System: Flow Diagram on overall water supply Project. Various types of Unit flow diagrams used on Water Treatment System. Water Intake Structures and their classifications.

Purification of water: Aeration process, Importance and limitations. Gas Transfer two film model- Water in Air system and Air in Water system with their types. Significance of Dissolved Oxygen in Water. Principles and theory of Sedimentation Process and Solids Separation. Design of Sedimentation tank (Circular and Rectangular) in the removal of Discrete particles.

Teaching-Learning Process	Class room teaching

Module-3	

Coagulation and Flocculation: Coagulation and Flocculation process of water. Theory of Coagulation and Principle. Types ofCoagulants used with their merits and demerits. Chemical reaction with Coagulants and water, Chemical feeding system. Determination of Optimum Coagulant Dosage using Flocculator. Numerical problems on estimation of Coagulants.

Teaching-Learning Process	Class room teaching

Module-4	

Water Filtration Techniques– Principles and theory ofFiltration. Classification of sand filters used in treatment of water. Operational troubles and troubleshooting methods used for SSF and RSF in treatment of water. Design criteria used and Design of Slow and Rapid Sand Filters required for water treatment.

Teaching-Learning Process	Class room teaching

Module-5
Water Disinfection–Sterilization andDisinfection. Methods of Disinfection and their suitability. Theory of Disinfection, characteristics of a good disinfectant. Forms of Chlorination, Chemical reactions, Break point Chlorination. Determination of Chlorine Demand of water. Estimation of Chlorine and Bleaching powder required for treatment of water. **Miscellaneous Treatment of water-** Hardness of water and its significance. Numerical problems on determination of Hardness in water. Water softening methods. Fluoridation and Defluoridation techniques.

Teaching-Learning Process	Class room teaching

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

3. Three Unit Tests each of **20 Marks**
4. Two assignments each of **20 Marks**or**one**Skill Development Activity of 40 marks
   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

6. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
7. The question paper will have ten full questions carrying equal marks.
8. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
9. Each full question will have a sub-question covering all the topics under a module.
10. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:
Books

1. Fair, G.M., Geyer J.C and Okun, (1969),**Water supply Engineering** Vol- I, John Wiley Publications.
2. Weber W.J., (1975) **Physico - Chemical Processes for Water QualityControl**.
3. CPHEEO Manual, (2003), **Water Supply and TreatmentEngineering,** GOI- Publications, New Delhi.

Web links and Video Lectures (e-Resources):

- https://youtu.be/KMP9-49I1U4.

Skill Development Activities Suggested

- Visiting to nearby Water treatment plant.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the importance of drinking water quality.	1,2
CO2	Understand the Unit treatment process of water.	1,2,3,4
CO3	Know the Objectives and importance of treatment process of water by physico-chemical process.	1,2,3,4
CO4	Understand the Water filtration techniques and types	1,2,3,4
CO5	Gain the knowledge on water disinfection and softening process techniques.	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO10
11.	Project Management and Finance	PO11
12.	Life-long Learning	PO12

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	-	-	-	-	-	-	-	-
CO2	2	2	3	-	-	-	-	-	-	-
CO3	2	3	3	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-
CO5	2	3	-	-	-	-	-	-	-	-

Semester- I

Community Health and Environmental Sanitation			
Course Code	22CWH14	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:02	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
This course will enable students to;
- Know the concept of medicine to words Community health.
- Know the concept of health and disease.
- Communicable diseases, Control & prevention in rural and urban area.
- To know the principles of Epidemiology, prevention of Communicablediseases and Risk Approach.
- To know about the nutrition of health.
  Understand the objectives and maintenance of Environmental Sanitation.

Module-1

Introduction: Concept of Health, Communicable and Non communicable Diseases, classification of Communicable diseases Methods of communication, general methods and control.

Community Health and Sanitation: Importance of Community Health, Environmental Sanitation, Rural and urban sanitation, Classification of Health, Physical, Mental , Social Health Science.

Teaching-Learning Process	Class room teaching

Module-2

Principles of Epidemiology: Epidemiology and Aims of Epidemiology, Basic measurements, Common Sources of Epidemics and Control measures, Causes of Epidemiology.
Concept of Disease Transmission and Prevention: Dynamics of Disease Transmission, modes of Disease
Transmission, concept of screening, types & uses ofscreening.

Teaching-Learning Process	Class room teaching

Module-3

Epidemiology of communicable diseases and control: Small pox & chicken pox and their differences. Measles, rubella, influenza, yellow fever, chicken gunya, Cholera, Typhoid and their control.

Global Epidemic Diseases: Bird flu, Insect   Control: study on Life cycle of House fly and Mosquito. disease Transmission and control measures.

Teaching-Learning Process	Class room teaching

Module-4

Food and Milk   Sanitation: Food Poisoning, Types and sources. Preventionand Control measures, Essentials for milk sanitation and Test for milk quality, Pasteurization, CattleBorn Diseases.
Nutrition of health: Nutrients, proteins, fats and carbohydrates.   Nutritional problems in public health andsurveillance.

Teaching-Learning Process	Class room teaching

Module-5

Environmental sanitation: Environmental sanitation, Rural and Urban sanitation. Importance of safe drinking water, water borne diseases and control, methods of waste disposal.

Occupational health and Safety: Occupational health hazards and diseases, health of worker and safety measures.

Teaching-Learning Process	Class room teaching

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

5. Three Unit Tests each of **20 Marks**
6. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**
   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

11. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
12. The question paper will have ten full questions carrying equal marks.
13. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
14. Each full question will have a sub-question covering all the topics under a module.
15. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:
Books

- Joseph .A. Salvato, by Environmental Sanitation.
- E.W. Steel , Water Supply and Sanitary Engineering,
- **J.E. Park and K. Park,** Preventive and Social medicine, M/S. Banarsidas
- Bhanot Publications.
- **Baljeeth s kapoor,** Environmental sanitation, S Chand & Co.
- **P.K. Goel,** Water Pollution Causes, Effects and Control, New AgeInternational (Pvt.) Ltd

Web links and Video Lectures (e-Resources):

-

Skill Development Activities Suggested

-

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To understand the roll and important concepts of health.	1,2.3.4
CO2	To understand the Dynamics of Disease Transmission and controlmeasures.	1,2,3,4
CO3	To know about the principles of epidemiology.	1,2,3,4
CO4	To know about food sanitation and nutrients.	1,2,3,4
CO5	Control and remedial measures to maintain good Sanitation.	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO010
11.	Project Management and Finance	PO011
12.	Life-long Learning	PO012

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO010
CO1	2	1	2	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-
CO3	1	2	2	-	-	-	-	-	-	-
CO4	2	1	2	-	-	-	-	-	-	-
CO5	1	2	2	-	-	-	-	-	-	-

Semester- I

Hazardous Waste Management			
Course Code	22CWH15	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:02	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
This course will enable students to;
- have knowledge on need and principles of Hazardous waste management.
- risk assessment, management and methodologies to handle safelythe hazardous waste.
- Provide detailed aspects on the treatment and disposal methods ofHazardous wastes.

Module-1

Introduction: Sources & Classification of hazardous waste, Hazardous waste Properties. Identification of Hazardous waste. Hazardous waste management strategy. Legislation conditions of hazardous waste Management, life styles and the environment, public and Government awareness on hazardous waste.

Toxicity and risk management: Health of people exposed to toxic chemicals, relationship of toxicology to hazardouswaste management.

Teaching-Learning Process	Class room teaching

Module-2

Industrial Hazardous waste: Solvent industrial waste, Waste from petroleum refinery, Pesticide industries, explosives manufacturing industries.

Environmental Legislation and Regulations: Rivers and Harbors Act, Atomic energy act of 1984, occupational safety and health act. The calm air act, Motor vehicles emission act, Toxic pollutants, Toxic substances control act.

Teaching-Learning Process	Class room teaching

Module-3

Physico-chemical Treatment: physical treatment- screening, sedimentation, clarification, cyclone separation, flotation, filtration, adsorption, absorption, evaporation, distillation and condensation reverse osmosis.

Chemical treatment: solubility, neutralization, coagulation and flocculation, jar and extender tests, oxidation and reduction, disinfection, ion exchange, stabilization and fixation systems.

Teaching-Learning Process	Class room teaching

Module-4

Treatment process: Methods of Treatment, Treatment for organic hazardous waste. Thermal process: Incineration process, types, Advantages and disadvantages of incineration.

Transportation and storage of hazardous waste: Transportation of hazardous waste, POT and EPA. Nuclear waste regulations, commission. Containers used for hazardous waste material and Bulk transport.

Teaching-Learning Process	Class room teaching

Module-5

Pollution prevention and waste minimization: governmental policy on waste reduction, benefits ofhazardous waste pollution prevention and reduction approaches to hazardous waste pollution prevention and reduction.

Waste minimization techniques: Reduction, Substitution and Recycling of Hazardous waste from the source. selection of waste minimization process, Methods of Nuclear waste safe disposal.

Teaching-Learning Process	Class room teaching

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

7. Three Unit Tests each of **20 Marks**
8. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**
   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

16. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
17. The question paper will have ten full questions carrying equal marks.
18. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
19. Each full question will have a sub-question covering all the topics under a module.
20. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:
Books

1. Lehman, (1983), **"Hazardous Waste Disposal"**, Plenum Press.
2. Lagrega M.D., Buckingham P.L., and Evans J.C., (1994), **"Hazardous Waste Management"**, McGraw Hill InternationalEdition.
3. Wentz C.A., (1989), "**Hazardous Waste Management**", McGraw Hill.
4. Dawson and Mercer, (1981), **"Hazardous Waste Management"**, John Wiley. Fawcett, (1984), "**Hazardous and Toxic Materials: Safe Handlingand Disposal"**, John Wiley.
5. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), "**Industrial Safety and Pollution Control Handbook"**

Web links and Video Lectures (e-Resources):
-

Skill Development Activities Suggested
-

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Identify the sources and describe characteristics of hazardous wastes.	1,2.3.4
CO2	Review of case studies with respect to risk identification, assessment andemergency preparedness.	1,2,3,4
CO3	Enumerate on waste minimization and resource recovery techniques.	1,2,3,4
CO4	Prepare the transportation protocol for safe transport of hazardous wastes	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO010
11.	Project Management and Finance	PO011
12.	Life-long Learning	PO012

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	2	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-
CO3	1	2	2	-	-	-	-	-	-	-
CO4	1	2	1	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	-	-	-	-

RESEARCH METHODOLOGY AND IPR			
[As per Choice Based Credit System (CBCS) scheme]			
Course Code	22RMI16	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:00	SEE Marks	50
Total Hours of Pedagogy	40 hrs of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
- To understand the concept and objectives of research methodology.
- To gain the knowledge on literature review and research design.
- To understand the design of sampling, measurement and scaling.
- Understand the steps involved in the testing of hypothesis and Chi-square test.
- Gain the knowledge on interpretation and report writing and intellectual property rights.

Module-1
Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and 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.

Teaching-Learning Process	Black board, LCD, NPTEL Courses, Literature study. Field Visits.

Module-2
Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review 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,

Teaching-Learning Process	Black board, LCD, NPTEL Courses, Literature study, online sources.

Module-3
Design of Sampling: Introduction, Sample Design, 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 Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.

Teaching-Learning Process	Black board, LCD, Literature study.

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 Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference 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, Cautions in Using Chi Square Tests.

Teaching-Learning Process	Black board, LCD, NPTEL Courses,

Module-5

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 Conventionfor 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.

Teaching-Learning Process	Black board, LCD, NPTEL Courses, Literature study, online sources. Field Visits

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**
   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:
Text Books:

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), RanjitKumar,SAGE Publications,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.

Reference Books:

- Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.

Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

Web links and Video Lectures (e-Resources):
   NPTEL Materials: https://nptel.ac.in/courses

Skill Development Activities Suggested

- **Literature review**
- **Case study analysis**

Water and Wastewater Analysis Lab-I			
Course Code	**22CWHL17**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:2:0	SEE Marks	50
Credits	2	Exam Hours	3

Course objectives: This course will enable the students to;

- Understand the Concept, objectives and significance of water testing and waste waters from various sources.
- Getting basic knowledge on preparation of various chemical solutionsrequired for testing of water and waste water samples.
- Gaining basic knowledge of analysis for small projects on water and wastewater Engineering.

Sl.No.	Experiments
1	Sampling techniques and preservation of water and wastewater samples.
2	Preparation of Standard chemical solutions.
3	Determination of pH by various methods,
4	Determination of Electrical Conductivity and TDS.
5	Determination of Acidity and Alkalinity.
6	Determination of Calcium, Magnesium and Total Hardness
7	Determination of Solids in wastewater samples.
8	Determination of Dissolved Oxygen.
9	Determination of Chlorides.
10	Determination of percentage of Chlorine available in a sample of Bleaching powder and determination of residualChlorine.
11	Determination of Turbidity by Nephelometer.
12	Determination of Optimum Coagulant Dosage usingFlocculator.
	Demonstration Experiments (For CIE) if any
13	Preparation of Standard chemical solutions.
14	Use of Muffle furnace for various purpose.

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- Achieve the Knowledge of development of experimental skills.
- Understand the principles of design of experiments.
- Knowing the Objectives and principles to carry out experimentalProjects.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40%of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure

and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

- Manual of Water and Wastewater Analysis – **NEERI Publications**.

- Standard Methods for Examination of Water and Wastewater, American Publication Health Association (APHA), Water Pollution Control Federation, American Water Works Association (AWWA),Washington DC.- latest edition.

- BIS Standards and WHO Guidelines.

- Chemistry for Environmental Engineering by Sawyer and Mc. Carty.

Semester- II

MUNICIPAL AND INDUSTRIAL WASTE WATER TREATMENT SYSTEM			
Course Code	**22CWH21**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:02	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
 This course will enable students to;
- To understand the basic characteristics of wastewater.
- Understanding the kinetics of biological system.
- Understand the design and working principle of various treatmentmethods.
- Understand magnitude and influence of hazardous content.

Module-1

Introduction: Objectives of wastewater treatment system, need for sanitation, classification of sewerage systems. Factors affecting DWF & WWF, Estimation of Dry and Wet weather flow
Design of sewers: Characteristics & sampling techniques of municipal wastewater, BOD & COD - methods of determination. hydraulic formula used for velocity, design of hydraulic elements for circular sewers for full flow and partial flow conditions.

Teaching-Learning Process	Class room teaching

Module-2

Treatment of Municipal wastewater: Flow chart of Municipal waste water treatment system, screenings, grit chamber, Oil and Grease removal, CNS cycles.
Low cost wastewater treatment: Methods-Septic tank, Oxidation Pond and Oxidation ditches. Reuse and recycle of wastewater.

Teaching-Learning Process	Class room teaching

Module-3

Wastewater Treatment: Aerobic and Anaerobic treatment methods. Suspended growth system; Conventional activated sludge process and its modifications. Attached growth system; Trickling filters and Rotating Biological contactors. Sludge disposal methods.
Disposal of Effluents: Self purification phenomenon, oxygen sag curve, zones of purification, sewage farming, sewage sickness, numerical problems on disposal of effluents, Streeter-Phelps equation.

Teaching-Learning Process	Class room teaching

Module-4

Industrial Waste water: Difference between domestic and industrial waste water, Effect of effluent discharge on streams.
Methods of industrial wastewater treatment; Volume reduction, Strength reduction, Neutralization, Equalisation and Proportioning. Removal of organic, inorganic and colloidal solids, combined treatment methods; merits, demerits and feasibility, principles of discharge of wastes in to streams.

Teaching-Learning Process	Class room teaching

Module-5

Industries: Industrial Process & treatment flow chart, Sources and characteristics of: Cotton and Textile industry, Tanning industry, Cane sugar, Distilleries, Dairy industry, Paper and Pulp industry, Food processing industry.

Teaching-Learning Process	Class room teaching

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one** **Skill Development Activity of 40 marks**
   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Wastewater Engineering - Treatment and Reuse", Metcalf and Eddy Inc., (2003), 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. Wastewater Treatment Concepts and Design Approach, Karia G.L., and Christian R.A., (2001), Prentice Hall of India Pvt. Ltd., New Delhi.

Web links and Video Lectures (e-Resources):

-

Skill Development Activities Suggested

-

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Know the concept sanitation along with designs of sewers.	1,2,3
CO2	know the basic characteristics of wastewater and the kinetics of biological system.	1,2,3,4
CO3	Understand the design and working principle of various treatmentmethods.	1,2,3,4
CO4	Understand the attributes which deals with industrial and municipal wastewater.	1,2,3,4
CO5	Understand the unit manufacturing process involved in the various industries	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO10
11.	Project Management and Finance	PO11
12.	Life-long Learning	PO12

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	1	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-
CO3	1	1	2	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	-	-	-	-

Semester -II

<table>
<tr><td colspan="5" align="center">Integrated Solid Waste Management</td></tr>
<tr><td>Course Code</td><td>22CWH22</td><td>CIE Marks</td><td>50</td></tr>
<tr><td>Teaching Hours/Week (L:P:SDA)</td><td>3:2:0</td><td>SEE Marks</td><td>50</td></tr>
<tr><td>Total Hours of Pedagogy</td><td>40 hours Theory + 10-12 Lab slots</td><td>Total Marks</td><td>100</td></tr>
<tr><td>Credits</td><td>4</td><td>Exam Hours</td><td>3 Hrs</td></tr>
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Course objectives:
- Gain knowledge on collection, transfer, and transport of municipal solidwaste.
- Understand the methods on processing and operation of solid waste underland filling process.
- Understand the strategies for collecting the recyclable materials and resourcerecovery.
- Understand the methods of solid waste disposal techniques.
- Understand the recent developments on solid waste management.

MODULE-1

Introduction: Solid waste management, Classification of solid waste, sources, properties of solid waste. Estimation of moisture content and density of a solid waste, materials flow in society, functional elements and impact of solid waste management.

System for solid waste management: Solid waste generation, factors affecting generation rates, on site storage collection services, Modes of collection system, collection routes & optimization ,Transfer stations.

Teaching-Learning Process	Class room

MODULE-2

Processing Techniques: Processing methodologies and waste minimization, Mechanical Size reduction, Volume reduction, Density separation

Land Filling: Factors considered in selection of site for landfill, Sanitary Landfilling, Land filling methods and operations, occurrence of gases and Leachate in Landfills control of leachate movement. Control of gas movement,

Teaching-Learning Process	. Class room

MODULE-3

Treatment Methodologies: Composting- Aerobic and Anerobic process, Factors affecting composting process, Vermi-composting process. Incineration, Pyrolysis and Energy recovery.

Thermal Treatment: Incineration and Types, 3T's Concept. Pyrolysis, Energy recovery concept and methods.

Teaching-Learning Process	Class room

MODULE-4

Hazardous waste: Introduction, Identification of Hazardouswastefrom solid waste, Classification, Treatment and disposal techniques.

Refuse Disposal: Methods of Disposal, Significance of refuse disposal and management, Environmental impact of open land dumping. 3R concept in solid waste disposal.

Teaching-Learning Process	Class room

MODULE 5

Bio-medical waste Management: Introduction, sources and generation ofbio-medical waste. Bio-medical waste management.

E-Waste Management: Introduction, E-wastemanagement. Health hazards.

Plastic waste Management: Environmental Impact of plastic waste,Recycling of plastic

waste, Disposal of plastic waste.	
Teaching-Learning Process	Class room

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Determination of components of municipal solid waste.
2	Estimation of moisture content of solid waste.
3	Estimation of density of a solid waste.
4	Leachate analysis.
5	Vermi-composting process

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

1. Two Tests each of **20 Marks**

2. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.

- The laboratory test at the end /after completion of all the experimentsshall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.
.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:
Books
1. Tchobanoglous G., Theissen H., and EIiassenR.(1991), **"Solid Waste Engineering Principles and Management Issues"**,McGraw Hill, NewYork.
2. Peavy, Rowe and Tchobanoglous (1985), "**Environmental Engineering**",McGraw Hill Co. 4th Edition
3. CPHEEO, Manual on **Municipal Solid waste management**, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
4. K. Shashi Kumar, **Solid waste management,** PHI Publications.

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
- Visit to solid waste Land filling site
- Visit to Vermi composting Units.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Apply the basic principles behind solid waste management, for solving practical problems.	1,2,3,
CO2	To know the roll and importance of solid waste management in asociety.	1,2,3,
CO3	Know the methods required for the treatment of waste and recovery ofmaterials.	1,2,3,
CO4	To understand the recent developments on solid waste management and its importance.	1,2,3,

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO10
11.	Project Management and Finance	PO11
12.	Life-long Learning	PO12

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1	-	-	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-
CO3	1	1	2	-	-	-	-	-	-	-
CO4	1	1	1	-	-	-	-	-	-	-
CO5	1	2	1	-	-	-	-	-	-	-

Semester- II

Environmental Planning and Management			
Course Code	**22CWH231**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
This course will enable students to;
- Understand the management and to apply the skills of the management when they become an entrepreneur

Module-1	
Introduction– Nature and characteristics of Management, Scope and functional areas of management– Management as a science, Art or Professional Management. **Administration**–Role of Management, Levels of Management, Development of Management thought–Early management approaches, Modern management approaches. Planning Nature, Importance and purpose of planning process– Objectives, Types of planning, Decision making – Importance of planning, Steps in planning & planning premises, Hierarchy of plans.	
Teaching-Learning Process	Class room teaching

Module-2	
Organization and Staffing- Nature and purpose of organization, Principles of organization, Types of organization – Departmentation, Committees, Centralization Vs Decentralization of authority and responsibility ,Span of control – MBO and MBE (Meaning only) Nature and importance of Staffing – Process of Selection & Recruitment. **Direction & Control-** Meaning and nature of directing –Leadership styles, Motivation Theories, Communication – Meaning and importance – Coordination, meaning and importance and Techniques of Coordination. Meaning and steps in controlling – Essentials of a sound control system – Methods of establishing control.	
Teaching-Learning Process	Class room teaching

Module-3	
Entrepreneurship-Meaning of Entrepreneur, Evolution of Concept, Functions of Entrepreneur, Types of Entrepreneur, Entrepreneur – an emerging class. Concept of Entrepreneurship –Evolution of Entrepreneurship, Development of Entrepreneurship, Stages in entrepreneurial process, Role of Entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – its Barriers.	
Teaching-Learning Process	Class room teaching

Module-4	
Small Scale Industry-Definition, Characteristics, Need and rationale, Objectives, Scope, role of SSI in Economic Development. Advantages of SSI. Steps to start an SSI – Government policy towards SSI. **Policies-** Different Policies of SSI., Government Support on SSI., during 5year plans. Impact of Liberalization, Privatization, Globalization on SSI. Effect of WTO / GATT Supporting Agencies of Government for SSI Meaning. Nature of support, Objectives, Functions.	

Teaching-Learning Process	Class room teaching

Module-5	
Preparation of Project- Meaning of Project, Project Identification, Project Selection, Project Report, Need and significance of Project, Contents, formulation, Guidelines by Planning Commission for Project Report. **Network Analysis-**Errors of Project Report, Project Appraisal. Identification of Business Opportunities. Market Feasibility Study, Technical Feasibility Study, Financial Feasibility Study & Social Feasibility Study.	

Teaching-Learning Process	Class room teaching

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

3. Three Unit Tests each of **20 Marks**
4. Two assignments each of **20 Marks**or**one**Skill Development Activity of 40 marks
   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

6. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
7. The question paper will have ten full questions carrying equal marks.
8. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
9. Each full question will have a sub-question covering all the topics under a module.
10. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:
Books
• Principles of Management – P.C. Tripathi, P.N. Reddy, Tata McGraw Hill,
• Dynamics of Entrepreneurial Development & Management – VasantDesai, Himalaya Publishing House.
• Entrepreneurship Development – Small Business Enterprises – Poornima M. Charantimath – Pearson Education – 2006 (2&4).

Web links and Video Lectures (e-Resources):
•

Skill Development Activities Suggested
•

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Identify, select a suitable Project	1,2
CO2	Write a Project Report, with formulation and understand the Guidelinesby Planning Commission for Project Report.	1,2,3,4
CO3	Understand the basic things required to become a Entrepreneur	1,2,3,4
CO4	Understand the policies and regulation for industries.	1,2,3,4
CO5	Understand the importance of planning and network analysis of Project.	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO10
11.	Project Management and Finance	PO11
12.	Life-long Learning	PO12

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	1	1	-	-	-	-	-	-	-
CO2	1	2	1	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	-	-	-	-
CO4	2	1	1	-	-	-	-	-	-	-
CO5	1	2	1	-	-	-	-	-	-	-

Semester- II

Environmental Impact Assessment			
Course Code	22CWH232	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
This course will enable students to;

- Identify environmental attributes for the EIA study.
- Identify methodology and prepare EIA reports.
- Specify methods for prediction of the impacts.
- Formulate environmental management plans.

Module-1

Introduction: salient features of EIA, EIA procedure, analytical functions associated with EIA, identification of impacts on the environment by preliminary overview, classification and prediction of impacts.

EIA as planning tool: introduction, preparation of environmental base map (EBM), formation of EIA study team, preparation of EIA report, Environmental monitoring and management plan.

Teaching-Learning Process	Class room teaching

Module-2

EIA methodologies: criteria for selection of EIA methodology, EIA methods, application of rapid assessment procedure in EIA models and modelling.

Assessment of impacts on soil and ground water environment: methodology for the prediction and assessment of impact on soil and ground water, environmental impact on soil and ground water for road
construction project.

Teaching-Learning Process	Class room teaching

Module-3

Assessment of impact on surface water environment: introduction, projects which create impact concerns for the surface water environment, methods for evaluation of impacts on surface water environment.

Assessment of impact on Biological Environment: introduction, methodology for assessment of impacts on biological environment, systematic approach for evaluating biological impacts, assessment of impacts of road
development on flora and fauna.

Teaching-Learning Process	Class room teaching

Module-4

Assessment of impact on Air Environment: introduction, approach for assessment of Air pollution impact. **Assessment of Impact of Noise on the Environment:** introduction, basic information of noise, noise measurement, effects of noise on people, methodology for assessing
environmental impacts of noise.

Teaching-Learning Process	Class room teaching

Module-5
Environmental Risk Assessment (ERA): introduction, Environmental risk assessment, risk assessment and treatment of uncertainty key steps in performing an ERA, advantages and limitations of ERA. **EIA Case Studies:** Environmental impact of industrial development, human use values, quality of life values, factors to be considered in making assessment decisions, preparations of EIA of Land clearing projects.

Teaching-Learning Process	Class room teaching

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

5. Three Unit Tests each of **20 Marks**
6. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**
   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

11. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
12. The question paper will have ten full questions carrying equal marks.
13. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
14. Each full question will have a sub-question covering all the topics under a module.
15. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:
Books

- Canter, L.W., Environmental Impact Assessment, McGraw Hill Pub. Co.,1997
- David P. Lawrence, Environmental Impact Assessment: PracticalSolutions to Recurrent Problems, John Wiley & Sons, 2003
- Hosetti, B. B., Kumar A, Eds, Environmental Impact Assessment & Management, Daya Publishing House, 1998

Web links and Video Lectures (e-Resources):
-

Skill Development Activities Suggested
-

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To know about the salient features of EIA procedure required to predictproject descriptions.	1,2
CO2	To know about the knowledge on Environmental clearance before establishing mini projects.	1,2,3,4
CO3	To know the impact identification and impact assessment.	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO010
11.	Project Management and Finance	PO011
12.	Life-long Learning	PO012

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO010
CO1	2	2	1	-	-	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-

Semester- II

Occupational Safety and Health Management			
Course Code	22CWH233	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
 This course will enable students to;

- Know the Importance of Sector specific safety and risks.
- Observe and understand about biological and physical health hazards.
- To impart the knowledge of women safety, child labour.
- Observe and understand the Asbestosis, NIHL PFT.
- Know the importance of legislations in India, ESI Act.

Module-1

Introduction – concept and scope of occupational safety and Environmental health, basic requirements for healthy environment and environmental quality, human exposure and impact of environment factors on health.

Specific Occupational Health and Safety Issues – Health and safety risks in mining, Health hazards in electronics industry, food processing industries, Textile industry, construction industry, wastewater treatment plants, solid waste landfills.

Teaching-Learning Process	Class room teaching

Module-2

Fire prevention and protection – Fire triangle, fire development and its severity, effect of enclosures, early detection of fire, classification of fire and fire extinguishers.

Safe Handling; Safe handling of chemicals, safety procedures of Nuclear installations. Health risk assessment and management.

Teaching-Learning Process	Class room teaching

Module-3

Ergonomics at work place: - Preventing ergonomic hazards, Ergonomic task analysis, Ergonomic standards, and Ergonomic programs.

Occupational Diseases: Health problems and Preventions- Asbestosis, Silicosis, Farmer's lung, Pneumoconiosis, Anthracosis, Bagassosis, Byssinosis, Tobacossis.

Teaching-Learning Process	Class room teaching

Module-4

Preventive Techniques – Accident analysis, monitoring of hazards, reporting and investigation of accidents, prevention and control of accidents, ensuring safety measures.

Personal protective Equipments – Types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability.

Teaching-Learning Process	Class room teaching

Module-5

Occupational health and safety legislations: Overview of existing OHSA legislations in India, Factories act, Mining act, Workmen's compensation act, Employee's state insurance act, Present state of OHS legislation in India. Inadequacy of OHS Legislation in India. Occupational Health and Safety Administration- Laws governing OSHA and Right to know, National safety Law.

Teaching-Learning Process	Class room teaching

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:
7. Three Unit Tests each of **20 Marks**
8. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**
   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:
16. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
17. The question paper will have ten full questions carrying equal marks.
18. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
19. Each full question will have a sub-question covering all the topics under a module.
20. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:
Books

1. Goetsch D.L., (1999), "**Occupational Safety and Health for Technologists**", Engineers and Managers", Prentice Hall.
2. Heinrich H.W., **"Industrial Accident Prevention",** McGraw Hill Publication Newyork.
3. Colling D.A., "**Industrial Safety Management and Technology**", Prentice Hall, New Delhi.

Web links and Video Lectures (e-Resources):
   •

Skill Development Activities Suggested
   •

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To understand the role and importance of Safety in various sectors.	1,2
CO2	Understand the basics of health hazards.	1,2,3,4
CO3	Learn the safety measures for women in unorganised sectors	1,2,3,4
CO4	To evaluate the occupation diseases like asbestosis, silicosis	1,2,3,4
CO5	Achieve knowledge about various legislation in India.	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO010
11.	Project Management and Finance	PO011
12.	Life-long Learning	PO012

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO010
CO1	1	2	2	-	-	-	-	-	-	-
CO2	1	1	1	-	-	-	-	-	-	-
CO3	2	1	2	-	-	-	-	-	-	-
CO4	2	1	1	-	-	-	-	-	-	-
CO5	1	2	2	-	-	-	-	-	-	-

Semester- II

<table>
<tr><td colspan="4" align="center">**Environmental Pollution and Control Management**</td></tr>
<tr><td>Course Code</td><td align="center">**22CWH241**</td><td>CIE Marks</td><td align="center">50</td></tr>
<tr><td>Teaching Hours/Week (L:P:SDA)</td><td align="center">02:00:02</td><td>SEE Marks</td><td align="center">50</td></tr>
<tr><td>Total Hours of Pedagogy</td><td align="center">50</td><td>Total Marks</td><td align="center">100</td></tr>
<tr><td>Credits</td><td align="center">03</td><td>Exam Hours</td><td align="center">03</td></tr>
</table>

Course Learning objectives:

This course will enable students to;

- To understand the various types of Environmental pollutions & Control techniques.
- To understand the Impact of Pollution on Environmental System.
- To understand the monitoring and assessing the impact of Pollutants through Air, Water and Soil.
- To know the concept of Radioactive pollution, Thermal Pollution, Heavymetal interference and Oil Pollution and their effects.

Module-1

Introduction: Environmental Pollution and Sources, types of pollution and their control, Regional and local environmentaleffects.

Air Pollution: Classifications and sources of air pollutants. Secondary pollutants and formation of Photo-chemical Smog,PAN, PBN, Acid rain. Atmospheric Diffusion and Plume Behaviour, Effects of air pollutants on plants.

Teaching-Learning Process	Class room teaching

Module-2

Water Pollution: Sources of water and their contamination, Types of pollutants, Industrial effluents- pulp and paper mills, Sugar, Distillery, Effluents from water treatment plants.

Soil Pollution: Plants are soil pollution indicators, Formation of salts in soil, Causes of soil pollution. Effects of Fungicides and weedicides on soil. Different kinds of synthetic fertilizers (N, P, K), their toxicity and control.

Teaching-Learning Process	Class room teaching

Module-3

Nuclear Pollution: Concept of Nuclear fusion and fission**,** Nuclear reactors, Classification, components of Nuclear reactors, Nuclear fuels, Types of nuclear waste, Safe disposal methods for nuclear waste.

Biological impact and health hazards associated with radiation, control of Radioactive pollution.

Teaching-Learning Process	Class room teaching

Module-4

Noise Pollution: Sources of Noise Pollution, Measuring devices, Effects of noise pollution and control methods in industries.

Thermal pollution: Introduction**,** sources, effects of thermal pollution on environment, Control of thermal pollution.

Teaching-Learning Process	Class room teaching

Module-5

Oil pollution: Introduction, major oil spills in the world, fate and movement of oil after spillage - spreading, evaporation, emulsification, dispersion, dissolution, sedimentation, biodegradation. Effects and control of oil pollution, Remote sensing in water quality monitoring.

Teaching-Learning Process	Class room teaching

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

9. Three Unit Tests each of **20 Marks**
10. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**
    to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

21. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
22. The question paper will have ten full questions carrying equal marks.
23. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
24. Each full question will have a sub-question covering all the topics under a module.
25. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:
Books

1. S.S.Dara, **Environmental Chemistry and Pollution Control**, S.Chand and Co Ltd., New Delhi.
2. Environmental. Protection and **Pollution Control Manual** –Karnataka State Pollution Central Board.
3. B.K. Sharma, and H. Kaur, **Environmental Chemistry**.

Web links and Video Lectures (e-Resources):
-

Skill Development Activities Suggested
-

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Estimate amount of pollutant by different agencies in different medium.	1,2
CO2	Understand the contamination related to soil	1,2,3,4
CO3	Understand the effects and causes by the nuclear actions.	1,2,3,4
CO4	Understand the concept of thermal pollution	1,2,3,4
CO5	Understand the concept of oil pollution	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO010
11.	Project Management and Finance	PO011
12.	Life-long Learning	PO012

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	1	1	-	-	-	-	-	-	-
CO2	2	1	2	-	-	-	-	-	-	-
CO3	1	2	1	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-
CO5	1	1	1	-	-	-	-	-	-	-

Semester- II

Rural Sanitation			
Course Code	**22CWH242**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
 This course will enable students to;
- Understand the Concept of Rural sanitation.
- Understand the need and necessity for protected water supply.
- Understand the Importance of Rural waste disposal methods.
- Understand the Land pollution and causes.

Module-1

Rural water supply: Introduction: Need for a protected water supply, Investigation and selection of water sources, water borne diseases, protection of well water, drinking water quality standards. Water supply schemes in Rural areas. Various policies.
Water treatment methods – disinfection, deflouridation, hardness and iron removal, ground water contamination and control.

Teaching-Learning Process	Class room teaching

Module-2

Environmental Sanitation: Classification, Importance of Environmental sanitations, Phases of Environmental sanitations, New policies for rural sanitations, Factors to be considered for rural sanitations. Importance of safe disposal of Excreta.

Teaching-Learning Process	Class room teaching

Module-3

Rural sanitation: Public latrine, concept of Eco-sanitation, trenching and composting methods, Two pit latrines, Aqua privy, W.C, septic tank, soak pit.

Teaching-Learning Process	Class room teaching

Module-4

Drainage systems: Storm water and sullage disposal, rain water harvesting and uses.
Communicable diseases: Terminology, classifications, methods of communication, general methods of control. INSECT CONTROL: House fly and mosquito – life cycle, diseases, transmission and control measures.

Teaching-Learning Process	Class room teaching

Module-5

Solid waste: Types of Solid waste, Characteristics of solid waste, Component of solid waste, Sewage sickness, Sewage farming, Leachate control. Refuse collection and disposal: collection methods, transportation, disposal – salvaging, dumping, manure pits, dumping in low lands ,composting, dung disposal – digester, biogas plant.
Land pollution: Causes for Land pollution, Soil pollution by agricultural waste, Control of Land Pollution in the rural areas. Cattle shed sanitation.

Teaching-Learning Process	Class room teaching

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

11. Three Unit Tests each of **20 Marks**
12. Two assignments each of **20 Marks** or **one** **Skill Development Activity of 40 marks**
    to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

26. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
27. The question paper will have ten full questions carrying equal marks.
28. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
29. Each full question will have a sub-question covering all the topics under a module.
30. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

- Environmental Sanitation - Joseph. A. Solveto
- Water Supply & Sanitary Engineering - E.W.Steel
- Preventive & Social Medicine - Park & Park
- Environmental Sanitation- Baljeet.S.Kapoor.

Web links and Video Lectures (e-Resources):

-

Skill Development Activities Suggested

-

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the need and necessity for protected water supply.	1,2
CO2	Understand the Concept of Rural sanitation.	1,2,3,4
CO3	Understand the Importance of Rural waste disposal methods	1,2,3,4
CO4	Understand the Land pollution and causes.	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO10
11.	Project Management and Finance	PO11
12.	Life-long Learning	PO12

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	-	-	-	-	-	-	-
CO2	2	1	2	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-
CO4	1	2	2	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-

Semester- II

Remote Sensing and GIS in Environmental Engineering			
Course Code	22CWH243	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
 This course will enable students to;

- Understand the fundamentals of remote sensing
- observe and process the GPS data
- use the image processing for the outburst of diseases.

Module-1

Fundamentals of Remote Sensing: Definition, Physics of remote Sensing, Electromagnetic.Radiation and its interactions with atmosphere, Spectralreflectance of earth features, Resolution Spectral, Temporal and Radiometric.

Teaching-Learning Process	Class room teaching

Module-2

Platforms Sensors and Image Processing: Aerial Photographs, Active and passive sensors, Data products, Various satellites in orbit and their sensors, Image Processing-Visual and digital image, Interpretation, Interrelation keys, Methodology, Training sets, Ground truth verification, Image analysis, Image enhancement, Rectification, Classification methods, Users accuracy, Producers accuracy and overall accuracy.

Teaching-Learning Process	Class room teaching

Module-3

Introduction to GIS: Data entry, storage andmaintenances, Data outputs. Data analysis, Hardware and Software

Teaching-Learning Process	Class room teaching

Module-4

Application of Remote Sensing and GIS: Applications of remotely sensed data for identifying solid waste disposal, forest fire mapping, EIA studies etc, Optimal routing if solid waste using GIS-Case study, Environmental sitting of industries and zoning atlas development

Teaching-Learning Process	Class room teaching

Module-5

Remodeling of water distribution system using GIS, Environmental degradation assessment using RS and GIS.

Teaching-Learning Process	Class room teaching

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

13. Three Unit Tests each of **20 Marks**
14. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**
    to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

31. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
32. The question paper will have ten full questions carrying equal marks.
33. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
34. Each full question will have a sub-question covering all the topics under a module.
35. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:
Books

- Manual of Remote sensing - Ed: Robert G Reeves.
- Theory of pattern recognition and modern forecasting - V.Karpin and Wright Pattern
- Digital Remote Sensing - Pritivish Nag M Kudrat ; Concept publication Principles of GIS for land and resources assessment, Burrough, P.A.,1986, Oxford.

Web links and Video Lectures (e-Resources):

-

Skill Development Activities Suggested

-

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Analyze the data and model the distribution network	1,2
CO2	Analyze the satellite images for epidemic studies	1,2,3,4
CO3	Understand the concept of remote sensing and GIS	1,2,3,4
CO4	Know the concept of remodelling related to water distribution.	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO10
11.	Project Management and Finance	PO11
12.	Life-long Learning	PO12

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1	-	-	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-
CO4	1	1	2	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-

Water and Wastewater Analysis Lab-II			
Course Code	**22CWHL26**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:2:0	SEE Marks	50
Credits	2	Exam Hours	03

Course objectives: This course will enable students to;

- ⬜ Create awareness for analysis of water and waste water.
- ⬜ know about the objectives of testing water and wastewater in thelaboratory.
- ⬜ The objective of this course is to make students to learn principles ofconducting experiments and its significance.
- ⬜ understand the analysis methodology on water and waste water.

Sl.NO	Experiments
1	Preparations of Standard chemicals required for various analysis.
2	Determination of Dissolved Oxygen present in a given sample of water and wastewater and its importance in environmental engineering.
3	Determination of Bio-chemical Oxygen demand (BOD) present in a given sample of water and wastewater. Preparation of Dilution water.
4	Determination of BOD_5 at 20°c and BOD_U of a given sample of water and wastewater.
5	Determination of Chemical Oxygen Demand (COD) for a given sample of wastewater.
6	Determination of Oil and Grease substances in a given sample of waste water .
7	Determination of Chlorides and Sulphates in a given sample of waste water.
8	Determination of Chlorine demand.
	Demonstration Experiments (For CIE) if any
9	Determination Nitrates and Nitrites in a given sample of water and waste water using by spectrophotometer.
10	Determination Fluoride in a given sample of water.

Course outcomes (Course Skill Set):

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

- To understand the roll and importance of analysis of water and wastewater contaminants.
- To know about the existing quality and status of water and waste water.
  To know the Objectives and importance of analysis of water and waste water there by knowing the treatment process required before its disposalwith respect to standards.
- Achieve Knowledge of Doing and development of experimental skills.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40%of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure

and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

- **Manual on Water and Wastewater Analysis** – NEERI Publication.

- **Standard Methods for Examination of Water and Wastewater**, American Publication: AWWA, APHA. Association, Water Pollution Control Federation, American Water Works Association.

- **BIS Standards :**2490-1974, 3360-1974, 3307-1974.

- **Chemistry for Environment Engineering**. Sawyer and Mc Carty.

Semester- III

Atmospheric Air Pollution and Control Management				
Course Code	22CWH31	CIE Marks	50	
Teaching Hours/Week (L:P:SDA)	03:00:02	SEE Marks	50	
Total Hours of Pedagogy	40 hours theory + (10-12 hoursSDA/Tutorials)	Total Marks	100	
Credits	04	Exam Hours	03	

Course Learning objectives:

This course will enable students to;
- Know the Importance of Air Pollution from industries and Effects.
- Study on Meteorological factors used to measure air Pollutants.
- To impart the knowledge on effect of Air pollution from major Industries.
- Study on impact of Air pollution and to know the Economic losses.
- Study on Air pollution control Equipments to control Particulate matter and Gaseous pollutants.

Module-1

Introduction: Air Pollution, Constituents of Atmospheric Air, Primary and Secondary Pollutants. Sampling procedures for air pollutants, Instruments used for sampling of waste gases and Sampling methods.

Meteorology: Measurement of Meteorological variables, Wind speed and direction recording devices, Construction of Wind Rose diagram for industrial stacks. Maximum Mixing Depth (MMD), Temperature Inversions.

Module-2

Industrial Plant Location and City Planning: Selection of site for Industrial Plant Location. Industrial Stack Emissions and Plume behavior, measurement of Smoke Density from Industrial Stacks using Ringelmann chart. Heat Island Effect in Urban areas.

Study on typical industries producing specific pollutants, Dust control in Thermal power plants, cement industry and stone crusher industry.

Module-3

Effect of Air Pollution from major Industries: Study on effect of air pollution from major industries: cement Industry, stone crushers and Petroleum Refineries.

Environmental Effects: Health effects, Effect on plants and Economical Losses. Green House Effect, Acid Rain, Global Worming, Photo-chemical Smog, Indoor Air Pollution, Occupational diseases.

Module-4

Air Pollution Control Equipments: Objectives of using control Equipments, Air pollution control Equipments for particulate matter. Working principle and field applications of: Gravity Settling Chambers, Centrifugal Collectors, Wet Collectors, Fabric filters and Electrostatic precipitators (ESP). Control methods for Gaseous Pollutants- Adsorption, Absorption and Combustion Process.

Module-5
Air pollution Legislation and Regulations: Introduction, Functions of central Board and Functions of state board, Classification of Pollutions sources, Ambient air quality standards, Major Air Pollution Disasters, Bhopal Gas Tragedy.   **Noise Pollution and Control in Industries**: Sources, Effects of Noise Pollution. Noise measuring devises, Standards, Noise control measures in Industrial establishments and Personnel protections.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum mark. The minimum passing mark for SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- Three Unit Tests each of **20 Marks**
- Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**
  to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks.**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books:

1. Colls, J., **Air Pollution: Measurement, Modeling and Mitigation**,CRC Press, 2009.
2. **Fundamentals of Air Pollution**, Academic Press, 1984. Wark K., WarnerC.F., and Davis W.T., (1998), "**Air Pollution - ItsOrigin and Control**", Harper & Row Publishers, New York.
3. Perkins H.C.(1974), "**Air Pollution**", McGraw Hill.
4. Crawford M.,(1976) "**Air Pollution Control Theory**", TATA McGrawHill.
5. Stern A.C., "**Air Pollution**", Vol I, II, III.
6. M.N.Rao and H V N Rao, "**Air Pollution",** TATA McGrawHill Pvt Ltd,NewDelhi.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=u142u-wJFwI&list=PLLy_2iUCG87BwOQUbS7WSdMVWHDXByk- w&index=2
- https://www.youtube.com/watch?v=z4YFkK3Wtsg&list=PLLy_2iUCG87BwOQUbS7WSdMVWHDXByk - w&index=4
- https://www.youtube.com/watch?v=GVBeY1jSG9Y

Skill Development Activities Suggested :

- Visit to nearby industries having air pollution control Equipments.
- Hands on training on air pollution monitoring system.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To understand the role and important of Air pollution and its control methods.	1,2
CO2	Understand the basics on Meteorology and importance of atmosphere.	1,2,3,4
CO3	Learn to know use of controlling devices used and measurement of Air pollutants using Specific devices.	1,2,3,4
CO4	To evaluate the effect of Air pollutants on Health and Economical Losses.	1,2,3,4
CO5	Achieve knowledge about Global Warming, Acid rain, etc., from major industrial activities in urban area including Noise Pollution.	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs
1.	Engineering Knowledge	PO1
2.	Problem Analysis	PO2
3.	Design / Development Solutions	PO3
4.	Conduct Investigations of Complex problems	PO4
5.	Modern tool usage	PO5
6.	Engineer and Society	PO6
7.	Environment and Sustainability	PO7
8.	Ethics	PO8
9.	Individual and Team-Work	PO9
10.	Communication	PO10
11.	Project Management and Finance	PO11
12.	Life-long Learning	PO12

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-
CO3	2	3	3	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-
CO5	2	2	1	-	-	-	-	-	-	-

Renewable and Non-Renewable Energy Resources

Course Code	22CWH321	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	25 hours theory + 10-12 hours tutorials	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to:
- Gain the Knowledge on conventional and non-conventional energy resources.
- Understand about the Bio-mass, bio energy, biogas plants with their functions.
- Understand about solar radiation, power generation and its utilization.
- Understand about geothermal energy and tidal energy generation and utilization.
- Understand about the nuclear power generation, utilization and nuclear waste disposal methods.

Module-1

Introduction: sources of energy, primary energy resources and secondary energy resources, world renewable energy resources and energy strategies. Renewable and non-renewable energy sources and availability. Conventional and non-conventional energy sources. use of various sources of energy consumption in the world.

Fossil Fuels: Classification of fossil fuels, composition, physico-chemical characteristics, natural Gas formation, exploration, Mining and uses of coal oil and natural gas.

Module-2

Bio-Energy: Bio-Mass energy, Bio mass Conversion technologies, Benefits of using Biomass, bio-fuels, bio-power, bio-products. Biogas production and uses. Classification of biogas plants. Indian floating type gas digester (KVIC), Fixed dome type digester. Advantages and disadvantages. problems involved with biogas production. Factors affecting generation of Biogas.

Module-3

Solar Energy: Introduction, solar radiation at earth's surface, Beam and Diffuse solar radiation. Measurement ofsolar radiation. Solar energy collectors-concentrating and non- concentrating collectors, advantages and disadvantages. Physical principles of conservation of solar radiation into heat energy.

Solar Electricity generation: Solar Photo-voltaic, solar distillation, solar furnace and solar cooking, advantages and disadvantages. Solar Pond construction and principle ofoperation. Electric power generation from solar ponds.

Module-4

Geo-thermal Energy: Introduction on energy from Earth, applications of Geo thermal energy, Geo-thermal resources, hydro-thermal resources, Geo- pressured resources, Petro-thermal resources, Magma resources. Advantages and disadvantages over other energy forms.

Tidal Energy: Introduction, Ocean Thermal Energy Conversion (OTEC), Open cycle and Closed cycle system for OTEC, Energy from Tides-basic principles of Tidal power generation, Components of Tidal power plants, advantages and limitations of Tidal

power generation.

Module-5

Nuclear Energy: Introduction, Nuclear Energy, advantages and disadvantages of Nuclear power plants, Nuclear fission and Nuclear fusion concepts and necessity.

Nuclear Reactors: General components of Nuclear reactors. Classification of Nuclear Reactors, types of nuclear reactors, PWR and BWR. Location of Nuclear power plant, types of nuclear waste and methods of disposal of Nuclear waste.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum mark. The minimum passing mark for SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Mathur, A.N., and Rathore, N.S., "Renewable Energy and Environment" – Proceedings of the National Solar Energy, HimanshuPublications, Udaipur.
2. Rao and Parulekar B.B., (1977), "Energy Technology– Non-conventional,
3. Renewable and Conventional Energy Resources", 2nd Edition, Khanna Publishers.
4. Rai, G.D , "Non-conventional Energy Sources", Khanna Publications.

Web links and Video Lectures (e-Resources):

- https://www2.tulane.edu/~sanelson/eens1110/energy.htm
- https://www.eia.gov/energyexplained/biomass/
- https://www.iberdrola.com/sustainability/renewables-energy-wind-power
- https://www.hydropower.org/iha/discover-types-of-hydropower
- https://www.britannica.com/science/fossil-fuel

Skill Development Activities Suggested

- Visit to the nearby renewable energy plants
- Study on Solar Power system established.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the various resources of Energy and its utilization.	1,2
CO2	know about Conventional and Non-conventional energy resources.	1,2,3,4
CO3	know about Bio-fuels, bio-energy and bio-gas plants.	1,2,3,4
CO4	know about solar energy, Geothermal energy, Tidal energy and nuclear energy with their merits and demerits	1,2,3,4

Program Outcome of this course:

Same as in 22CWM321.

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1	-	-	-	-	-	-	-
CO2	2	2	3	-	-	-	-	-	-	-
CO3	2	3	3	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-
CO5	2	3	1	-	-	-	-	-	-	-

Ecology and Environment

Course Code	22CWH322	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	25 hours theory + (10-12 hours tutorials)	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to;
- Gain the Knowledge on Ecology & Environment.
- Understand about the aquatic and Terrestrial Ecosystem.
- Understand about System Ecology.
- Understand about Ecosystem modelling.

Module-1

Ecology: Classification of Ecosystems, Structure and Function of Ecosystems, Energy flow in Ecosystems,Ecological Niche and succession, Bio-geochemical cycles, Ecological Pyramids.

Module-2

Aquatic and Terrestrial Ecosystems: Diversity and dominance Indices, Ecosystem Models.
Lake Ecosystem: Trophic levels, nutrient loading, nutrient enrichment, Leibig's Law, control of eutrophication.

Module-3

Systems ecology: Systems ecology and ecosystems modelling biodiversity and ecological perspective -human benefits, threats, conservation preservation and protection

Module-4

Ecosystem Modelling: Ecosystem models and their environmental applications, Types of Models, Model Design.

Module-5

Environmental Education and Information: Goals, Objectives and guiding principles of Environmentaleducations. Environmental educational Programs; Environmental Education in India

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum mark. The minimum passing mark for SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Kormondy, "Concepts of Ecology", Prentice Hall Publication, New Jersey.
2. Odum, "Fundamentals of Ecology", Adisson Co.
3. Krebs J., "Ecology - The Experimental Analysis of Distribution and Abundance", I Edition, Harper International.
4. Hall C.A.S., and Day J.W., "Ecosystem Modeling in Theory and Practice: An Introduction with Case Histories", JohnWilley.
5. Verma P.S and Agarwal V.K 1998. Concept of Ecology, S. Chand and company Ltd.,

Web links and Video Lectures (e-Resources):

- https://www.conserve-energy-future.com/types-importance-examples-ecology.php
- https://www.environmentalpollution.in/ecosystem/aquatic-ecosystem-and-terrestrial-ecosystem- explained-with-diagram/260
- https://onlinecourses.nptel.ac.in/noc22_hs125/preview
- https://www.conserve-energy-future.com/environmental-education-and-its-components.php

Skill Development Activities Suggested

- Development of models on ecosystems.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Develop an appreciation of the modern scope of scientific inquiry in the field of Ecology	1,2
CO2	Become familiar with the variety of ways that organisms interact with both the physical and the biological environment	1,2,3,4
CO3	Develop an understanding of the differences in the structure and function of different types of ecosystems	1,2,3,4
CO4	Understand about Ecosystem modelling.	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	1	1	-	-	-	-	-	-	-
CO2	1	2	1	-	-	-	-	-	-	-
CO3	1	1	1	-	-	-	-	-	-	-
CO4	1	2	2	-	-	-	-	-	-	-
CO5	1	1	1	-	-	-	-	-	-	-

Human Impact on Marine and Coastal Environment

Course Code	22CWH323	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	25 hours theory + 10-12 hours tutorials	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

This course will enable students to;
- To provide students understanding of the materials and processes associated with the major natural geo-hazards: floods, earthquakes, volcanic activity, landslides, and coastal hazards.
- Study on coastal Environment.

Module-1

Estuaries and Saltwater Marshes; Adaptations of Estuarine and Saltwater Organisms – Sea-grass Ecosystem – Mangrove Ecosystem – Barrier Islands, Biogeography – Coral **Reefs and Atolls** – Open Ocean – Marine Benthos and Tidal Communities – Human Impact on the Marine Environment.

Module-2

Coastal Hazard: Coastal Hazard; Natural vs. Man-made hazard - Cyclones, Coastal Erosion, Tsunami, Flood, Storm surges, Sea Level Rise and Others – Impacts on Natural and Human environment.

Module-3

The Human Coast: The Human Coast - Governance of the Coast: Institutions, Policy and Jurisdictions – Technological Hazards - Biological and Anthropogenic Coastal Hazards - Hazards and Disasters; Definition, Causes, Effects, Differences and their relationship to each other.

Module-4

Case Studies Examples – Case Studies – Lessons Learnt – Preparing for the Future growth.

Module-5

Coastal Hazard Management Ethical Dimensions - Competing Values - Growth Management: tools, plans, principles – Mitigation: Definition, approaches, types and examples - Coastal Hazards Management Framework -Hazard Mitigation Planning.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum mark. The minimum passing mark for SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- Three Unit Tests each of **20 Marks**
- Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**
- to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

- Barnes, R.S.K. and Hughes, R.N. Introduction to Marine Ecology, 3rded.,Blackwell Publishing, 1999.
- Beatley, T., David, J.B. and Anna, K.S. An Introduction to Coastal ZoneManagement, Island Press, Washington D.C., 2002.
- Bryant, E., Natural Hazards, Cambridge University Press, New York,2006.
- Burby, R.J., ed., Cooperating WithNature: Confronting Natural Hazards With Land-Use Planning for Sustainable Communities, Joseph Henry Press, Washington D.C. 1998.)

Web links and Video Lectures (e-Resources):
- https://www.youtube.com/watch?v=eIs4M_2QG0
- https://www.youtube.com/watch?v=C-JVJTwQgLI&list=PLbMVogVj5nJTirggwW73R_PPtqi4VRzxm
- https://www.youtube.com/watch?v=kgVRlG42VNE&list=PLbMVogVj5nJTirggwW73R_PPtqi4VRzxm&inde x=10
- https://www.youtube.com/watch?v=CxgwgMtzrsQ&list=PLbRMhDVUMngdZvhdNC31fHsV_HLlW5Jby

Skill Development Activities Suggested

- Site visit.
- Visiting to Research Centres to study on Natural Costal Environmental system.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the systems of Estuaries and Saltwater Marshes.	1,2
CO2	Analyze of Impacts on Natural and Human environment.	1,2,3,4
CO3	Understand the Coastal Hazard Management	1,2,3,4

Program Outcome of this course

Sl. No.	Description	POs

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1	-	-	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-

Instrumentation Techniques in Environmental Engineering				
Course Code	**22CWH331**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	25 hours theory + 10-12 hours tutorials	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to;
- Gain the Knowledge of Principles of instrumentation.
- Understand about the Spectrophotometric Methods.
- Understand about Electro-chemical Methods.
- Understand about Physical and Biological Methods.

Module-1

Treatment of Data in Quantitative Analysis - Accuracy, Precision, Standard deviation, Types of errors, Minimization of errors. Significant figures, Criteria for rejection of data, Principles of instrumentation.

Module-2

Spectrophotometric Methods - Principles, applications, advantages & limitations of the following Spectrophotometric methods: Colorimetry & Spectrophotometry, FTIR, NMR, Atomic absorption spectrophotometry, Flame photometry, Fluorimetry, Nephelometry and Turbidimetry, Inductively coupled plasma spectroscopy & Mass spectroscopy.

Module-3

Electrochemical Methods - Principles, applications, advantages & limitations of following electrochemical methods: Polarography, Pulse polarography, Ion selective electrode oscilloscopic polarography, cyclic voltametry & anode stripping voltametry

Module-4

Chromatography - Principles, applications, advantages & limitations of following chromatographic methods: Adsorption, Partition, Column chromatography, Paper chromatography, Thin layer chromatography, Gas chromatography, High Performance Liquid Chromatography (HPLC), Ion-chromatography & size exclusion chromatography.

Module-5

Physical and Biological Methods - Analytical methods in Biotechnology & bio-process control, Electrophoresis, X-ray crystallography, Bio-informatics tools, Bio-assay of pharmaceutical products, online & off line measurement systems, microprocessor-based control systems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum mark. The minimum passing mark for SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- Three Unit Tests each of **20 Marks.**
- Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**
  to attain the COs and POs.

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Instrumental Methods of analysis, Willard H H& Dean LL, John Willey,1976.
2. Modern Methods of chemical analysis Recsok RL, & Shields LD, JohnWilley & sons, Inc 1990.
3. Instrumental Methods of chemical analysis, Ewing GW, McGrw Hill BookCompany, Inc. 1975.

5. Fundamental of molecules spectroscopy. Banwell CN, McGraw Hill,NY, 1990.
6. Chemistry for Environment Engineering. Sawyer and Mc Carty. Standard Methods for Examination of Water

Web links and Video Lectures (e-Resources):

- https://www.youtube.com › watch
- https://www.accessengineeringlibrary.com › chapter24.
- https://www.quora.com › What-is-environmental-instrum...
- https://uspas.fnal.gov › materials › Instrumentat...
  https://books.google.com › Science › Chemistry › Analytic

Skill Development Activities Suggested

- Visiting to environmental research centre.
- Visiting to R & D Centre to study on various Instruments used in environmental engineering.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To Know the Principles of Instrumentation.	1,2,3,4
CO2	To understand the merits and demerits of various instruments like spectrophotometer, Flame photometer and Turbidity meter.	1,2,3,4
CO3	Know the principles of various instruments using Electrochemical methods.	1,2,3,4
CO4	Know about the principles of Chromatography and its applications.	1,2,3,4
CO5	Know about use of Physical and biological methods in pharmaceutical products.	1,2,3,

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	1	1	-	-	-	-	-	-	-
CO2	1	2	1	-	-	-	-	-	-	-
CO3	1	2	1	-	-	-	-	-	-	-
CO4	1	1	1	-	-	-	-	-	-	-
CO5	1	2	2	-	-	-	-	-	-	-

Aquatic Chemistry and Microbiology			
Course Code	**22CWH332**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	25 hours theory + (10-12 hours Tutorials)	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to;
- Gain the Knowledge on Aquatic Chemistry.
- Understand about the Control and Measurement of Microorganisms.
- Understand about Industrial wastewater Pollution control.
- Understand about Disinfection process of water.

Module-1

Introduction to Aquatic Chemistry - Importance of Environmental Chemistry. Environmental Significance of Dissolved Oxygen, methods of determination of Dissolved Oxygen in the laboratory and Biochemical Oxygen Demand, Numerical problems on determination of BOD. Self-purification phenomenon of streams, oxygen sag curve, zones of purification, numerical problems on disposal of effluents into a stream. Eutrophication of lakes, its Effect and control.

Module-2

Control and Measurement of Microorganisms – Microbiology of Domestic water and wastewater, Importance of Bacteriological Examination of water. Most Probable Number (MPN) and numerical problems. Need for protected water supply. Sources and characteristics of surface and subsurface water. Drinking water quality standards as per BIS. Effect of water quality parameters.

Module-3

Industrial Wastewater Pollution control: Sources and characteristics of industrial wastewater and Municipal waste water. Effects on environment, Concept of Aerobic and anaerobic biological treatment process. Advanced wastewater treatment methods; waste volume reduction, waste strength reduction, neutralization, equalization and proportioning. Principles of treatment process and flow charts on distillery, dairy and sugar industry.

Module-4

Disinfection process of water: Theory of disinfection, methods of disinfection Process with merits and demerits. Chlorination, Break point chlorination and determination of Chlorine demand in the laboratory. Estimation of quantity bleaching powder, Numerical problems.

Module-5
Miscellaneous treatment Process: Objectives of water treatment. Hard water, treatment methods-water softening methods, Lime soda and Zeolite process. Health significance, estimation of hardness from water. Fluoridation and De-fluoridation, Nalgonda technique for domestic Level and large-scale process.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum mark. The minimum passing mark for SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- Three Unit Tests each of **20 Marks.**
- Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks,** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks.**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Sawyer C.N. and McCarty, P.L ., (2003), "Chemistry for Environmental Engineering and Science", 5th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. Pelczar M.J ,Chan ECS, Krieg, NR(1998) "Textbook of Microbiology" 5th edition Tata McGraw Hill Publishing Co.
3. McKinney R.E.(1962) "Microbiology for Sanitary Engineers", Newyork McGraw Hill.
4. APHA, (2002), "Standard Methods for Examination of Water and Wastewater"; 21st Edition.
5. Gaudy and Gaudy (1980), "Microbiology for Environmental Scientists and Engineers", McGraw Hill.

6. Prescott L.M., Harley, Klein, (2002), "Microbiology" 5th edition, McGraw Hill Higher Education

Web links and Video Lectures (e-Resources):

- https://chem.libretexts.org › Environmental Chemistry
- https://youtu.be/frtln5ZoeNQ
- https://en.wikipedia.org › wiki › Eutrophication
- https://www.britannica.com › Science › Environment
- https://www.researchgate.net/publication/291139679_Handbook_of_Water_and_Wastewater
- _Microbiology
- https://www.youtube.com › watch
- https://www.egyankosh.ac.in › bitstream › Unit-14

Skill Development Activities Suggest

- Vising to Environmental Research Laboratory.
- Study on Water and Waste water treatment Systems.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the role and importance of Aquatic chemistry and stream pollution.	1,2,3
CO2	Understand about the analysis and control of microorganisms in aquatic environmental system.	1,2,3,4
CO3	Understand the importance and methods of treatment of industrial wastewater.	1,2,3
CO4	Understand about control of pathogenic bacteria under disinfection process.	1,2,3
CO5	Understand about the importance of hardness and Fluorosis in water.	1,2,3

Program Outcome of this course

Sl. No.	Description	POs

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	1	2	-	-	-	-	-	-	-
CO2	1	2	1	-	-	-	-	-	-	-
CO3	1	2	1	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	-	-	-	-

Industrial Effluents Treatment Technology

Course Code	22CWH333	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	25 hours theory + 10-12 hours tutorials	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to;

- Understanding the Industrial effluent characteristics and their effects on environment.
- Understand treatment and disposal alternatives of industrial effluents.
- Understand the reduction of organic and inorganic dissolved solids from effluents.
- Understand a specific treatment and disposal technics from specific industries.

Module-1

Effects of Industrial Wastes on sewerage system and sewage treatment plants and receiving water bodies. Effects of waste additions on physical and chemical properties of soil.

Effluent standards and receiving water quality standards. Different aspects and choices of various disposal alternatives.

Module-2

Industrial Waste survey-Process flow charts, condition of waste stream. Material balance, Sampling-Grab, Composite and integrated samples. Continuous monitoring – pH, Conductivity, Bio-monitoring.

Module-3

Pre-treatment of Industrial Wastewater–Volume reduction, Strength reduction, Neutralization, Equalization and Proportion, Removal of Organic and inorganic dissolved solids.

Module-4

Wastewater Treatment for specific industries: Distillery, Sugar Industry, Pulp and paper, Cement Industry, Textile, Dairy Industry, Fertilizer, Pesticides and Pharmaceuticalindustries.

Module-5

Design of complete treatment system & disposal of Effluents: Distillery, Diary, Sugar Paper and Pulp mill to meet PCB. standards.

Treatment of Radio Active Wastes - Low activity and high activity radiation, application of radioactive techniques for wastewater treatment. **Bio-Remediation** of contaminatedsoils.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum mark. The minimum passing mark for SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- Three Unit Tests each of **20 Marks**
- Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-

Suggested Learning Resources:

Books

1. "Wastewater Engineering - Treatment and Reuse", Metcalf and Eddy Inc., (2003), 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. "Wastewater Treatment Concepts and Design Approach", Karia G.L., and Christian R.A., (2001), Prentice Hall of India Pvt. Ltd., New Delhi.
3. "Wastewater Treatment", Rao M.N., Datta A.K., (2008), 3rd edition,
4. Oxford & IBH Publishing Co. New Delhi.
5. Nemerow N.N., (1971) – "Liquid Waste of industry theories, "Practices and Treatment, Addison Willey New York.

6. "Wastewater Engineering - Treatment and Reuse", Metcalf and Eddy Inc., (2003), 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

Web links and Video Lectures (e-Resources):

https://bmsit.ac.in › pdf › civil › studymaterial
- https://www.researchgate.net › ... › Industrialization
- https://www.internationaljournalssrg.org › IJCE
- https://en.wikipedia.org › wiki › Industrial_wastewater_tr...
- https://www.netsolwater.com › Blog - STP - ETP

Skill Development Activities Suggested

- Visit to near by industrial effluent treatment plant.
- Study on experimental analysis wrt effluent samples.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To understand the role and importance of industrial waste water management.	1,2
CO2	Understand the basics of treatment methodologies.	1,2,3
CO3	Understand basics on removal of organic & inorganic dissolved solids.	1,2
CO4	Understand the safe disposal methods of industrial effluents.	1,2

Program Outcome of this course

Sl. No.	Description	POs

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	1	1	-	-	-	-	-	-	-
CO2	2	1	2	-	-	-	-	-	-	-
CO3	1	1	2	-	-	-	-	-	-	-
CO4	1	2	2	-	-	-	-	-	-	-
CO5	1	2	2	-	-	-	-	-	-	-

Hydraulics of Water and Waste Water

Course Code	**22CWH334**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	25 hours theory + 10-12 hours tutorials	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course will enable students to;
- Formulate momentum, energy and mass transport models
- Solve diffusion-dispersion equations
- Apply basic flow equations for steady and unsteady flows in openchannels

Module-1

Introduction: Water Supply System-types of systems, population forecasting methods, water demands, pressure, design period, Pipe materials and roughness coefficient.

Storage Reservoirs – Site selection**,** Need, different types, capacity determination and

evaluation of pumping system.

Pipe Networks – Peak factors for intermittent and continuous distribution system. Branch and Grid Iron systems. Design Layouts of distribution systems, Evaluation of distribution system.

Module-2
Basic concepts of open channel flows; conservation laws,continuity equation, momentum equation, Application ofmomentum and energy equations. Critical flow, its propertiesand application; location of critical flow and its computation**Uniform flow;** flow resistance, equations of flow resistance,computation of normal depth,　　Gradually varied flow, governing equations classification of water surface profiles.

Module-3
Hydrologic processes; Hydrologic cycle and its interaction with human activity, Hydrologic analysis, Hydrologic statistics. Transport processes. **Diffusion system-** phenomena, Flicks' First and second Laws of diffusion, Advection diffusion equation, Turbulent diffusion and dispersion mixing phenomenon in rivers, Contaminant transport system, Saltwater intrusion into aquifers, Non aqueous phase liquid (NAPL) in groundwater,

Module-4
Water Quality in Distribution System – Factors affecting water quality, predictive tools and intermediate disinfection. **Wastewater Collection System** – Separate and Combined Sewer Systems, relevant equations for flow conditions, Pipe materials and roughness coefficient, design guidelines and examples. Sewer Appurtenances.

Module-5
Sewer Network – Estimation of Nodal Flows, PumpingStations, Evaluation of Different Network Options. **Storm Sewers** – Flooding and water quality problems, run-offcalculations, storm water inlets, open drains and sewer pipes and design for different conditions of flow of storm sewage.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum mark. The minimum passing mark for SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**
   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Sincero A.P., and Sincero G.A., (1999), "**Environmental Engineering – A Design Approach",** Prentice Hall of India Pvt. Ltd., New Delhi.
2. Hammer M.J., and Hammer Jr. M.J., (2008), **"Water and Wastewater Technology**", Prentice Hall of India Pvt. Ltd., New Delhi.
3. Walski T.M., (1987), "**Analysis of Water Distribution Systems**", CBS Publications, New Delhi."

Web links and Video Lectures (e-Resources):

- https://openjicareport.jica.go.jp › pdf
- http://designwss.weebly.com › uploads › ch1
- https://web.iitd.ac.in › files › CEL795_2011
- https://www.researchgate.net › publication › 350843795...
- https://scholarsbank.uoregon.edu › handle › Tal...

Skill Development Activities Suggested

- .Visiting to nearby sewage treatment plant.
- Visiting to nearby hydrology research centre..

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	solve basic equations of flow through porous medium	1,2
CO2	formulate forecast models for operation of hydrologic systems.	1,2,3
CO3	Understand the diffusion system in ground water system.	1,2

Program Outcome of this course

Sl. No.	Description	POs

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	2	1	-	-	-	-	-	-	-
CO2	1	1	2	-	-	-	-	-	-	-
CO3	1	2	2	-	-	-	-	-	-	-
CO4	1	2	2	-	-	-	-	-	-	-
CO5	2	2	1	-	-	-	-	-	-	-

PROJECT WORK PHASE – 1			
Course Code	22CWH34	CIE Marks	100
Number of contact Hours/Week (L:P:S)	00:06:00	SEE Marks	--
Credits	03	Exam Hours	--

Course objectives:
- Support independent learning.
- Guide to select and utilize adequate information from varied resources maintainingethics.
- Guide to organize the work in the appropriate manner and present information(acknowledging the sources) clearly.
- Develop interactive, communication, organisation, time management, and presentationskills.
- Impart flexibility and adaptability.
- Inspire independent and team working.
- Expand intellectual capacity, credibility, judgement, intuition.
- Adhere to punctuality, setting and meeting deadlines.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to
- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment inwhich the students are motivated to reach high standards and become self-confident.

Course outcomes:
At the end of the course the student will be able to:
- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation, and solution.
- Design engineering solutions to complex problems utilising a systems approach.
- Communicate with engineers and the community at large in written an oral forms.

SOCIETAL PROJECT			
Course Code	22CWH35	CIE Marks	100
Number of contact Hours/Week (L:P:S)	00:06:00	SEE Marks	--
Credits	03	Exam Hours	--

Course objectives:
- Support independent learning.
- Guide to select and utilize adequate information from varied resources maintainingethics.
- Guide to organize the work in the appropriate manner and present information(acknowledging the sources) clearly.
- Develop interactive, communication, organisation, time management, and presentationskills.
- Impart flexibility and adaptability.
- Inspire independent and team working.
- Expand intellectual capacity, credibility, judgement, intuition.
- Adhere to punctuality, setting and meeting deadlines.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the societal Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to
- Present the seminar on the selected societal project orally and/or through power pointslides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment inwhich the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:
- Demonstrate a sound technical knowledge of their selected societal project topic.
- Undertake problem identification, formulation, and solution.
- Design engineering solutions to complex problems utilising a systems approach.
- Communicate with engineers and the community at large in written an oral forms.

Semester III

<table>
<tr><td colspan="4" align="center">INTERNSHIP</td></tr>
<tr><td>Course Code</td><td>22CWHI36</td><td>CIE Marks</td><td>50</td></tr>
<tr><td>Number of contact Hours</td><td>06 Weeks</td><td>SEE Marks</td><td>50</td></tr>
<tr><td>Credits</td><td>06</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">

Course objectives:

Internship provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,
- To put theory into practice.
- To expand thinking and broaden the knowledge and skills acquired through course workin the field.
- To relate to, interact with, and learn from current professionals in the field.
- To gain a greater understanding of the duties and responsibilities of a professional.
- To understand and adhere to professional standards in the field.
- To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.
- To identify personal strengths and weaknesses.
- To develop the initiative and motivation to be a self-starter and work independently.

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Internship/Professional practice: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to
- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.
- The participants shall take part in discussion to foster friendly and stimulating environmentin which the students are motivated to reach high standards and become self-confident.

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</table>

Semester IV

<table>
<tr><td colspan="5" align="center">PROJECT WORK PHASE -2</td></tr>
<tr><td>Course Code</td><td>22CWH41</td><td>CIE Marks</td><td colspan="2">100</td></tr>
<tr><td>Number of contact Hours/Week (L:P:S)</td><td>00:08:00</td><td>SEE Marks</td><td colspan="2">100</td></tr>
<tr><td>Credits</td><td>18</td><td>Exam Hours</td><td colspan="2">03</td></tr>
<tr><td colspan="5">

Course objectives:
- To support independent learning.
- To guide to select and utilize adequate information from varied resources maintainingethics.
- 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 presentationskills.
- 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.

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Project Work Phase - II: 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 guideand prepare the project report as per the norms avoiding plagiarism.

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Course outcomes:
At the end of the course the student will be able to:
- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluateideas 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 writtenand oral forms.

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</table>