SAMPLE TEMPLATE for PCC/PEC/OEC

Program Outcome of M.Tech Environmental Engineering course

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	PO1
2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	**Conduct investigations of complex problems**: Use research-based knowledge and researchmethods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	PO5
6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	PO6
7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	PO8
9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	PO9
10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	PO10
11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	PO11
12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	PO12

Blooms Texonomy

Texonomy	Level
Remembering	L1
Understanding	L2
Applying	L3
Analysing	L4
Evaluating	L5
Creating	L6

Semester- First Semester

Advanced Computational Methods and Optimization			
Course Code	**22CEE11**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40 Hours of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Analyze the environmental data and characterize with regression equations.
- Select and apply the appropriate distribution to experimental/field data.
- Able to apply optimization concepts to environmental problems.
- Select suitable numerical methods to search the solution of nonlinear optimization equation.
- Apply numerical methods to solve algebraic, transcendental and partial differential equations.

Module-1	
Statistics: Frequency Distribution – Characteristics of Distributions: Central tendency and dispersion. Methods of least square and regression, multiple regression, Solutions of regression analysis problems Analysis of Variance.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-2	
Probability: Concept of probability, Random Variables, Binomial, Poisson and Normal distribution – applications, Chi- squared test, F test, t-test.	
Teaching-Learning Process	Emphasis and inflection in different form , power point presentation and video lecture

Module-3	
Optimization: Concept, need, importance and applications related to environmental engineering, Single and multivariable optimization without and with constraints. Linear programming – standard form of problems, pivotal reduction of equations. Solutions of linear programming problems, Simplex method – single and two phase methods, Concept of Dual Linear Programming and conversion of primal to Dual.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-4	
Non-Linear Programming: Numerical search methods non- linear problems-Dichotomous. Fibonacci and Golden section methods. Quadratic and cubic interpolation methods, Numerical Integration.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-5	
Numerical Methods: Regular false method**,** Newton – Raphson method for solution of algebraic and transcendental equations, Numerical solutions of partial differential equations – finite difference, solution of elliptic, parabolic and hyperbolic equations.	
Teaching-Learning Process	Emphasis and inflection in different form , power point presentation and video lecture.

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**oneSkill 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. Rao, S.S. (1996), "Optimization: Theory and applications", Wiley Eastern Ltd. Publications.
2. Grewal. B.S., and Grewal. J.S., "Numerical methods in Engineering and Science", Khanna Publishers, 9th Edition, New Delhi.
3. .Taha H.A., "Optimization Research":An introduction, Pear son Prentice Hall, 8th Edition
4. .Shanthakumar M.S., "Numerical Methods and Analysis", Tata McGrawhill Pubs.
5. .Levin R I., (2008), "Statistics for Management", Pearson Education India.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses

Skill Development Activities Suggested

- Hands on Practice

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Describe and apply concepts of probability, central tendency and distribution. methods to characterize or analyse the environmental data**.** Formulate null hypothesis and apply regression analysis for a given set of data, Apply explicit and implicit methods to solve simple parabolic problems	L4
CO2	Classify, analyse and solve simple to complex optimization problems with and without constraints.	L3
CO3	Apply numerical search method for both linear and non-linear problems. Use interpolation methods for environmental data analysis and interpretation	L4
CO4	Analyse the partial differential equations using Newton-Raphson and finite Element methods and arrive at solutions	L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	3	2	2	2	1	2	2
CO2	2	2	3	2	2	3	3	3	1	2	3	3
CO3	2	3	3	2	3	3	2	1	2	1	2	3
CO4	3	2	3	2	3	2	3	2	1	2	2	3

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

Semester - 1

ADVANCED WATER TREATMENT TECHNOLOGY			
Course Code	**22CEE12**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:02:00	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

- Analysis of physical and chemical characteristics of water treatment technology
- Understand and design of different unit operations and unit processes in water treatment technology

MODULE-1

Introduction–Objectives and necessity for Treatment of water. Sources of water and their characteristics. Micro-organisms in natural water purification system. Drinking water quality requirements as per BIS & WHO guidelines. Sources of Water Pollution, Diseases and Control. Public Health Significance.

Flow Diagram on overall water supply Project for villages & cities. Unit diagrams and flow charts on Water Treatment System. Suitability of Intake Structures and types.

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

MODULE-2

Treatment Operations and Engineering Systems for Water Purification – Typical treatment for ground water containing Hardness and Turbid surface water contaminated with organisms. Water Aeration process, Importance and limitations. Gas Transfer two film model: Water in Air system and Air in water system. Estimation of Solubility of Air in water with Henry's Law. Significance of DO in Water Principles of Sedimentation Process and Stokes law in Detail. Separation of Solids. Design Criteria and design of Sedimentation tank. Type-I and Type-II Settling pattern in the removal of Discrete particles.

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

MODULE-3

Coagulation and Flocculation Process – Theory of Coagulation and Principle. Types of Coagulants used and their characteristics, Chemical reaction with water. Alkalinity Coagulation relationship. Coagulant Aids, Chemical feeding devices. Determination of Optimum Coagulant Dosage. Numerical design problems on estimation of Coagulants.

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

MODULE-4

Water Treatment by Filtration Process – Theory of Filtration and basic Principles. Classification of Filters used in treatment of water. Filterswashing Technique/back wash. Operational troubles and trouble shooting. Design criteria used and Design of Slow and Rapid Sand Filters required for water treatment plant.

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

MODULE 5
Water Disinfection Process – Disinfection methodologies and their suitability. Theory of Disinfection and characteristics of good disinfectant. Forms of Chlorination, Chemical reactions, Break point Chlorination. Measurement of Chlorine Demand and residual Chlorine. Estimation of quantity of Chlorine and Bleaching powder required for treatment of water. **Water Softening** - Hardness removal techniques, numerical problems on determination of Hardness in water sample and Studies on effects of hardness. Fluoridation and Defluoridation techniques in affected areas.

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

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

Sl.NO	Experiments
1	Chemistry Laboratory practice: Sampling and characterization of water and wastewater by gravimetric, volumetric.
2	Chemistry Laboratory practice: Sampling and characterization of water and wastewater by and colorimetric methods, Good laboratory practice – Analytical quality control
3	Determination of Chlorine Demand for a given water sample and to plot the Break Point Chlorination Curve
4	Determination of Optimum Coagulant Dose using Jar Test Apparatus for given water samples
5	Microbiology Laboratory : Bacteriological analysis of water, sewage, test for plate count – coli forms – fecal coli forms – E coli – M.P.N. and M.F. techniques
6	Techniques for studying aquatic organisms – identification of phytoplankton and zooplankton – bioassay study and biodegradation.
7	Solid Waste and leachate analyses:, for– Moisture content, organic content, pH,
8	Solid Waste and leachate analyses:, for– Sulphur, carbon, nitrogen and Trace metals
9	Sampling and analysis of ambient air Instrumental methods of analyses for particulates, PM10, PM2.5, HC.
10	**Can be Demo experiments for CIE** Noise measurements.
11	**Can be Demo experiments for CIE** Demonstration of Advanced Instruments such as ICP, UV-VIS Spectrophotometer, HPLC

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 experiments shall 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. Fair, G.M., Geyer J.C and Okun, (1969) "Water and Waste water Engineering" Vol II, John Wiley Publications.
2. Weber W.J., (1975) "Physico - Chemical Processes for Water Quality Control".
3. Peavy, H.S., Rowe and Tchobonoglous,G., (1985), "Environmental Engineering", McGraw Hill.
4. ViessmanJr, Hammer J. M, Perez, E.M, and Chadik, P. A, Water Supply and Pollution Control, PHI Learning, New Delhi, 2009.
5. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, Environmental Engineering, McGraw Hill., 1984

FOR LABORATORY:

1. Manual on water supply and Treatment, CPHEEO, Ministry of Urban Development, GoI,New Delhi, 1999.

2.Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development,GoI, New Delhi,

3. Software Package Manual on BRANCH, LOOP, SEWER – UNDP/UNEP.

4. WATPLANT and QUALOOP Softwares. – CPHEEO – Manual.

5. Relevant Software Manuals– USEPA

6. Wark.K, Warner G.F. and Davis W.T – Air Pollution its origin and control, Addison-Wesley,

7. Thomann R.V and Mueller J.A –. Principles of surface water quality modeling and control, Harper & Row Publishers,

8. Sincerio A.P.&Sincerio G.A., Environmental Engineering – A Design Approach Prentice Hall of India.

9. "Standard Methods for the Examination of Water and Wastewater", 21th Edition, American

10. Public Health Association, Washington. D.C . 2005

Web links and Video Lectures (e-Resources):

Software Package Manual on BRANCH, LOOP, SEWER – UNDP/UNEP.

WATPLANT and QUALOOP Softwares. – CPHEEO – Manual.

Relevant Software Manuals– USEPA

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

Visit to nearby treatment plant and design of treatment plant for different MLD

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Objectives and importance of water treatment processes and to assess the water quality parameters	L1
CO2	Understand the principles and operations of aeration and sedimentation process of water treatment systems	L2
CO3	Understand the theory and principle of coagulation and estimate the coagulant dosage	L2
CO4	Evaluate the performance of filter unit along with filter back washing	L3
CO5	To learnt the disinfection, softening, fluoridation and defluoridation technique	L2

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**	**-**	**2**	**-**	**2**	**3**	**1**	**3**	**3**	**1**	**1**
CO2	**3**	**2**	**3**	**1**	**-**	**2**	**2**	**1**	**1**	**-**	**-**	**1**
CO3	**3**	**2**	**3**	**1**	**-**	**2**	**2**	**1**	**1**	**-**	**-**	**1**
CO4	**3**	**1**	**-**	**2**	**-**	**2**	**3**	**1**	**3**	**3**	**1**	**1**
CO5	**3**	**2**	**3**	**1**	**-**	**2**	**2**	**1**	**1**	**-**	**-**	**1**

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

Semester- First Semester

APPLIED ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY			
Course Code	**22CEE13**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 hours of teaching + 10-12 Sessions of SDA	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:

- The chemistry provides an in depth knowledge of basics of chemistry, variety of reactions and introduces equilibrium chemistry and lays foundation of electrochemistry, colloidal and surface chemistry.
- It encompasses water and wastewater analytical and instrumental methods of analysis.
- It provides the basics of microbiological aspects related to the Environment

Module-1

Importance of Environmental Chemistry as applied to the Environmental Engineering, types of reactions, reversible and irreversible reaction, redox reactions, and reaction kinetics. Modes of expression for molarity, normality, molality, etc., Electrochemistry and its applications. Physical and equilibrium Chemistry– fundamentals and applications. pH–Principle, Measurement, Numerical Examples, Buffersand Bufferindex

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-2

ColloidalChemistry:Colloids – Types, properties and environmental significance. Colloidal dispersions in water, air and emulsions. Theory of colloids – double layer theory, zeta potential, destabilization of colloids (Schulze – Hardy rule) as applied to coagulation process. Absorption and adsorption process, adsorption isotherms.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-3

Instrumental methods of analysis: Lambert's and Beer's law. Colorimetry – estimation of iron and manganese in water samples. Methods of determining the trace organic and inorganic contaminants using emission and absorption technique.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-4

Water & wastewater analysis: Fluoridation, deflouridation, chlorination, BOD, DO, types and measurement of BOD, rate of BOD & theoretical oxygen removal, COD- determination & its application in wastewater treatment.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-5

Microbiology - Microorganisms of importance in air, water and soil environment Principles and applications of microscopy, microscopic flora and fauna of importance.
Metabolism and metabolic pathways, Bioconcentration, Biomagnification and Bioaccumulation.
Bacteria – Morphology, typical growth curve and generation time, Measurement Techniques – APC, MPN (Probability and Thomas methods), MFT. Monod's equation and its applications.

Algae - orphology, classification and their importance. Fungi - Protozoa - morphology, classification and their importance. Enzymes - classification, kinetics – Michaelis - Menten equation, factors influencing enzyme reaction. Virology - Types, characteristics and enumeration methodology.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

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**oneSkill 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. Pelczar M.J ,Chan ECS, Krieg, NR "Textbook of Microbiology" 5th edition Tata McGraw Hill Publishing Co. Ltd., New Delhi
2. Sawyer C.N. and McCarty, P.L ., , "Chemistry for Environmental Engineering and Science", 5th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi
3. Gaudy and Gaudy, "Microbiology for Environmental Scientists and Engineers", McGraw Hill.
4. APHA, "Standard Methods for Examination of Water and Wastewater"; 21st Edition
5. Stumn and Morgan, "Aquatic Chemistry", John Willey & Sons

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses

Skill Development Activities Suggested

- Advanced instruments demonstration and Training.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Identify types of chemical reactions and evaluate the feasibility of given reaction based on thermodynamics properties. List and describe types of electrodes and electrode potential. Measure pH, emf and other related parameters.	L1
CO2	Classify colloids, discuss their properties and their environmental significance. Apply the understanding of the underlying concepts of chemistry in the design of water and wastewater treatment systems.	L2
CO3	Apply the knowledge of instrumental analytical techniques for measuring different types of environmental pollutants. Discuss the need for microbiology and identify different flora and fauna of importance in water, air and soil media.	L3
CO4	Apply the understanding of the underlying concepts of chemistry in the design of water and wastewater treatment systems.	L1
CO5	Apply the knowledge of using microbes in pollution control activities. Review emerging microbial contaminants and Formulate enzymatic relationships using kinetics.	L1

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	2	-	2	3	1	3	-	1	1
CO2	2	2	2	2	2	2	2	2	2	2	3	2
CO3	2	2	2	2	2	2	2	2	2	2	3	1
CO4	3	1	-	3	-	2	3	1	3	3	3	1
CO5	3	3	2	2	2	2	2	2	2	2	2	2

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

Semester- First

SOLID WASTE ENGINEERING AND MANAGEMENT			
Course Code	**22CEE14**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 Hours of teaching+ 10-12 sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- The student will have a thorough knowledge of key functional elements in municipal solid waste management including waste minimization concepts.
- Designing of engineered land fill sites for the disposal of solid wastes.

Module-1	
Introduction : Sources and engineering classification, characterization, generation and quantification; Objectives, principles, functional elements of solid waste management system – Regulatory aspects of solid waste management, major problems. Environmental implications of open dumping, Construction debris – management &handling, E- Waste Management, Rag pickers and their role.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-2	
Waste Generation: Rate of generation, frequency, storage and refuse collection, physical and chemical composition, quantity of waste, engineering properties of waste, prediction, modelling concepts. **Collection, Segregation and Transport**: Handling and segregation of wastes at source, Collection (primary & secondary) and storage of municipal solid wastes, collection equipment, transfer stations, collection route optimization and economics, regional concepts. System dynamics.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-3	
Waste Minimization: 4R: reduce, recover, recycle and reuse, case study, guidelines **Treatment Methods :**Refuse processing technologies. Mechanical and thermal volume reduction. Biological and chemical techniques for energy and other resource recovery: composting, vermicomposting, vermigradation, fermentation. Incineration of solid wastes.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-4	
Disposal Methods: Impacts of open dumping, site investigation and selection, sanitary land filling - Types, geotechnical considerations, design criteria and design, Liners - earthen, geo membrane, geo synthetics and geo textiles. **Operational aspects of MSW Landfills** : Daily cover, leachate disposal, Ground Water monitoring, leachate and gas collection systems – Design, leachate treatment. Landfill Final Cap Design and Water Balance, Modelling (HELP – Hydraulic Evaluation of Landfill Performance), post-closure environmental monitoring; landfill remediation.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-5

Recent Developments in Solid Wastes Reuse and Disposal : Power Generation, Blending with construction materials and Best Management Practices (BMP). Community based waste management, Waste as a Resource concept, Public private partnership (PPP)

Role of various organizations in Solid Waste Management : Governmental, Non - Governmental, Citizen Forums.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

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**oneSkill 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.

Suggested Learning Resources:

Books

- Tchobanoglous G., Theissen H., and EIiassen R., "Solid Waste Engineering Principles and Management Issues", McGraw Hill, New York. Pavoni J.L., "Handbook of Solid Waste Disposal".
- Peavy, Rowe and Tchobanoglous, "Environmental Engineering", McGraw Hill
- CPHEEO Manual on Solid Waste Management. WHO Manual on Solid Waste Management.
- Vesiland A., "Solid Waste Engineering", Thompson Books.
- Flintoff F., (1976), "Management of Solid Wastes in Developing Countries", WHO 4. Regional Publications, South East Asia, New Delhi

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=k0ktJRoRcOA
- https://youtu.be/qX516jcwCKE
- https://youtu.be/YujIiRB_bCE
- https://youtu.be/CME8ym5WbcY
- https://youtu.be/o_8a-zVUO1Y
- https://youtu.be/bhHi2GUh12E

Skill Development Activities Suggested

- Field visit to the nearby disposal site and quantisation of solid wastes/day

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Identify improper practices of solid waste disposal and their environmental implications. Know the basic engineering principles of solid waste management	L1
CO2	Describe the need for economics in collection and transportation of solid waste and clearly discuss various types of collection systems and analyse system dynamics	L3
CO3	Understand the management concepts, define 4 R approach, apply PPP model and community involvement for effective management of solid waste	L2
CO4	Develop a concise idea on various conventional and advanced treatment options for solid waste	L2L3
CO5	Conceive the design aspects of engineered disposal options and apply the gained knowledge	

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	-	1	3	3	2	1	2	3	3
CO2	2	1	3	3	2	1	3	3	2	3	2	2
CO3	1	1	3	3	2	2	3	3	2	2	3	2
CO4	2	2	3	3	2	3	3	2	2	3	2	1
CO5	3	3	3	3	3	2	3	3	2	2	3	2

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

Semester- 1

OCCUPATIONAL SAFETY AND HEALTH (OSHA)			
Course Code	**22CEE15**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 Hours of teaching+ 10-12 sessions of SDA	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives:

- This course enables student to learn the basic principles of safety, OSH act and the national policy.
- It gives knowledge on cause - effect relationships of accidents at work places, need for economics & ergonomics, hazard identification and control aspects, fire prevention and control.
- Work place health related issues are covered.

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.

Occupational Safety and Health Occupational Health and Safety Administration- Laws governing OSHA and Right to know, National safety Law, types of diseases and their spread, Health Emergency.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-2

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

Occupational hazard and control – Hazard analysis, Human error and fault tree analysis, Emergency response, Principles of Safety.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-3

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

Electrical safety, Product safety - safe handling of chemicals, safety procedures of nuclear installations.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-4

Accidents – causation, investigstion, methods of acquiring accident facts, supervisory role in accident investigation.

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	Chalk and talk, power point presentation and video lecture.

Module-5

Occupational health and safety considerations.

Water and wastewater treatment plants, handling of chemicals and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC plants, precast plants and construction sites. Policies, roles and responsibilities of workers, managers and supervisors.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

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**oneSkill 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

- Goetsch D.L., (1999), "Occupational Safety and Health for Technologists,
- Engineers and Managers", Prentice Hall.
- Colling D.A., (1990), "Industrial Safety Management and Technology", Prentice Hall, New Delhi.
- Della D.E., and Giustina, (1996), "Safety and Environmental Management", Van 4. Nostrand Reinhold International Thomson Publishing Inc. Biomedical Waste (Handling and Management) Rules
- Trevethick, R.A., ((1973), "Environmental and Industrial Health Hazards"- William 10. Heinemann Medical Books Ltd., London

Web links and Video Lectures (e-Resources):

- .**https://nptel.ac.in/courses/114106017**
- **https://youtu.be/8nbOI-0U9Co**
- **https://youtu.be/Be9inw8xlw8**
- **https://youtu.be/n7oUOUCIblg**

Skill Development Activities Suggested

- Visit to nearby Industry and acquire knowledge on safety measures

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Gain knowledge on safety and health principles, OSHA and Right to know, National safety Law, types of diseases and their spread, Health Emergency.	L1
CO2	Develop the skills of understanding the ergonomics and address specific problems with appropriate strategies. Identify the problems related to the ergonomics and suggest remedial measures.	L2
CO3	Perform accident investigation and report preparation, describe the need for the product safety and acquire knowledge on various aspects of fire – types, prevention and protection.	L2
CO4	Perform basic accident investigation and report preparation. concept of Protective equipment's and environmental management plan.	L2
CO5	Discuss Health and Safety Considerations at different work places with a thorough understanding of PPEs. List different types of diseases and recommend health emergency mechanism. Gain knowledge through some best management practices.	L1

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	3	2	3	2	2	2	3	2	2
CO2	3	2	1	2	3	2	3	3	2	2	3	1
CO3	3	2	1	3	3	2	3	2	2	2	3	2
CO4	3	2	2	3	3	2	3	2	2	3	2	1
CO5	2	2	3	2	3	2	3	2	2	3	2	3

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

Semester- First

RESEARCH METHODOLOGY AND IPR			
Course Code	**22MI16**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40 Hours of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Research methodologies tell the systematic method for acquiring data and studying it for deriving out crucial findings.

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	Chalk and talk, power point presentation and video lecture.

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, Basic Principles of Experimental Designs, Important Experimental Designs.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
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. **Data Collection**: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-4	
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 **Data Collection**: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-5	
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	Chalk and talk, power point presentation and video lecture.

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**oneSkill 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

- Research Methodology: Methods and Techniques, C.R. Kothari, GauravGarg,New Age International,4th Edition, 2018.
- Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), RanjitKumar,SAGE Publications,3rd Edition, 2011.
- 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.
- 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):

- https://nptel.ac.in/courses.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Discuss research methodology and the technique of defining aresearch problem	L1
CO2	Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review	L1,L2
CO3	Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.	L1,L3
CO4	Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports	L2,L3
CO5	Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.	L1,L2,L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	1	1	1	1	1	1	1	1
CO2	2	1	2	1	1	1	1	1	2	1	1	1
CO3	2	2	2	1	1	1	2	2	2	2	2	2
CO4	3	2	1	2	1	1	1	2	2	1	1	1
CO5	3	2	1	2	1	2	1	2	1	2	2	2

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

ENVIRONMENTAL ENGINEERING LABORATORY-1			
Course Code	**22CEEL17**	CIE Marks	50
Teaching Hours/Week (L:P: S)	01:02:00	SEE Marks	50
Credits	02	Exam Hours	03

Course objectives:

- The lab course provides an opportunity to collect and preserve water samples from different sources, conduct various tests on water quality parameters, perform experiments on selected lab scale treatment processes.
- It also enriches the student knowledge of determining coagulant dose, efficiency of settling basin.

Sl.NO	Experiments
1	Chemistry Laboratory practice: Sampling and characterization of water and wastewater by gravimetric, volumetric.
2	Chemistry Laboratory practice: Sampling and characterization of water and wastewater by and colorimetric methods, Good laboratory practice – Analytical quality control
3	Determination of Chlorine Demand for a given water sample and to plot the Break Point Chlorination Curve
4	Determination of Optimum Coagulant Dose using Jar Test Apparatus for given water samples
5	Microbiology Laboratory : Bacteriological analysis of water, sewage, test for plate count – coli forms – fecal coli forms – E coli – M.P.N. and M.F. techniques
6	Techniques for studying aquatic organisms – identification of phytoplankton and zooplankton – bioassay study and biodegradation
7	Solid Waste and leachate analyses:, for– Moisture content, organic content, pH,
8	Solid Waste and leachate analyses:, for– Sulphur, carbon, nitrogen and Trace metals.
9	Sampling and analysis of ambient air Instrumental methods of analyses for particulates, PM10, PM2.5, HC,
10	Noise measurements.

Course outcomes (Course Skill Set):

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

- Acquaint with precision and accuracy of analytical data and to appreciate rounding off to a significant value in the context of water quality parameters. Apply various methods of sample preservation and conduct titrimetric and instrumental analyses on water samples
- Carryout jar test for optimum dose of coagulant and settling
- Understand the significance of break point chlorination and to analyse the percentage of chlorine in bleaching powder

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 supply and Treatment, CPHEEO, Ministry of Urban Development, GoI,New Delhi, 1999.
- "Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development,GoI, New Delhi,
- Software Package Manual on BRANCH, LOOP, SEWER – UNDP/UNEP.
- Wark.K, Warner G.F. and Davis W.T – Air Pollution its origin and control, Addison-Wesley,
- "Standard Methods for the Examination of Water and Wastewater", 21th Edition, American Public Health Association, Washington. D.C . 2005

INDUSTRIAL WASTEWATER TREATMENT			
Course Code	**22CEE21**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 hours of teaching + 10-12 sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- The course provides a strong base of different industrial waste processes, effluent flow and Characteristics.
- Approaches to waste minimization, strength and volume reduction.
- Exposes the student to the areas of toxicity and treatability studies. Makes the student to Understand the need for process flowsheets with waste streams of different 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. Feasibility of combined Treatment of Industrial Raw Waste with Domestic Waste	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-2	
Industrial Waste survey-Process flow charts, Sampling – Grab, Composite and integrated samples. Dissolved oxygen Sag Curve in Stream, Streeter– Phelps formulation, Numerical Problems on DO prediction.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-3	
Pretreatment of Industrial Wastewater – Volume reduction, Strength reduction, Neutralization, Equalization and Proportion, Removal of Organic and inorganic dissolved solids.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-4	
Wastewater Treatment in specific industries: Distillery, Sugar, Pulp and paper, Cement, Textile, Dairy, Fertilizer, Pharmaceutical, canning & tanning industries **Designof complete** treatment system & disposal for industries: Distillery, Diary, Textile, paper and pulp mill to meet P.C.B. norms.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-5	

Radio Active Wastes treatment- Low activity and high activity radiation, application of radioactive techniques for wastewater treatment. Biomonitoring, Bio-Remediation of contaminated soils

Environmental Auditing: Introduction, Cost of Pollution, Environmental audit solutions, Criminal and Regulatory liabilities 05 Hours

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

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**oneSkill 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

- Nemerow N.N., "Liquid Waste of industry theories, "Practices and Treatment. Addison Willey New York.
- Eckenfelder, "Industrial Water pollution Control"- McGraw hill Company, New Delhi American Chemical Society, Washington D.C. USA 7. Bioremediation books
- Azad N. S.,– "Industrial Wastewater Management Hand Book" McGraw Hill book Co., Newyork.
- Ross R.D. "Industrial Waste Disposal", Reinhold Environmental Series – New York.
- Mahajan," Pollution control in Process industries". TMH, New Delhi.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/content/storage2/courses/105105048/M1L1.pdf.
- https://link.springer.com/article/10.1007/s11104-005-4641-x.
- https://nptel.ac.in/courses/105105048
- https://nptel.ac.in/courses/105107207
- https://nptel.ac.in/courses/105106056/
- https://nptel.ac.in/courses/120108004

Skill Development Activities Suggested

- Visit to nearby industries and draw the wastewater treatment flow diagram of that Industries.

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 effect of industrial wastewater on water and land. Knowledge on monitoring and its protocol.	L1
CO2	Understand the self purification processes of the streams	L2
CO3	Understand the technical approaches to waste minimization and pre-treatment of industrial wastewater.	L2
CO4	Understand the characteristicsand treatment flow schemes for selected industries	L2
CO5	Know how to carryout environmental auditing and Bioremediation of soils.	L2

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	2	3	2	1	2	2	2
CO2	3	3	2	2	1	3	2	2	1	2	3	1
CO3	3	3	2	2	1	2	3	2	2	2	2	2
CO4	3	3	3	3	2	3	2	2	2	2	3	2
CO5	2	3	3	3	2	2	3	3	2	2	1	3

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

ADVANCED WASTE WATER TREATMENT TECHNOLOGY			
Course Code	**22CEE22**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:02:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

- To provide a basic description and understanding of the principal unit processes used in the treatment of wastewater.
- This will include coverage of the scientific basis of each unit process, as well as the conventional approach to their engineering design.
- In the area of wastewater treatment the course will provide an understanding of the kinetic theory of biological growth and apply it to typical aerobic processes, and an appreciation of the purpose and practice of sludge treatment.

MODULE-1	
Domestic Wastewater characteristics, flow fluctuations, types of reactors and mass balance approach. Wastewater Treatment: Flow Diagrams and Hydraulic Profile. Design of Sewers: Design of sanitary sewer; partial flow in sewers, economics of sewer design. Kinetics of biological wastewater treatment systems – monads, biokinetic constants, their determination and their applications, batch and continuous system.	
Teaching - Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
MODULE-2	
Design principles and design of unit operation systems - screen, Skimming (Floatation) tank equalization basin, grit chamber, and primary settling tank.	
Teaching-Learning Process	. Chalk and Talk, Power Point Presentation and Video Lecture.
MODULE-3	
Design Criteria and design of Biological processes – suspended and attached growth systems, conventional activated sludge process and its modifications. Design principles of trickling filter, bio-towers and rotating biological	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
MODULE 4	
Advanced Wastewater Treatment: Need and technologies used. **Nitrification and Denitrification** Processes, colour & COD removal of waste water by Ozonation, &Fentons Oxidatition , Application ofElectro oxidation processes for Effluent treatment Phosphorous removal. Wastewater disinfection	
Teaching-	

Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

MODULE 5	
Biological Sludge separation, conditioning and volume reduction Design of Sludge Processing units – secondary settling tank, g thickeners and digesters– aerobic and anaerobic. Wastewater treatment systems for small communities – septic tanks, soak pits, two-pit latrines, eco-toilet.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

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

Sl.NO	Experiments
	To write the C programs for
1	Design of wastewater Collection units – Sewer network analysis and design.
2	Design of wastewater treatment units – Septic tank and Screen.
3	Design of wastewater treatment units -Grit chamber, Secondary settling tank.
4	Design of wastewater treatment units ASP, Trickling filter.
5	Design of Waste stabilization pond and Oxidation ditch.
6	Design of Sludge digester and sludge drying beds

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

4. Two Tests each of **20 Marks**
5. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**
6. 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)

5. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
6. The question paper will have ten questions. Each question is set for 20 marks.
7. 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.

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

(2) Karia G.L., and Christian R.A., "Wastewater Treatment Concepts and Design Approach", Prentice Hall of India Pvt. Ltd., New Delhi.

(3) Fair G.M., Geyer J.G and Okun, "Water-wastewater Engineering"FOR LAB:

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_ce27/preview
- https://archive.nptel.ac.in/content/storage2/courses/105104102/Lecture%207.htm
- https://nptel.ac.in/courses/105104102
- https://onlinecourses.nptel.ac.in/noc22_ce27/preview
- https://nptel.ac.in/courses/105106119

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

- Visit to nearby wastewater treatment plant and design for other MLD.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the need for wastewater treatment, categorize the wastewater based on characteristics, illustrate reactor types in wastewater treatment; explain the basic concept of mass balance; plan the treatment scheme through flow diagram, sewer design and hydraulic profile.	L1
CO2	Understand and apply the design principles and criteria in designing units such as screen, grit chamber, primary settling tank. Establish biokinetic constants in the engineering design of wastewater treatment processes.	L2
CO3	Describe the design criteria and design the suspended and attached growth biological wastewater treatment systems like activated sludge process, trickling filter,RBC,Biotowers.	L3
CO4	Emphasize the need for sludge separation, thickening and volume reduction. Design the facilities for biological sludge handling and treatment of biological sludge.Applications of advance wastewater treatment.	L3
CO5	Illustrate wastewater treatment systems for rural areas. Explain the applicability of natural systems for treatment of wastewater.	L1

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	12
CO1	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**2**	**3**	**2**
CO2	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**1**
CO3	**3**	**3**	**3**	**2**	**3**	**2**	**1**	**2**	**2**	**2**	**1**	**3**
CO4	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**2**
CO5	**2**	**2**	**1**	**1**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**1**

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

ENVIRONMENTAL GEO-TECHNOLOGY			
Course Code	**22CEE231**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 hours of teaching + 10-12 Sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To identify the causes for soil pollution and behavior of the pollutants.
- To understand the current practice for waste disposal.
- To evaluate and remediate contaminated sites and monitor to bring natural attenuation

Module-1	
Soil- Pollutant Interaction: Introduction to geo environmental engineering – environmental cycle – sources, production and classification of waste – causes of soil pollution – factors governing soil-pollutant interaction- Physicochemical behaviour and modelling -failures of foundations due to pollutants	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-2	
Characterization, Stabilization and Disposal Safe disposal of waste – site selection for land fills – characterization of land fill sites – waste characterization –stability of land fills – current practice of waste disposal- passive contaminant system - Hazardous waste control and storage system – mechanism of stabilization - solidification of wastes – micro and macro encapsulation – absorption, adsorption, precipitation-detoxification — organic and inorganic stabilization	
Teaching - Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-3	
Transport of Contaminants: Contaminant transport in sub surface – advection – diffusion – dispersion – governing equations – contaminant transformation – sorption – biodegradation – ion exchange – precipitation – hydrological consideration in land fill design – ground water pollution – bearing capacity of compacted fills – pollution of aquifers by mixing of liquid waste – protecting aquifers.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-4	
Detection and Testing Methods Methodology- review of current soil testing concepts – Proposed approach for characterization and identification of contaminated ground soil for engineering purposes	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-5	

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

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

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:

- Three Unit Tests each of **20 Marks**
- Two assignments each of **20 Marks**or**oneSkill 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

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

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/105/101/105101196/
- https://onlinecourses.nptel.ac.in/noc21_ag09/preview.
- https://www.digimat.in/nptel/courses/video/105103205/L33.html
- http://www.nitttrc.edu.in/nptel/courses/video/105101196/L33.html
- https://freevideolectures.com/course/4080/nptel-environmental-geotechnics/33
- https://archive.nptel.ac.in/courses/105/107/105107181/

Skill Development Activities Suggested

- Gain the practical knowledge with respect to the geotechnical properties

Course outcome (Course Skill Set)

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

Sl. No.	Description	Bloom s Level
CO1	Understand causes for soil pollution and behaviour of the pollutants.	L2
CO2	Contaminants transport, detection and testing methods.	L3
CO3	Application of geo synthetics in solid waste management	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	2	3	1	2	2	1	3
CO2	3	3	3	2	3	1	1	2	2	2	2	2
CO3	2	2	1	-	1	2	3	2	2	1	2	1

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

RISK ASSESMENT AND HAZARDOUS WASTES MANAGEMENT			
Course Code	**22CEE232**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 hours of teaching + 10-12 Sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To provide detailed knowledge and skills in the management, treatment, disposal and recycling options for hazardous wastes, while focusing on key engineering and technical aspects involved.
- Understanding of the basic principles of waste and resource management will be supplemented, where appropriate, by practical problem-solving exercises in the context of civil engineering

Module-1

Risk – Importance, Identification, characterization, communication – Internal & External, Risk - Management Structure, management Cycle, Participation and Consultation

Ecological Health impact assessment. Exposure assessment. risk factors. Sorption/ partitioning of organics, volatilization and structural / property activity relation.

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-2	
Risk factor calculation, impact identification – Risk Area, impact, Likelihood, consequences, Controls, Severity, risk score calculation; Toxicology and Risk Assessment: Toxic effects, Dose response assessment, Risk exposure assessment, Carcinogenesis, ecotoxicology, risk characterization.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-3	
Hazard identification and Risk Assessment – HAZOP, HAZID, Risk Ranking Matrix, Process and Instrumentation Diagram, and importance of Standard operating procedures, Material safety and Data Sheets, Guidelines, case study **Emergency Preparedness**, Incident Investigation, Non Conformity, action and Preventive and Corrective Actions, Auditing.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-4	
Hazardous Waste Management Sources, Classification, Impacts of Mismanagement, Problems in Developing Countries,and Regulations for Hazardous Waste Management **Hazardous Waste Characterization**, Designated Hazardous Wastes, Waste Minimization and Resource Recovery – Approaches, Development of a Waste Tracking System, Selection of waste Minimization Process, Case Studies.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-5	
Biomedical Waste management: Biomedical (Handling and Management) Rules 2008 ,sources, treatment and disposal **Transportation of Hazardous Waste** – requirements, regulations, containers and Labelling, bulk and non-bulk transport, Emergency Response, personal protective equipment. **Treatment & Disposal:** Physico-chemical, Chemical and Biological Treatment of hazardous waste, Thermal treatment - Incineration and pyrolysis	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

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:

- Three Unit Tests each of **20 Marks**
- Two assignments each of **20 Marksor****oneSkill 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

- Lagrega M.D., Buckingham P.L., and Evans J.C., (1994), "Hazardous waste Management", McGraw Hill International Edition
- Wentz C.A.,(1995),"Hazardous Waste Management", McGraw
- Hazardous waste (management and handling) Rules, 2001
- Biomedical (Handling and Management) Rules 2008
- Charles A. Wentz; "Hazardous Waste Management", McGraw Hill Publication, 1995.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105106056/
- https://onlinecourses.nptel.ac.in/noc22_mg55/preview
- https://onlinecourses.swayam2.ac.in/cec19_hs20/preview
- https://dth.ac.in/medical/courses/Microbiology/block-9/3/index.php
- https://onlinecourses.swayam2.ac.in/cec20_ge34/preview
- http://www.nitttrc.edu.in/nptel/courses/video/105105178/L42.html

Skill Development Activities Suggested

- Visit to the nearby hazardous waste disposal site

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand and apply the basic scientific and sustainability principles behind waste management, for solving practical waste management challenges	L2&L3
CO2	Understand the fundamental principles of existing and emerging technologies for the treatment of waste and recovery of value from waste.	L2
CO3	Appreciate the increasing importance of waste and resource management in achieving environmental sustainability.	L1

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

Mapping of COS and POs

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**3**	**2**	**1**	**2**	**1**
CO2	**3**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**1**
CO3	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**2**	**2**	**1**	**1**	**1**

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

ENVIRONMENTAL PLANNING AND MANAGEMENT			
Course Code	**22CEE233**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 hours of teaching + 10-12 Sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To introduce the basic knowledge of current environmental management systems applied in both public and private sectors.
- Class discussions will cover conventional development of ISO 14001 Environmental Management Systems (EMS) for various levels of organizations.
- Possible extensions of internal and external environmental auditing, environmental label, and life cycle assessment can be made based on relevant Total Quality Environmental Management (TQEM) requirements.

Module-1	
Environment and Sustainable Development: Carrying capacity, relationship with quality of life, carrying capacity and resource utilization. Engineering Methodology in Planning and its Limitations: Carrying capacity based short and long term regional planning.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-2	
Environmental Protection: Economic development and social welfare consideration in socio economic developmental policies and planning. Total cost of development and environmental Protection cost. Case studies on Regional carrying capacity	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-3	
Engineering Economics: Value Engineering, Time Value of Money, Cash Flows, Budgeting and Accounting	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-4	
Environmental Economics: Introduction, economic tools for evaluation, Green GDP, Cleaner development mechanisms and their applications.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-5	

Total Quality Management in environmental management and protection – ISO 9000, 14000 and 18000 series of standards. Environmental Audit – methods, procedure, reporting and case studies.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

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:

- Three Unit Tests each of **20 Marks**
- Two assignments each of **20 Marks**or**oneSkill 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 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

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Suggested Learning Resources:

Books

- Lohani B.N , "Environmental Quality Management",South Asian Publishers, New Delhi
- Chanlett, "Environmental Protection", McGraw Hill Publication, Newyork
- Danoy G.E., and Warner R.F., "Planning and Design of Engineering Systems", Unwin Hyman Publications.
- MOEF, Government of India, "Carrying Capacity Based Developmental Planning Studies for the National Capital Region", 1995-96.
- NEERI, Nagpur, Annual Reports 1995 & 1996.
- UNEP / UNDP – "Environmental Sustainable Development".

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/120108004
- https://onlinecourses.nptel.ac.in/noc20_hs02/preview
- https://onlinecourses.nptel.ac.in/noc21_ar12/preview
- https://onlinecourses.nptel.ac.in/noc22_hs21/preview

Skill Development Activities Suggested

- Involving students in open discussion on environmental planning and management

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Sound understanding of the principal environmental policy issues confronting managers in diverse geographical and culture situations.	L2
CO2	An awareness of the ethical and moral issues involved in seeking the wise and sustainable use of resources	L1
CO3	A range of relevant practical skills, particularly in the fields of impact assessment, audit and law.	L3

Mapping of COS and POs

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**1**	**2**	**3**	**1**	**2**	**3**	**3**	**2**	**2**	**1**	**1**	**1**
CO2	**2**	**2**	**1**	**1**	**2**	**3**	**3**	**2**	**2**	**1**	**1**	**1**
CO3	**2**	**1**	**1**	**2**	**2**	**3**	**3**	**2**	**1**	**2**	**1**	**1**

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

FUNDAMENTALS OF GIS AND APPLICATION IN ENVIRONEMTAL ENGINEERING			
Course Code	**22CEE234**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 hours of teaching + 10-12 Sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Introduction to GIS is designed to provide the students with an understanding of the methods and theories of spatial analysis.
- Create data, maps, and reports with GIS-industry recognized data standards, cartographic conventions, and reporting methods.
- To apply GIS knowledge and skills to environmental engineering problems.

Module-1

Introduction to GIS

Introduction to GIS principles , raster and vector-based GIS and data structures, Spatial data sources, Generation of thematic maps.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-2

Data input and storage formats Geo-referencing, Digitization , Data Editing, Edge Matching and Mosaic, Linking Spatial and Non Spatial Data, Errors and quality Control, Data Storage, Data formats.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-3	
Geodatabases : Geo-databases, Database concepts, Database management in GIS- Introduction to Visual Basic for applications , Data manipulations: attribute operations, area/distance calculations, overlay analyses. Map Projections, Global Positioning System.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-4	
3D Models &GIS Analysis: Surface mapping, interpolation (including TIN), digital elevation model (DEM), Terrain classification- slope aspect Statistical analysis, Measurement, Proximity analysis (buffering), Overlay analysis, Multicriteria analysis, site suitability analysis, Nearest neighbour analysis.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-5	
Spatial correlation and Applications: Spatial interpolation, Regression and correlation analysis, change detection & Applications in environmental engineering problems.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

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:

- Three Unit Tests each of **20 Marks**
- Two assignments each of **20 Marks**or**oneSkill 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

6. Chang, KT, Introduction to Geographic Information System, 4th Edition, Tata McGraw Hill.

Burrough& McDonnell,
7. Principles of Geographical Information Systems, Oxford University Press Yang, Snyder & Tobler,
8. Map projection Transformation principles and applications, Taylor and Francis Jan Van Sickle, GPS for land surveyors, Sleeping Bear Press
9. Remote sensing methods & applications – R. Michael Hord, Wily Interscience Publication.

Web links and Video Lectures (e-Resources):

- https://opensourceoptions.com/blog/qgis-tutorial-for-beginners/
- Wikipedia. "Cartography." 30 Aug. 2016.
- Foote, Kenneth E. and Shannon Crum. The University of Colorado -The Geographer's Craft - Cartographic Communication. 1995.
- David Rumsey Map Collection. 2016.
- Eykamp, Christopher. ArcMap Standard Palatte. 1996-2004.
- ArcGIS Pro Help. "Fundamentals of the geodatabase." 11 Jun. 2018.
- ArcGIS Pro Help. "Table basics." 11 Jun. 2018.
- ArcGIS Pro Help. "Types of geodatabases." 11 Jun. 2018. ESRI. "3D GIS: ArcGIS Capabilities." 20 Jan. 2019

Skill Development Activities Suggested

- Open source software for analysis (QGIS)
- Use of public domain data and analysis

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Comprehend fundamental concepts and practices of Geographic Information Systems (GIS) and advances in Geospatial Information Science and Technology (GIS&T)	L1
CO2	Demonstrate organizational skills in file and database management and data visualization data and representation	L3
CO3	Apply GIS analysis to address geospatial problems and/or research questions	L2

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	3	3	2	2	1	2	1	1
CO2	3	2	3	2	2	2	1	2	1	2	1	1
CO3	3	3	2	2	1	2	1	2	2	2	2	2

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

WATER RESOURCES ENGINEERINGAND APPLIED HYDRAULICS			
Course Code	**22CEE241**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 hours of teaching + 10-12 Sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- The course deals with the significance of hydrologic cycle, global and Indian water resources, influencing natural processes, urban and groundwater hydrology and modern tools for water resources management.

Module-1	
Hydrology: Water resources of the world, India and Karnataka, National Water Policy, Hydrologic cycle, estimation of missing precipitation and rain gauge density.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-2	
Hydrograph theory: Unit hydrograph-derivation, flow routing, low flow analysis. Urban Hydrology - Run-off estimation – Design of Storm water Drains.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-3	
Unsteady Flow through Conduits: Water hammer analysis, Water hammer protection methods - surge tanks. **Flow Measurements:** – Area –Velocity method, Weir method, flumes, end-depth method & chemical and radioactive tracers method.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-4	
Groundwater: Basic equations of flow, confined and unconfined aquifers, sea water intrusion, artificial recharge, groundwater pollution, borewells - types & design principles, open wells – types, yield tests.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-5	

Basics and applications of Remote Sensing and GIS: Characteristics of Recently launched Indian Remote sensing satellites with Advantages and Disadvantages various applications related to agriculture, water resource and urban planning etc. Different types of sensors used in remote sensing, Spectral properties of soil, water and vegetation. Contrast enhancement techniques/Image enhancement techniques, Different types data input techniques used in GIS, Theoretical framework for GIS

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

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:

- 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

- K. Subramanya, "Engineering Hydrology", Tata McGraw Hill Publishers, New Delhi.
- K. Todd, "Ground Water Hydrology", Wiley and Sons, New Delhi.
- BasudebBhatta, "Remote sensing and GIS", Oxford University
- Raghunath H.M. "Advanced Hydrology", Wiley Eastern Ltd New Delhi.
- Ven T. Chow, "Hand Book of Applied Hydrology", 1st Edition Mc Graw Hill Publications.
- Lillesand, Kiefer, Chipman, "Remote Sensing and Image Interpretation", Wiley, 2011.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105107129
- http://karenvis.nic.in/Database/Water_Resources_7898.aspx
- https://archive.nptel.ac.in/courses/105/105/105105214/
- https://www.studocu.com/row/document/the-copperbelt-university/water-resources/unsteady-flow-in-pipes-lecture-notes-1/4766706
- http://wgbis.ces.iisc.ernet.in/energy/monograph1/Gispage7.html

Skill Development Activities Suggested

- Visit to the nearby water resources projects

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 hydrology and its components. Measure precipitation and analyze data.	L2
CO2	Use unit hydrograph theory in estimating the peak discharge and design storm water drains in urban area.	L1
CO3	Analyze the flow unsteadiness in pipes and compute the flow rate in the streams.	L4
CO4	Estimate the quantity of ground water and select appropriate method of augmenting the ground water resources	L5
CO5	Identify the use of remote sensing and GIS concepts in various applications of water resources and environmental engineering.	L2

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**2**	**1**	**1**	**3**	**2**	**1**	**2**	**2**	**1**	**1**	**1**
CO2	**2**	**2**	**3**	**1**	**1**	**2**	**1**	**2**	**2**	**1**	**1**	**1**
CO3	**2**	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**1**	**2**	**1**	**1**
CO4	**2**	**2**	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**1**	**1**
CO5	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

ECOLOGY			
Course Code	**22CEE242**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 hours of teaching + 10-12 Sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- The course introduces both ecology for environmental engineers.
- It explains different ecosystems and their interactions through symbiotic and synergic relationships, reviews ecological indices and modes.
- It describes trophic levels of lakes, influence of nutrient loading and control measures for eutrophication.

Module-1	
Ecology: Classification of Ecosystems, Structure and Function of Ecosystems, Energy flow in Ecosystems, Ecological Niche and succession, Bio-geochemical cycles, Ecological Pyramids.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-2	
Aquatic and TerrestrialEcosystems: Diversity and dominance Indices, Ecosystem Models. **Lake Ecosystem**: Trophic levels, nutrient loading, nutrient enrichment, Leibig's Law, control of eutrophication.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-3	
Systems ecology and ecosystems modelling. biodoversity and ecological perspective - human benifits, threats, conservation preservation and protection.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-4	
Ecosystem Modelling.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-5	
Environmental Education and Information: Goals, Objectives and guiding principles of Environmental educations. Environmental educational Programs; Environmental Education in India.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

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**oneSkill 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

- Kormondy, "Concepts of Ecology", Prentice Hall Publication, New Jersey.
- Odum, "Fundamentals of Ecology", Adisson Co.
- Reference Books
- Krebs J., "Ecology - The Experimental Analysis of Distribution and Abundance", I Edition, Harper International.
- Hall C.A.S., and Day J.W., "Ecosystem Modeling in Theory and Practice: An Introduction with Case Histories", John Willey.
- 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 enquiry in the field of Ecology	L3
CO2	Become familiar with the variety of ways that organisms interact with both the physical and the biological environment	L1
CO3	Develop an understanding of the differences in the structure and function of different types of ecosystems	L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**1**	**2**	**2**	**2**
CO2	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**
CO3	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**1**	**1**	**1**	**1**	**1**

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

RENEWABLE ENERGY AND ALTERNATIVE FUELS			
Course Code	**22CEE243**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 hours of teaching + 10-12 Sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To create awareness in students familiar about importance of alternative fuels.
- To teach combustion and emission characteristics of various gaseous and liquid alternative flues.
- To teach adaptability of engines to alternative fuels.

Module-1	
Introduction to energy and resources – Renewable energy sources - Availability of solar energy – Sun-earth relationships - - Solar radiation measurement – Flat plate collectors – Solar water heating systems – Evacuated Tubular Concentrators - Solar air heating systems and applications – Concepts on solar drying, cooking, desalination, solar ponds and solar cooling - Passive heating and cooling of buildings – Basics of solar concentrators and types Solar thermal power generation.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-2	
Biomass to energy conversion processes – Anaerobic digestion, process parameters, biogas composition, digester types, high rate anaerobic conversion systems – Alcohol from biomass – Biodiesel: preparation, characteristics and application - Biomass combustion and power generation – Briquetting – Gasification: Process, types of gasifiers, applications – Waste to energy technologies.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-3	
Power in the wind - Types of wind mills – WEG components, Power curves and energy estimation– Indian wind potential. Small Hydro Power: Types, site identification, head and flow measurement, discharge curve, estimation of power potential and system components. Technologies for harnessing renewable energy sources like geothermal, wave, tidal and ocean thermal energy.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-4	

Fossil fuels and their availability - Potential alternative liquid and gaseous fuels - Merits and demerits of various alternative fuels - Engine requirements Methods of production - Properties - Blends of gasoline and alcohol - Performance in SI engines – Adaptability - Combustion and emission characteristics - Performance in CI engines - Emission characteristics - Properties of alcohol esters. Production and properties of CNG, LPG, hydrogen gas, biogas and producer gas - Performance and Storage, distribution and safety aspects.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-5	
Various vegetables oils - Properties - Esterification - Performance and emission characteristics - Bio-diesel: Feed stock, characteristics, preparation (lab and commercial), storage, applications, environmental impacts, economics, policy.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

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**oneSkill 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

- Frank Kreith and D.YogiGoswami (2007), Handbook of Energy Efficiency and Renewable Energy, CRC Press.
- John Twidell and Tony Weir (2006), Renewable Energy Resources, 2nd Edition, Taylor & Francis, USA.
- John A. Duffie and William A. Beckman (2006),
- Solar Engineering of Thermal Process, 3rd Edition, John Wiley & Sons.
- Gilbert M. Masters (2004), Renewable and Efficient Electric Power Systems, Wiley Interscience.
- Osamu Hirao and Richard Pefley (1988), Present and Future Automotive Fuels, Wiley Interscience Publication, New York
- Alcohols and Motor Fuels: Progress in Technology - Series No. 19 - SAE Publication USA

C

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

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Learn need for alternative fuels	L1
CO2	Learn sources of various alternative flues	L1,L2
CO3	An understanding limitation of fossil fuels and combustion characteristics fuels	L2

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	1	2	1	1	1	1	1	1	1
CO2	2	1	1	1	1	1	1	2	1	1	1	1
CO3	2	2	2	2	1	1	1	1	1	1	1	1

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

ENVIRONMENTAL POLLUTION AND CONTROL MANAGEMENT			
Course Code	**22CEE244**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 hours of teaching + 10-12 Sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To understand the various types of Environmental pollutions & Control techniques, impact of Pollutants through Air, Water and Soil.

Module-1	
Introduction: Environmental Pollution and Sources, types of pollution and their Global, regional and local environmental effects. **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	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-2	
Water Pollution: Sources of water and their contamination, Types of pollutants, Industrial effluents-pulp and paper mills, Sugar, Distillery, Domestic wastes, Effluents from water treatment plants. Eutrophication – causes, effects and control measures. **Soil pollution:** Plants as soil pollution indicators, Formation of salts in soils,Causes of soil pollution, Effects of Fungicides and weedicides on soil components and pollution. Different kinds of synthetic fertilizers (N, P, K), their toxicity and Environmental effects, control of soil pollution.	
Teaching-Learning Process	. Chalk and Talk, Power Point Presentation and Video Lecture.
Module-3	
Radioactive Pollution: Types of radiations (Alpha, Beta,Gamma), Units of radioactivity, Sources of radioactivematerial in environment, Biological impact and healthhazards associated with radiation, control of Radioactivepollution. Fate and movement of radioactive material inenvironment. **Heavy Metal Pollution:** Sources of heavy metals,Accumulation of heavy metals in abioticenvironment andbiotic components, Bioaccumulation, Bio-magnification,Toxic effects (Lead, Mercury, Arsenic).	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-4	
Noise Pollution: Basic properties of sound, Units, Sources of Noise Pollution, Effects of noisepollution, Measurement ofsound. Measures to control noise pollution in industries -automotive type silencers, vibration isolation, damping,lagging. Protection of personnel – ear plugs, ear muffs, helmets, isolation. **Thermal pollution:** Definition and Sources, effects of thermal pollution – physical, chemical, biological, control of thermal pollution.	
Teaching-Learning	Chalk and Talk, Power Point Presentation and Video Lecture.

Process	

Module-5

Oil pollution: introduction, major oil spills in the world, fateand 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	Chalk and Talk, Power Point Presentation and Video Lecture.

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**oneSkill 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. 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.
4. Handbook of Environmental Health and Safety – principle and practices , Vol. II.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses

Skill Development Activities Suggested

- involving students in discussions for giving remedial measures of environmental pollution control

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 various types of Environmental pollutions & Control techniques.	L2
CO2	To understand the Impact of Pollution on Environmental System	L2
CO3	To understand the monitoring and assessing the impact of Pollutants through Air, Water and Soil.	L1,l2
CO4	To know the concept of Radioactive pollution, Thermal Pollution, Heavy metal interference and Oil Pollution and their effects.	L2

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	1	2	1	1	1	1	1
CO2	2	2	2	1	1	1	1	1	1	1	1	1
CO3	3	2	2	2	2	2	3	3	2	2	2	1
CO4	3	2	2	2	2	2	2	1	1	1	1	1

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

MINI PROJECT WITH SEMINAR			
Course Code	**22CEE25**	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	00:04:02	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

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

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

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**oneSkill 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

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Present the mini-project and be able to defend it.	
CO2	Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.	L1,l2
CO3	Habituated to critical thinking and use problem solving skills.	L3
CO4	Communicate effectively and to present ideas clearly and coherently in both the written and oral forms	L1,l2,l3
CO5	Learn on their own, reflect on their learning and take appropriate actions to improve it.	L1,L3,L6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	1	1	2	2	2	2	1	1	1
CO2	3	3	3	3	3	3	2	2	2	2	2	2
CO3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	2	1	1	1	1	1	1	1	1	1
CO5	3	1	1	1	1	1	1	1	1	1	1	1

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

ENVIRONMENTAL ENGINEERING LABORATORY-II			
Course Code	**22CEEL26**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	01:02:00	SEE Marks	50
Credits	02	Exam Hours	03

Course objectives:

- This unique course lays a strong foundation for the students to appreciate, understand and develop theoretical knowledge related to computer programme writing skills for a variety of environmental engineering applications

Sl.NO	Experiments
	Writing programmes in C-language & Running for the following
1	Design of wastewater Collection units – Sewer network analysis and design.
2	Design of wastewater treatment units – Septic tank, Screen,
3	Design of wastewater treatment units -Grit chamber, Secondary settling tank,
4	Design of wastewater treatment units Trickling filter,
5	Design of Oxidation ditch, Sludge digester, Sludge drying beds
6	Design of Sanitary Landfill for Municipal Solid Waste Disposal.
7	GIS Operations – Spatial Data Input, Data Management Display.
8	Air quality system: Gaussian Plume model for gaseous and particulate dispersion.
9	Air quality system: effective stack height determination and particulate control devices design.
	Demonstration Experiments (For CIE) if any
10	C program for design of Waste stabilization pond
11	C program for design of Activated Sludge Process.
12	Running following application software packages: a. WAT PLANT and DOWATTS for treatment units.

Course outcomes (Course Skill Set):

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

- CO1-. Outlines and writes programmes related to sewer design.
- CO2- Writes programmes related to wastewater treatment system design
- CO3- Learns about application Software for treatment plant.

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 supply and Treatment, CPHEEO, Ministry of Urban Development, GoI,New Delhi, 1999.
- CPHEEO "Manual on Sewerage and Sewage Treatment",, M/s. Jain Book Agency, C-9, Connaught place, New Delhi,
- Software Package Manual on BRANCH, LOOP, SEWER – UNDP/UNEP.
- WATPLANT and QUALOOP Softwares. – CPHEEO – Manual.
- Relevant Software Manuals– USEPA
- Wark.K, Warner G.F. and Davis W.T – Air Pollution its origin and control, AddisonWesley,
- Thomann R.V and Mueller J.A)–. Principles of surface water quality modeling and control, Harper & Row Publishers,
- Sincerio A.P.&Sincerio G.A.–, Environmental Engineering – A Design Approach Prentice Hall of India.

ATMOSPHERIC AIR POLLUTION AND CONTROL			
Course Code	**22CEE31**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:02	SEE Marks	50
Total Hours of Pedagogy	40 hours of Teaching + 10-12 Sessions of SDA	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:

- The course covers the air pollution sources, classification, effects, and measurement of air pollutants, standards, importance of meteorology in air pollutant dispersion, fate and transport of air pollutants using various mathematical tools, as well as air and noise pollution control technologies and regulations.

Module-1

Introduction: Definition of Air Pollution, sources, characterization and classification of atmospheric pollutants, air pollution episodes. Effects of air **pollutants** on human health, vegetation, animals and materials and monuments. Composition and structure of the atmosphere; Visibility and other related atmospheric characteristics.

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

Module-2

Meteorology: Wind circulation, solar radiation, lapse rates, atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth, Temperature Inversions, plume behaviour, Wind rose diagram, general characteristics of stack emissions, heat island effect.
Monitoring of particulate matter: Respirable, non-respirable and nano - particulate matter. Monitoring of gaseous pollutants – CO, CO_2, Hydrocarbons, SO_X and NO_X, photochemical oxidants. Monitoring equipment and sampling devices – stack sampling (Isokinetic sampling), air samplers, gas exhaustanalyzer. Air Pollution Index.

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

Module-3

Pollutants' dispersion models: Point, line and areal sources models. Box model, Gaussian plume dispersion model – for point source (with and without reflection), Gaussian dispersion coefficient, Determination of ground level concentrations. Infinite line source Gaussian model. plume rise and effective stack height calculations.

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

Module-4

Air Pollution Control Equipment: Mechanisms, Control equipment for particulate matter – gravity settling chambers, centrifugal collectors, wet collectors, scrubbers, fabric filters, electrostatic precipitator (ESP) - Design principles and criteria with design
Control Equipment for gaseous pollutants – adsorption, absorption, condensation and combustion. Design principles.

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

Module-5	
Indoor Air Pollution: Sources, indoor air contaminants, effects and control. air changes per hour (ACH), IAQ Standards **Noise** - sources, measurements, effects and occupational hazards. Standards, Noise mapping, Noise attenuation equations and methods, prediction equations, control measures, Legal aspects of noise.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

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**oneSkill 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

- Crawford, M., (1980)," Air Pollution Control Theory"- TATA McGraw Hill.
- Howard S. Peavy, Donald R. Rowe and George Technobanoglous., (2017) "Environmental Engineering" – McGraw Hill International Publications.
- Stern, A.C., Air Pollution, Vol I, II, III.
- Stern, A. C., (1977), "Air Pollution : The Effects of Air Pollution" – 3rd- Edition, Academic Press
- C.S Rao., (2006), "Environmental pollution control engineering"- New age international publishers.
- M. N Rao and H. V. N Rao.,(1999), "Air Pollution"- Tata McGraw-Hill Publishing Company Limited, New Delhi.
- Wark, K., Warner, C.F., and Davis, W.T., (1998), "Air Pollution"-

Web links and Video Lectures (e-Resources):

- https://www.digimat.in/nptel/courses/video/105104099/L01.html
- https://www.digimat.in/nptel/courses/video/105104099/L02.html
- https://www.digimat.in/nptel/courses/video/105104099/L03.html.

Skill Development Activities Suggested

- Visit to nearby industry having air pollution control equipments.
- Hands on training on air pollution monitoring and desire software's.

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 composition and structure of atmosphere, sources, classification, effects of air pollutants, and measurement of air pollutants, air pollution standards and control regulations.	L2, L4
CO2	Understand the basic concepts of various meteorological factors which influence the dispersion of air pollutants and to create wind rose diagram, Gain Knowledge about the monitoring of particulate matter.	L2,L3 ,L4
CO3	Prediction of dispersion of air pollutants using different models and to evaluate the plume rise using various model equations and get a fair knowledge on stack sampling.	L2,L5,L 6
CO4	Understand and analyze the basic mechanisms involved, working principles and design aspects of various air pollution controlling equipment's through demonstration.	L2,L4,L 6
CO5	Understand the concept of Indoor Air Pollution and Noise Source and Control.	L2,L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	3	3	2	2	2	1	2
CO2	3	3	2	2	1	2	3	3	2	2	1	2
CO3	2	2	3	3	3	2	3	2	2	1	2	2
CO4	3	2	3	3	3	2	3	2	1	2	2	1
CO5	3	3	2	3	3	2	3	2	2	3	2	2

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

Semester- 3

ENVIRONMENTAL IMPACT ASSESSMENT			
Course Code	**22CEE321**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40 hours of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- The course provides a detailed insight into the Indian environmental legislation aspects including National Environmental Policy, legal framework, Green Tribunal and various Acts related to environmental pollution, Prevention and control.
- The course also deliberates on carrying capacity concepts, objectives, scope and types of impact assessment.
- Explains the process of impact assessment; and deals with various methodologies.

Module-1	
Environmental Legislation: Introduction & need, Constitution of India, Environmental Jurisprudence, National Environmental Policy, Environmental Tribunal (Green Tribunal) Legal framework Legislative act, rules, regulations notification and amendments	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-2	
Indian Environmental Acts: Environment (Protection) Act, 1986, Air & Water Acts. Biomedical Waste (Managing and Handling) Rules, 2011, Recycle Plastics (Manufacturing and Usage) Rules, 1999, Water Act, 1974, Air Act, 1981, Forest Act, 1927, Environmental Tribunal Authority, 1995. Wild Life Protection Act, 1972, Biodiversity Rules, 2004.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-3	
Environmental Impact Assessment: Definition, Objectives, Types – Rapid and Comprehensive EIA, EIS, FONSI. Step-by step procedure for conducting EIA and Limitations of EIA, Prevention of Significant Deterioration (PSD) Programme. Carrying capacity concept.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-4	
Attributes, Standards and Value functions: Public participation in EIA. Environmental Management Plan (EMP) and Disaster Management Plan (DMP).	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-5	
EIA Case Studies –Thermal Power Plant, Mining, Fertilizer, Construction Projects, Air port, Water and Wastewater Treatment Plants.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

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**oneSkill 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:

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

Suggested Learning Resources:

Books

10. Anjaneyulu and ValliManickam, (2010), "Environmental Impact Assessment Methodologies", BS Publications, Hyderabad
11. Canter L., "Environmental Impact Assessment", McGraw Hill
12. Jain R.K., Urban L.V., Stacey G.S., (1977), "Environmental Impact Analysis-A New Dimension in Decision Making", Van Nostrand Reinhold.

Web links and Video Lectures (e-Resources):

- .**https://youtu.be/xPO1qIZOtY0**

Skill Development Activities Suggested

- Visit to nearby developing projects .

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the Constitution of India, National Environmental policy and Legal framework related to environmental aspects.	L1,L2
CO2	List and identify various Indian Environmental Acts in vogue, Amendments, modifications and notifications.	L1,L2
CO3	Discuss the concept of Carrying Capacity, Defines objectives and types of EIA. Lists and describes various EIA methodologies, step by step procedures to carryout EIA.	L2,L4
CO4	Describe the scope of EIA along with the framework. Propose the need for public participation in EIA. Explain importance of attributes. Lists and explains Contents of EMP & DMP	L1.L3
CO5	Environmental Impact Assessment studies for various developmental activities and Industries.	L2,L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	3	3	3	3	3	2	2
CO2	3	2	1	2	0	2	3	2	2	2	1	1
CO3	3	2	2	3	2	2	3	3	2	2	1	1
CO4	3	2	2	3	2	2	3	2	2	3	1	1
CO5	3	2	2	2	0	2	3	3	2	2	1	1

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

Semester- 3

TRANSPORT PROCESSES AND MODELING OF AQUATIC SYSTEMS			
Course Code	**22CEE322**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40 hours of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- The course emphasizes on various transport processes and illustration of mathematical models in simulation and prediction of pollutant concentration, and dispersion in surface and subsurface water bodies.

Module-1	
Introduction: Modelling: Introduction, applications in environmental management. Physical phenomena – advection, diffusion, dispersion, Fick's laws of diffusion and convective - diffusion equations for turbulent & shear flow regimes.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-2	
Steady-state water quality modeling: Models for conservative and non-conservative substances. Data collection and analysis - specialized water quality surveys,estimation of decay and reaeration rates.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-3	
1-D Oxygen balance models: Streeter-Phelps equation, critical point method. Calibration and verification of 1-D oxygen model. Error measures.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-4	
Mixing zones in rivers: Types of outfalls and mixing regimes. Steady-state 2-D analysis. Field study methodology. Parameter estimation – lateral mixing co-efficient - critical point method – simple numerical problems. Dissolved oxygen models for lakes under completely mixed and stratified conditions.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-5	

Eutrophication models: Simplified nutrient loading models for rivers and lakes. Ocean disposal of wastewater: Siting and design of outfalls.Ground water quality modeling concepts: Formulation 1-D & 2-D models with decay and retardation for instantaneous sources, plume delineation studies.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

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**oneSkill 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

- Rich L.G., "Environmental Systems Engineering", McGraw Hill.
- Schnoor J.L., "Environmental Modelling – Fate and Transport of Pollutants in Water, Air and Soil", John Wiley and Sons.
- Thomann R.V., and Mueller J.A., "Principles of Water Quality Management and Control", Harper & Row Publications.
- Thomann R.V., "Systems Approach to Water Quality Management", McGraw Hill.

Web links and Video Lectures (e-Resources):

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 simulation models for predicting fate and transport of pollutants with examples. Describe and differentiate the transport processes of advection and convection processes and derive related equations with analytical solutions.	L2,
CO2	Apply mathematical models and predict pollutant (conservative and non-conservative) concentrations in lakes and rivers under steady-state conditions; solve simple numerical problems.	L3,L4
CO3	Describe the concept of mixing zone in natural aquatic bodies and its influence on pollutant dispersion; prepare field monitoring protocol for measuring hydraulic as well water quality parameters.	L3,L4
CO4	Compare stratified and completely-mixed lake systems; describe mathematical equations to compute pollutant distribution in lake and estuarine systems. Design outfall system for ocean disposal.	L2,L3,L4
CO5	Derive and apply 1-D groundwater model considering the influencing processes, field validation. Demonstrate the application of different prediction models for quality predictions and decision making.	L3,L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**0**	**2**	**2**	**1**	**1**
CO2	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**1**	**1**
CO3	**2**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**
CO4	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**1**	**1**	**1**	**1**
CO5	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**1**	**1**	**1**	**1**

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association

Semester- 3

NON – POINT SOURCES OF POLLUTION AND MANAGEMENT			
Course Code	**22CEE323**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40 hours of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- The course deals with importance, significance and types of non-point sources of pollution.
- It also covers mathematical simulation models for qualitative and quantitative assessment of non point source pollution and exposes to best management practices

Module-1	
Introduction: Non-point Pollution, Problem, definitions, magnitude of Non- point Pollution, Non-point Pollution Control Laws, Waste Assimilative Capacity and Stream Standards Pollution From the Atmosphere: Atmospheric Inputs – fall out, radio-nuclides Rainfall, General Hydraulics system model, Lumped Overland flow routing of the precipitation excess, River routing by Muskingum Method.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-2	
Groundwater Pollution: Sources of Groundwater Contamination, Groundwater Movement. Pollution from impervious urban areas: Introduction Deposition and Accumulation of Pollutants on Impervious Surfaces Removal of Solids from street Surfaces, Porous Pavement.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-3	
Non point Pollution Simulation Models: Basic Concepts, Nonpoint Pollution Simulation Models-SWAT MODEL.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-4	
Land use and non-point pollution: Effects , Comparative Assessment of Pollution Impact from land use, agricultural runoff, mining area runoff, Effect of hydrologic Modifications Management Practices of Non-point pollution control: Introduction, Source Control Measures Collection Control and Reduction of Delivery.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-5	
Planning for Nonpoint Pollution Control: Introduction, Water Quality Planning Process, Selection of Best Management Practices for Non Point Source Pollution Control – detention ponds, exfiltration and infiltration trenches, vegetative swales.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

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:

- Three Unit Tests each of **20 Marks**
- Two assignments each of **20 Marks**or**oneSkill 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. .Novotny V., and Chesters G., " Hand Book of Non-point Pollution, Sources and Management", Van Nostrand Reinhold Environmental Engineering Series, New York.
2. Pavoni J L, (Ed) "Hand Book of Water Quality Management Planning", Van Nostrand Reinhold, Environmental Engineering Series.New York
3 Pluarg, Pollution from Land Use Activities Reference Group Novotny V and Chesters G, , "Hand Book of Non-point Pollution, Sources and Management", Van Nostrand Reinhold Company

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Describe the problem and magnitude of non-point source pollution, relate with waste assimilative capacity of natural aquatic bodies and quantify the total load giving due consideration to components of hydrologic and atmospheric conditions	L1
CO2	Explain source, tracking and transport and fate of ground water pollution and assess influence of urbanization on pollution quantification and its movement	L1,L2
CO3	Apply the simulation models for pollution quantification and to evaluate the impacts of best management practices	L3
CO4	Understand of qualitative and quantitative aspects of non-point source pollution from agricultural and mining areas	L2
CO5	Select the best management practices for non -point source pollution control.	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	1	2	3	3	2	2	1	1
CO2	2	2	3	2	1	2	2	3	2	2	1	1
CO3	2	1	3	2	3	2	2	2	1	1	1	1
CO4	3	3	2	2	2	2	1	2	1	2	1	1
CO5	2	2	2	1	2	1	2	1	1	1	2	1

Semester- 3

CLIMATE CHANGE AND GLOBAL WARMING			
Course Code	**22CEE324**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40 hours of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Explain Earth's natural greenhouse effect and alternate Energy sources
- Identify natural and human created sources of greenhouse gases.
- Understand that the Earth's systems, Policy and laws to restrict climate change
- Explain why climate change is a global occurrence, not a local one.

Module-1

Global warming: Energy Issues and Climate Change ,Warming Earth - Heat and principles of Thermodynamics, Alternate Energy Sources.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-2

Green house gases : Green-House Effect as a Natural Phenomenon, Green House Gases GHGs) and their Emission Sources Quantificationof CO_2 Emission, Global Warming Potential (GWP) of GHGs.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-3

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

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-4

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

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-5

Cleaner Development Mechanisms: Various Projects related to CO_2 Emission Reduction, Alternatives of Carbon Sequestration: Conventional and non conventional techniques , Role of Countries and Citizens in Containing Global Warming.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

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**oneSkill 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

- Barry R.G., and Chorley R.L., "Atmosphere, Weather and Climate", 4th Edition, ELBS Publication. Bolin B., (Ed.), "Carbon Cycle Modelling", John Wiley and Sons Publications.
- Francis D., "Global Warming: The Science and Climate Change", Oxford University Press.
- Linden E.,, "The Winds of Change: Climate, Weather and the Destruction of Civilizations", Simon and Schuster Publications.
- Mintzer I.M., (Ed.), "Confronting Climate Change, Risks, Implications and Responses", Cambridge University Press.
- Srivatsava A.K., "Global Warming", APH Publications.
- Yadav, Chander and Bhan, "Global Warming: India's Response and Strategy", RPH Publications.

Skill Development Activities Suggested

- Raster analysis (QGIS)
- Use of public domain data and analysis

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 impacts that climate change is having on the natural environment	L1
CO2	understand causes and Impact of climate change and some alternative solutions to restrict global warming	L3
CO3	Recognise how systems work by seeing the relationships between climate and other forms of environmental change.	L2

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	2	3	3	2	2	1	1
CO2	3	2	2	2	1	2	2	2	1	2	1	2
CO3	3	2	1	1	1	1	2	2	1	2	1	1

Semester- 3

OPERATION AND MAINTENANCE OF ENVIRONMENTAL FACILITY			
Course Code	**22CEE331**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40 hours of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- The course encompasses the aspects of operation and maintenance of Environmental facilities.
- It highlights the operational problems and suggests the control, preventive and corrective measures.

Module-1

Operation & Maintenance Planning - Organizational Structure, Work Planning, Preparation and Scheduling, Cost Estimates.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-2

Data Base of Facilities for O&M – Detailed Plans, Drawings, Operation Manuals, Record keeping, standard operating procedure and Computer Applications in O&M and SCADA.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-3

O&M of Water Treatment and Supply and Facilities, Operational Problems and Corrective Measures in Different Units of Treatment. Water Distribution Network.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-4

O&M of Wastewater Collection and Treatment Facilities, Operational Problems and Corrective Measures in Different Units of Treatment, sewer network system. O & M of Industrial wastewater systems.

Teaching-Learning	Chalk and talk, power point presentation and video lecture.

Process	

Module-5

O&M of Air Pollution Control Facilities, Operational Problems and Corrective Measures in Different Units of Treatment.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

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**oneSkill 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

3. .Hammer M.J., and Hammer Jr. M.J., (2008), "Water and Wastewater Technology", Prentice Hall of India Pvt. Ltd., New Delhi.
4. Metcalf and Eddy Inc., (2003), "Wastewater Engineering - Treatment and Reuse", 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi
5. CPHEEO Manual., (1991) "Water Supply & Treatment", GOI Publication.
6. CPHEEO Manual., (1995) on Sewerage & Sewerage Treatment, GOI Publication,.
7. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), "Industrial Safety and Pollution Control Handbook".

Web links and Video Lectures (e-Resources):

- NPTEL

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 scope, types, basic principles, organizational structure, work planning and scheduling and cost estimates of O&M .	L1
CO2	Explain the importance of plans, drawing, map, record keeping. Recognize the need for operational manual and SOP. Discuss the advantages and limitations of SCADA based control systems.	L2
CO3	Identify and list the operational problems in water treatment and supply facilities. Apply preventive and corrective maintenance measures.	L4
CO4	Describe the operational problems in wastewater (Domestic and Industrial) collection and treatment facilities. Enumerate the remedial measures.	L1,L2
CO5	Identify and discuss the troubles in air pollution control systems and suggest the preventive and control measures.	L1,L2,L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	1	1	1	2	2	1	2	1	1
CO2	2	2	3	2	3	3	2	2	1	2	1	1
CO3	2	2	1	2	3	1	2	1	2	1	2	2
CO4	3	2	1	2	2	1	2	1	2	1	1	1
CO5	2	2	2	2	1	2	2	2	1	2	1	1

Semester- 3

NATURAL RESOURCES CONSERVATION AND MANAGEMENT			
Course Code	**22CEE332**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40 hours of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- The course describes natural resources and their significance for life existence with an emphasis on Sustainable Development.
- It deliberates in depth on the various conservation techniques to be adopted.
- The course also enriches the student with possible legislative measures and management options for effective and efficient management of available natural resources for human consumption and societal development.

Module-1

Introduction to Sustainable Development Need, importance and role of Environmental Engineers
Renewable and Non-renewable Resources Resources - Appraisal, problem, classes, renewable resources flow, destruction versus conservation

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-2

Forest Resources
Ecological and economic significance, types and management, forest resources of the world and India, deforestation and its impact and solution

Water Resources
Worldwide supply, renewal and distribution, water resources of India, Managing water resources, Environmental Impact of large dams, River water disputes, water pollution problems.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-3

Mineral Resources Sources, exhaustibility, Exploration and uses, Environmental impacts and solutions

Food Resources World food production and problems, agri production, live stock production, modern agri practices, use of pesticides and fertilizers – environmental impact, environmental limits of increasing food production, sustainable agriculture.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-4

Energy Resources

Energy resources, world energy demand, Indian resources, renewable, alternate / non-conventional energy resources – solar, tidal, wind, geothermal, hydel, hydrogen, biomass , nuclear, wave (ocean).

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

Module-5

Land Resources

Land as a resource, soil – types and degradation, soil conservation.

Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

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**oneSkill 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:

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

Suggested Learning Resources:

Books

8. Anjaneyulu Y., (2004), Introduction to Environmental Science", B.S. Publications, Hyderabad
9. Misra S.P. and Pandey S.N., (2008), "Essential Environmental Studies", Ane Book Publishers, New Delhi
10. Asthana D.K and Meeraasthana (2005), "Environment-Problems and solutions" S. Chand and company Ltd., New Delhi

11. Suresh K. Dhameja (2007), "Environmental Studies" Kataria and sons, Delhi.

Web links and Video Lectures (e-Resources):

- NPTEL

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Introduce the concept of sustainable development. Discuss the role of Environmental Engineers in sustainable development and conservation of natural resources	L1
CO2	Differentiate between biotic and abiotic, renewable and non – renewable resources of nature. Describe the flow of resources and resource use problems	L2
CO3	Describe the importance of forest, water and mineral resources, their deterioration and effective conservation and management practices	L2
CO4	Explain the significance of food, energy and land resources and identify the possible pollution sources and their effective management to conserve these resources	L1,L2
CO5	Apply the knowledge of legal frame work and management concepts through host of acts and regulations for natural resources conservation and management.	L2,L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	2	1	3	2	1	1	1	1
CO2	2	1	1	2	1	2	1	2	2	2	1	1
CO3	2	2	1	1	1	1	2	1	2	1	1	1
CO4	1	2	1	1	2	1	2	1	2	1	1	1
CO5	2	1	1	2	1	2	2	1	1	1	1	1

Semester- 3

Community Health and Environmental Sanitation

Course Code	**22CEE333**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40 hours of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- 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 Communicable diseases and Risk Approach.
- To know about the nutrition of health.
- Understand the objectives and maintenance of Environmental Sanitation.

Module-1

Introduction: Concept of Health, medicine to words health, dawn of scientific medicine in antiquity, modern medicine and modern health care. Community Health and disease:Classifications of Health as per WHO guidelines, changing concepts of health, dimensions of health, determinants of health concept of well being. Communicable & non-Communicable Diseases and sources. Disease control and prevention.

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

Module-2	
Principles of Epidemiology: Epidemiology and Aims of Epidemiology, Basic measurements, Common Sources of Epidemics and Control measures, Uses of Epidemiology. **Concept of Disease Transmission and Prevention**: Dynamics of Disease Transmission, modes of Disease Transmission, concept of screening, types & uses of screening.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
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, Swine flu, Ebola, Zika and Corona virus. Insect Control: House fly and Mosquito study on their Life cycle.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-4	
Food and Milk Sanitation: Food Poisoning, Types and sources. Prevention and Control. Essentials for milk sanitation and Test for milk quality, Pasteurization, Cattle Born Diseases. **Nutrition of health**: Nutrients, proteins, fats and carbohydrates. Nutritional problems in public health and surveillance.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.
Module-5	
Environmental sanitation: Environmental sanitation, Rural and Urban sanitation. Importance of safe drinking water, safe excreta and methods of waste disposal. **Occupational health and Safety**: Occupational health hazards and diseases, health of worker and safety measures.	
Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

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:

- 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:

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

- 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. BanarsidasBhanot Publications.
- Baljeeth s kapoor, Environmental sanitation, S Chand & Co.
- P.K. Goel, Water Pollution Causes, Effects and Control, New Age International (Pvt.) Ltd.

Skill Development Activities Suggested

- NPTEL

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	L2
CO2	To understand the Dynamics of Disease Transmission and control measures.	L2
CO3	To know about the principles of epidemiology.	L1
CO4	To know about food sanitation and nutrients.	L1
CO5	Control and remedial measures to maintain good Sanitation.	L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**
CO2	**2**	**1**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
CO3	**1**	**2**	**2**	**2**	**1**	**3**	**3**	**1**	**2**	**1**	**2**	**1**
CO4	**2**	**1**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**
CO5	**2**	**1**	**1**	**1**	**0**	**2**	**2**	**2**	**1**	**2**	**1**	**1**

Semester- 3

Fundamentals of Remote Sensing in Engineering Applications			
Course Code	**22CEE334**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40 hours of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To provide exposure to students in gaining knowledge on concepts and applications leading to modeling of earth resources management using Remote Sensing
- To acquire skills in storing, managing digital data for planning and development.
- To acquire skills in optical remote sensing for mapping, modeling and monitoring.

Module-1	
Introduction to Remote Sensing: Principles of Remote sensing, The electromagnetic spectrum, Classification of RS systems, , Indian Satellites. Interaction of EMR and atmospheric consideration, Atmospheric windows. Spectral Characteristics of vegetation water and soil, spectral signature.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-2	
Platforms and Sensors : Platforms Satellites and Sensors, Sensors and platforms , Data Products , Image Interpretation and Analysis. Satellite data products, Visual interpretation.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-3	
Satellite Digital Image Analysis: Introduction, Digital Analysis - Sources of error, Image rectification and restoration: Image Enhancement, Multi image manipulation.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-4	
Image Classification: Image Classification methods, Supervised, unsupervised, Accuracy Assessment NDVI, change detection studies.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.
Module-5	
Applications in environment Engineering: Role of Remote Sensing in Disaster Management (flood inundation modelling and mapping) , Applications of RS & GIS in Town & Country Planning (waste material disposal sites for Urban and Regional planning) ,Applications of RS & GIS in Forestry, Ecology & Environment (Forest mapping & classification, Study of Bio-diversity in different Biomes, Forest Fire: Identification, Control, Estimation of losses and management). Ground water and surface water potential mapping.	
Teaching-Learning Process	Chalk and talk, power point presentation and video lecture.

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:

- Three Unit Tests each of **20 Marks**
- Two assignments each of **20 Marks**or**oneSkill 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. Remote Sensing Principles and Interpretation, W. H. Freeman and Company, NY Lillesand, Thomas & Kiefer,
2. Remote Sensing and Image Interpretation, John Wiley & Sons Avery & Belin
3. Remote Sensing of the environment - An Earth Resource Perspective, Pearson Education
4. . Robert A. Schowengerdt, Remote Sensing,: Models and Methods for Image Processing, 3 rd Edition, Academic Press, 2007, ISBN-13: 978-0123694072.

Web links and Video Lectures (e-Resources):

- NPTEL

Skill Development Activities Suggested

- Raster analysis (QGIS)
- Use of public domain data and analysis

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Acquire knowledge about concepts of Remote sensing, sensors and their characteristics.	L1
CO2	A Gain skills in image analysis and interpretation in preparing thematic maps	L3
CO3	Prepare the candidates for Mapping and analysis	L2

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	1	2	1	2	1	1	1
CO2	2	3	3	2	3	2	2	2	2	1	1	1
CO3	2	2	3	2	2	2	1	1	2	1	1	2

Semester- 3

PROJECT WORK PHASE – 1			
Course Code	**22CEE34**	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	00:06:00	Total Marks	100
Credits	03	Exam Hours	03

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

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 in which the students are motivated to reach high standards and become self-confident

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.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Demonstrate a sound technical knowledge of their selected project topic.	L1,L2
CO2	Undertake problem identification, formulation, and solution	L2,L3
CO3	Design engineering solutions to complex problems utilising a systems approach	L2,L3
CO4	Communicate with engineers and the community at large in written an oral forms	L3
CO5	Demonstrate the knowledge, skills and attitudes of a professional engineer.	L5,L6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	3	3	3	2	2	2	2
CO2	2	3	3	3	2	3	2	2	3	2	2	3
CO3	3	3	3	3	3	2	2	2	3	2	3	3
CO4	3	2	1	1	1	3	3	3	3	3	3	3
CO5	3	0	0	1	1	2	3	3	3	3	3	3

Semester- 3

SOCIETAL PROJECT			
Course Code	**22CEE35**	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	00:06:00	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

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

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

Assessment Details for CIE

The weightage of Continuous Internal Evaluation (CIE) is 100% .The minimum passing mark for the CIE is 100% of the maximum marks. 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 CIE (Continuous Internal Evaluation).

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Present the Societal -project and be able to defend it.	L1,L2
CO2	Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.	L3
CO3	Habituated to critical thinking and use problem solving skills.	L1,L2
CO4	Communicate effectively and to present ideas clearly and coherently in both the written and oral forms	
CO5	Learn on their own, reflect on their learning and take appropriate actions to improve it.	L1,L2,L6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	1	1	2	2	2	2	1	1	1
CO2	3	3	3	3	3	3	2	2	2	2	2	2
CO3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	2	1	1	1	1	1	1	1	1	1
CO5	3	1	1	1	1	1	1	1	1	1	1	1

Semester- 3

INTERNSHIP			
Course Code	**22CEEI36**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	06 Weeks of internship	SEE Marks	50
Time/Period	Between II and III Sem Vacation	Total Marks	100
Credits	06	Exam Hours	03

Course Learning objectives:

Internship/Professional practice 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 work in 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.

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 environment in which the students are motivated to reach high standards and become self-confident.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Gain practical experience within industry in which the internship is done.	L1,L2
CO2	Acquire knowledge of the industry in which the internship is done.	L3
CO3	Apply knowledge and skills learned to classroom work.	L1,L2
CO4	Develop a greater understanding about career options while more clearly defining personal career goals.	
CO5	Experience the activities and functions of professionals.	L1,L2,L6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	1	1	2	2	2	2	1	1	1
CO2	3	3	3	3	3	3	2	2	2	2	2	2
CO3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	2	1	1	1	1	1	1	1	1	1
CO5	3	1	1	1	1	1	1	1	1	1	1	1

PROJECT WORK PHASE -2			
Course Code	20CEE41	CIE Marks	100
Number of contact Hours/Week	08	SEE Marks	100
Credits	18	Exam Hours	03

Course objectives:

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

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 guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

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

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

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Conduct systematic review of literature, identify research gaps, and define objectives and scope of work	L4
CO2	Develop skills in terms of design, conduct investigations and data analytics	L3
CO3	Develop oral and written communication skills for report preparation, paper publication and technical presentation	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	3	2	2	2	1	2	2
CO2	3	2	3	2	2	3	3	3	1	2	3	3
CO3	3	3	3	2	3	3	2	1	2	1	2	3

0--No Association. 1--- Low Association 2--- Moderate Association 3--- High Association