VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus
M.Tech Environmental Engineering (CEE)
(Effective from Academic year 2020 - 21)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
M.Tech ENVIRONMENTAL ENGINEERING (CEE)
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical	Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	20CEE11	**Advanced Computational Methods and Optimization**	03	--	02	03	40	60	100	4
2	PCC	20CEE12	Advanced Water Treatment Technology	03	--	02	03	40	60	100	4
3	PCC	20CEE13	Applied Environmental Chemistry & Microbiology	03	--	02	03	40	60	100	4
4	PCC	20CEE14	Solid Waste Engineering & Management	03	--	02	03	40	60	100	4
5	PCC	20CEE15	Occupational Safety and Health (OSHA)	03	--	02	03	40	60	100	4
6	PCC	20CEEL16	Environmental Engineering Lab-I	--	04	--	03	40	60	100	2
7	PCC	20CEEL17	Research Methodology and IPR	02	--	02	03	40	60	100	2
			TOTAL	**17**	**04**	**12**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Professional core.

Skill development activities:
Students and course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills.
The students should interact with industry (small, medium and large), understand their problems or foresee what can be undertaken for study in the form of research/ testing / projects, and for creative and innovative methods to solve the identified problem.
The students shall
(1) Gain confidence in modelling of systems and algorithms.
(2) Work on different software/s (tools) to Simulate, analyse and authenticate the output to interpret and conclude. Operate the simulated system under changed parameter conditions to study the system with respect to thermal study, transient and steady state operations, etc.
(3) Handle advanced instruments to enhance technical talent.
(4) Involve in case studies and field visits/ field work.
(5) Accustom with the use of standards/codes etc., to narrow the gap between academia and industry.
All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Internship: All the students have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted for the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

Note: (i) Four credit courses are designed for 50 hours Teaching – Learning process.

(ii) Three credit courses are designed for 40 hours Teaching – Learning process.
(iii) Two credit courses are designed for 25 hours Teaching – Learning process.

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II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Seminar	Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	20CEE21	Advanced Wastewater Treatment	03	--	02	03	40	60	100	4
2	PCC	20CEE22	Atmospheric Air Pollution & Control	03	--	02	03	40	60	100	4
3	PCC	20CEE23	Industrial Waste water Treatment	03	--	02	03	40	60	100	4
4	PEC	20CEE24X	Professional elective 1	04	--	--	03	40	60	100	4
5	PEC	20CEE25X	Professional elective 2	04	--	--	03	40	60	100	4
6	PCC	20CEEL26	Environmental Engg. Lab-II	--	04	--	03	40	60	100	2
7	PCC	20CEE27	Technical Seminar	--	02	--	--	100	--	100	2
TOTAL				**17**	**06**	**06**	**18**	**340**	**360**	**700**	**24**

Note: PCC: Professional core, PEC: Professional Elective.

Professional Elective 1		**Professional Elective 2**	
Course Code under 20CEE24X	**Course title**	**Course Code under 20CEE25X**	**Course title**
20CEE241	Environmental Geotechnology	20CEE251	WRE & Applied Hydraulics
20CEE242	Risk assesment and hazardous waste	20CEE252	Ecology
20CEE243	Environmental Planning & Management	20CEE253	Renewable Energy and Alternatives Fuels
20CEE244		20CEE254	

Note:
1. Technical Seminar: CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of the programme shall be mandatory.
The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25.
2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the

prescribed internship credit shall be counted in the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

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III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Mini–Project/ Internship	Skill Development activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	20CEE31	Environmental Impact Assessment	03	--	02	03	40	60	100	4
2	PEC	20CEE32X	Professional elective 3	03	--	--	03	40	60	100	3
3	PEC	20CEE33X	Professional elective 4	03	--	--	03	40	60	100	3
4	Project	20CEE34	Project Work phase -1	--	02	--	--	100	--	100	2
5	PCC	20CEE35	Mini-Project	--	02	--	--	100	--	100	2
6	Internship	20CEEI36	Internship	(Completed during the intervening vacation of I and II semesters and /or II and III semesters.)			03	40	60	100	6
TOTAL				**09**	**04**	**02**	**12**	**360**	**240**	**600**	**20**

Note: PCC: Professional core, PEC: Professional Elective.

Professional elective 3		**Professional elective 4**	
Course Code under 20CEE32X	**Course title**	**Course Code under**	**Course title**
20CEE321	Climate Change and Globalization	20CEE331	Remote Sensing & GIS
20CEE322	Natural resources conservation and management	20CEE332	Transport processes & Modelling of Aquatic System
20CEE323	Non-Point Source of Pollution and Management	20CEE333	Operation and maintenance of Environmental Facility
20CEE324		20CEE334	

Note:
1. Project Work Phase-1: Students in consultation with the guide/co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project

document, and present a seminar.
CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill and performance in Question and Answer session in the ratio 50:25:25.
SEE (University examination) shall be as per the University norms.
2. Internship: Those, who have not pursued /completed the internship shall be declared as fail in internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.

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IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
				L	P					
1	Project	20CEE41	Project work phase -2	--	04	03	40	60	100	20
			TOTAL	--	**04**	**03**	**40**	**60**	**100**	**20**

Note:

1. Project Work Phase-2:

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a Senior faculty of the department. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and performance in Question and Answer session in the ratio 50:25:25.

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

Advanced Computational Methods and Optimization			
Course Code	20CEE11	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

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.

Module-2

Probability: Concept of probability, Random Variables, Binomial, Poisson and Normal distribution – applications, Chi- squared test, F test, t-test.

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.

Module-4

Non-Linear Programming: Numerical search methods non- linear problems-Dichotomous. Fibonacci and Golden section methods. Quadratic and cubic interpolation methods.

Module-5

Numerical Methods: 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.

Course outcomes:

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

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

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks
(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.
Reference Books
(1) Taha H.A., "Optimization Research":An introduction, Pear son Prentice Hall, 8th Edition
(2) Shanthakumar M.S., "Numerical Methods and Analysis", Tata McGrawhill Pubs.
(3) Levin R I., (2008), "Statistics for Management", Pearson Education India.

ADVANCED WATER TREATMENT TECHNOLOGY			
Course Code	20CEE12	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

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.
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
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 devises. Determination of Optimum Coagulant Dosage. Numerical design problems on estimation of Coagulants.
Module-4
Water Treatment by Filtration Process – Theory of Filtration and basic Principles. Classification of Filters used in treatment of water. Filters washing Technique/back wash. Operational troubles and trouble shooting. Design criteria used and Design of Slow and Rapid Sand Filters required for water treatment plant.
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.

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

- To understand the roll and importance of drinking water Quality and control of water borne diseases.
- Transmission of Various diseases in a Community.
- By knowing the Objectives and importance of treatment process, one can judge the standards of water before used and supplying to a community.
- To understand the Dynamics of Water Purification and type of treatment required with respect to water characteristics.
- Gaining the knowledge on water softening process and Fluoridation & Defluoridation techniques.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

(3) 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**".

Reference Books

(1) Peavy, H.S., Rowe and Tchobonoglous,G., (1985), **"Environmental Engineering**", McGraw Hill.

(2) Viessman Jr, Hammer J. M, Perez, E.M, and Chadik, P. A, **Water Supply and Pollution Control**, PHI Learning, New Delhi, 2009.

(3) Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, **Environmental Engineering**, McGraw Hill., 1984

APPLIED ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY			
Course Code	20CEE13	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Importance of Environmental Chemistry as applied to the Environmental Engineering,typesof reactions, reversible and irreversible reaction,redoxreactions,reactionkinetics. Modes of expression for molarity, normality, molality, etc., Electrochemistryanditsapplications.Physicalandequilibrium Chemistry–fundamentalsandapplications. pH–Principle,Measurement, NumericalExamples,BuffersandBufferindex.

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

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

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

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, Bio 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.

Course outcomes:

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

(1) Master a broad set of chemical knowledge concerning the fundamentals in the basic areas of the discipline (organic, inorganic, analytical, physical and biological chemistry).

(2) Demonstrate that microorganisms have an indispensable role in the environment, including elemental cycles, biodegradation, etc.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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. ■

Textbook/ Textbooks

(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.

Reference Books

1. Gaudy and Gaudy, "Microbiology for Environmental Scientists and Engineers", McGraw Hill.
2. APHA, "Standard Methods for Examination of Water and Wastewater"; 21st Edition.
3. Stumn and Morgan, "Aquatic Chemistry", John Willey & Sons

SOLID WASTE ENGINEERING AND MANAGEMENT

Course Code	20CEE14	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

I**ntroduction :**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

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

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.

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.

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.

Course outcomes:

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

CO1: Identify improper practices of solid waste disposal and their environmental implications.

Know the basic engineering principles of solid waste management

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

CO3: Understand the management concepts, define 4 R approach, apply PPP model and community involvement for effective management of solid waste

CO4: Develop a concise idea on various conventional and advanced treatment options for solid waste

CO5: Conceive the design aspects of engineered disposal options and apply the gained knowledge

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.■

Textbook/ Textbooks

1. 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".

(2) Peavy, Rowe and Tchobanoglous, “Environmental Engineering”, McGraw Hill.
Reference Books
1) CPHEEO Manual on Solid Waste Management. WHO Manual on Solid Waste Management.
2) Vesiland A., “Solid Waste Engineering”, Thompson Books.
3) Flintoff F., (1976), “Management of Solid Wastes in Developing Countries”, WHO 4. Regional Publications, South East Asia, New Delhi

OCCUPATIONAL SAFETY AND HEALTH (OSHA)			
Course Code	20CEE15	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

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.

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.

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.

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.

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

Course outcomes:

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

CO1 - Gain knowledge on safety and health principles, OSHA and Right to know, National safety Law, types of diseases and their spread, Health Emergency.

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.

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.

CO4 - Perform basic accident investigation and report preparation. concept of Protective equipments and environmental management plan.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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. ■

Textbook/ Textbooks

(1) Goetsch D.L., (1999), "Occupational Safety and Health for Technologists,

(2) Engineers and Managers", Prentice Hall.

Reference Books

(1) Colling D.A., (1990), "Industrial Safety Management and Technology", Prentice Hall, New Delhi.

(2) Della D.E., and Giustina, (1996), "Safety and Environmental Management", Van 4. Nostrand Reinhold International Thomson Publishing Inc. Biomedical Waste (Handling and Management) Rules

(3) Trevethick, R.A., ((1973), "Environmental and Industrial Health Hazards"- William 10. Heinemann Medical Books Ltd., London

ENVIRONMENTAL LABORATORY AND FIELD TEST			
Course Code	20CEEL16	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

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	Sampling and analysis of ambient air Instrumental methods of analyses for particulates, PM10, PM2.5, HC,
4	Sampling and analysis of ambient air Instrumental methods of analyses for particulates, CO, NOx,SO_2, bio- aerosols,
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	Noise standards

10	Noise measurements.

Reference Books

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

RESEARCH METHODOLOGY AND IPR			
Course Code	20RMI17	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	1:0:2	SEE Marks	60
Credits	02	Exam Hours	03

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. ■

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. ■

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. ■

Module-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.

Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests. ■

Module-5

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

Course outcomes:

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

- Discuss research methodology and the technique of defining a research problem
- Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
- Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
- Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
- Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.■

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbooks
(1) Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg,New Age International,4th Edition, 2018.
(2) Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), RanjitKumar,SAGE Publications,3rd Edition, 2011.
(3) Study Material (For the topic Intellectual Property under module 5), Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.
Reference Books
(1) Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.
(2) Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

*** END OF I SEMESTER ***

ADVANCED WASTEWATER TREATMENT ENGINEERING			
Course Code	20CEE21	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Domestic Wastewater -characteristics, flow fluctuations, types of reactors and mass balance approach

Wastewater Treatment -Flow Diagrams and Hydraulic Profile. **Kinetics of biological wastewater treatment syst**ems – monads, biokinetic constants, their determination and their applications, batch and continuous system.

Module-2

Design principles and design of unit operation systems - screen, Skimming (Floatation) tank equalization basin, grit chamber, and primary settling tank.

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 contactors.

Module-4

Advanced Wastewater Treatment: Need and technologies used.

Nitrification and Denitrification Processes colour & COD removal of waste water by Ozonation, & Fentons Oxidatition , Application of Electro oxidation processes for Effluent treatment Phosphorous removal. Wastewater disinfection

Module-5

Biological Sludge separation, conditioning and volume reduction Design of Sludge Processing units – secondary settling tank, slude thickeners and digesters– aerobic and anaerobic.

Wastewater treatment systems for small communities – septic tanks, soak pits, two-pit latrines, eco-toilet.

Course outcomes:

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

1. A process flow sheet, concept of unit operations and biological units.
2. Appropriate treatment methods for municipal and certain industrial effluents.
3. Simple design equations for wastewater treatment plant.
4. The chemical and biological principles behind unit processes used in wastewater treatment unit processes.
5. The management of residuals from water and wastewater treatment.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.■

Textbook/ Textbooks

(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"

Reference Books

(1) Benefield R.D., and Randal C.W., , "Biological Process Design for Wastewater Treatment", Prentice Hall, Englewood Chiffs, New Jersey.

(2) Ronand L., and Droste, ,"Theory and Practice of Water and Wastewater Treatment", John Wiley and Sons Inc.

ATMOSPHERIC ENVIRONMENTAL POLLUTION AND CONTROL			
Course Code	20CEE22	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

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.

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, CO2, Hydrocarbons, SOX and NOX, photochemical oxidants. Monitoring equipment and sampling devices – stack sampling (Isokinetic sampling), air samplers, gas exhaust analyzer. Air Pollution Index.

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.

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 gaseouspollutants** – adsorption, absorption, condensation and combustion. Design principles.
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
Course outcomes: At the end of the course the student will be able to: **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. **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. **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. **CO4:** Understand and analyze the basic mechanisms involved, working principles and design aspects of various air pollution controlling equipment's through demonstration. **CO5:** Understand the concept of Indoor Air Pollution and Noise Source and Control.
Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60. • 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 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.■
Textbook/ Textbooks
(1) C.S Rao., (2006), "Environmental pollution control engineering"- New age international publishers.
(2) M. N Rao and H. V. N Rao.,(1999), "Air Pollution"- Tata McGraw-Hill Publishing Company Limited, New Delhi.
(1) Wark, K., Warner, C.F., and Davis, W.T., (1998), "Air Pollution"-
Reference Books
(1) Crawford, M., (1980)," Air Pollution Control Theory"- TATA McGraw Hill.

(2) Howard S. Peavy, Donald R. Rowe and George Technobanoglous., (2017) "Environmental Engineering" – McGraw Hill International Publications.
(3) Stern, A.C., Air Pollution, Vol I, II, III.
(4) Stern, A. C., (1977), "Air Pollution : The Effects of Air Pollution" – 3rd- Edition, Academic Press

INDUSTRIAL WASTEWATER TREATMENT			
Course Code	20CEE23	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

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

Effluent standards and receiving water quality standards.

Different aspects and choices of various disposal alternatives

Module-2

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

Biomonitoring

Module-3

Pretreatment of Industrial Wastewater – Volume reduction, Strength reduction, Neutralization, Equalization and Proportion, Removal of Organic and inorganic dissolved solids. Bio-Remediation of contaminated soils

Module-4

Wastewater Treatment in specific industries: Distrillery, Sugar, Pulp and paper, Cement, Textile, Dairy, Fertilizer, Pesticides, Pharmaceutical canning & tanning industries

Designof complete treatment system & disposal for industries:

Distillery, Diary, Textile, paper and pulp mill to meet P.C.B. norms.

Module-5

Radio Active Wastes treatment- Low activity and high activity radiation, application of radio active techniques for wastewater treatment.

Environmental Auditing: Introduction, Cost of Pollution, Environmental audit solutions, Financial and Managerial opportunities. Criminal and Regulatory liabilities

Course outcomes:

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

1. Learn physical/chemical/biological characteristics of and the evaluation technique for various industrial wastewater
2. Understand the theory, engineering application, and design technique for the industrial wastewater treatment unit

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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. ■

Textbook/ Textbooks

(1) Nemerow N.N., "Liquid Waste of industry theories, "Practices and Treatment. Addison Willey New York.

(2) Eckenfelder, “Industrial Water pollution Control”- McGraw hill Company, New Delhi American Chemical Society, Washington D.C. USA 7.Bioremediation books
Reference Books
(1) Azad N. S.,– “Industrial Wastewater Management Hand Book” McGraw Hill book Co., Newyork.
(2) Ross R.D. “Industrial Waste Disposal”, Reinhold Environmental Series – New York.
(3) Mahajan,” Pollution control in Process industries”. TMH, New Delhi.

ENVIRONMENTAL GEO-TECHNOLOGY			
Course Code	20CEE241	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Soil- Pollutant Interaction:

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

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

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.

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

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.

Course outcomes:

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

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

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.■

Textbook/ Textbooks

(1) Daniel, B.E., Geotechnical practice for waste disposal, Chapman and Hall, London, 1993.

(2) Fang, H.Y. Introduction to environmental Geotechnology, CRC press New York, 1997.

Reference Books

(1) Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.

(2) Lagrega, M.d., Bukingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.

RISK ASSESMENT AND HAZARDOUS WASTES MANAGEMENT

Course Code	20CEE242	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

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.

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.

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.

Module-4

Hazardous Waste Management

Sources, Classification, Impacts of Mismanagement, Problems in Developing Counties,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.
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
Course outcomes: At the end of the course the student will be able to: (1) Understand and apply the basic scientific and sustainability principles behind waste management, for solving practical waste management challenges (2) Understand the fundamental principles of existing and emerging technologies for the treatment of waste and recovery of value from waste (3) Appreciate the increasing importance of waste and resource management in achieving environmental sustainability.
Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60. • 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 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. ■
Textbook/ Textbooks
(1) Lagrega M.D., Buckingham P.L., and Evans J.C., (1994), "Hazardous waste Management", McGraw Hill International Edition
(2) Wentz C.A.,(1995),"Hazardous Waste Management", McGraw
Reference Books
(1) Hazardous waste (management and handling) Rules, 2001
(2) Biomedical (Handling and Management) Rules 2008
(3) Charles A. Wentz; "Hazardous Waste Management", McGraw Hill Publication, 1995.

ENVIRONMENTAL PLANNING AND MANAGEMENT			
Course Code	20CEE243	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

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.

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

Module-3

Engineering Economics: Value Engineering, Time Value of Money, Cash Flows, Budgeting and Accounting

Module-4

Environmental Economics: Introduction, economic tools for evaluation, Green

GDP, Cleaner development mechanisms and their applications.

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.

Course outcomes:

At the end of the course the student will have :

1. Sound understanding of the principal environmental policy issues confronting managers in diverse geographical and culture situations.
2. An awareness of the ethical and moral issues involved in seeking the wise and sustainable use of resources
3. A range of relevant practical skills, particularly in the fields of impact assessment, audit and law.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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. ■

Textbook/ Textbooks

(1) Lohani B.N , "Environmental Quality Management",South Asian Publishers, New Delhi

(2) Chanlett, “Environmental Protection”, McGraw Hill Publication, Newyork.
3. Danoy G.E., and Warner R.F., “Planning and Design of Engineering Systems”, Unwin Hyman Publications.
Reference Books
(1) MOEF, Government of India, “Carrying Capacity Based Developmental Planning Studies for the National Capital Region”, 1995-96.
(2) NEERI, Nagpur, Annual Reports 1995 & 1996.
(3) UNEP / UNDP – “Environmental Sustainable Development”.

TITLE OF THE COURSE			
Course Code	20CEE244	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03
Module-1			
Module-2			
Module-3			
Module-4			
Module-5			
Course outcomes: At the end of the course the student will be able to:			
Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60. • 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 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. ■			
Textbook/ Textbooks			
(1)			
(2)			
Reference Books			
(1)			
(2)			
(3)			

WATER RESOURCES ENGINEERING AND APPLIED HYDRAULICS			
Course Code	20CEE251	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Hydrology: Water resources of the world, India and Karnataka, National Water Policy, Hydrologic cycle, estimation of missing precipitation and rain gauge density.

Module-2

Hydrograph theory: Unit hydrograph-derivation, flow routing, low flow analysis. Urban Hydrology - Run-off estimation – Design of Storm water Drains.

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

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

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

Course outcomes:

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

1. Understand the importance of hydrology and its components. Measure precipitation and analyze data.
2. Use unit hydrograph theory in estimating the peak discharge and design storm water drains in urban area.
3. Analyze the flow unsteadiness in pipes and compute the flow rate in the streams.
4. Estimate the quantity of ground water and select appropriate method of augmenting the ground water resources.
5. Identify the use of remote sensing and GIS concepts in various applications of water resources and environmental engineering.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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. ■

Textbook/ Textbooks

(1) K. Subramanya, "Engineering Hydrology", Tata McGraw Hill Publishers, New Delhi.

(2) K. Todd, "Ground Water Hydrology", Wiley and Sons, New Delhi.

(3) Basudeb Bhatta, "Remote sensing and GIS", Oxford University

Reference Books

(1) Raghunath H.M. "Advanced Hydrology", Wiley Eastern Ltd New Delhi.

(2) Ven T. Chow, "Hand Book of Applied Hydrology", 1st Edition Mc Graw Hill Publications.

(3) Lillesand, Kiefer, Chipman, "Remote Sensing and Image Interpretation", Wiley, 2011.

ECOLOGY			
Course Code	20CEE252	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

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

Module-2

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

Module-3

Systems ecology and ecosystems modelling. biodoversity and ecological perspective - human benifits, threats, conservation preservation and protection

Module-4

Ecosystem Modelling

Module-5

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

Course outcomes:

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

1. Develop an appreciation of the modern scope of scientific inquiry in the field of Ecology
2. Become familiar with the variety of ways that organisms interact with both the physical and the biological environment
3. Develop an understanding of the differences in the structure and function of different types of ecosystems

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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. ■

Textbook/ Textbooks

(1) Kormondy, "Concepts of Ecology", Prentice Hall Publication, New Jersey.

(2) Odum, "Fundamentals of Ecology", Adisson Co.

Reference Books

(1) Krebs J., "Ecology - The Experimental Analysis of Distribution and Abundance", I Edition, Harper International.

(2) Hall C.A.S., and Day J.W., "Ecosystem Modeling in Theory and Practice: An Introduction with Case Histories", John Willey.

(3) Verma P.S and Agarwal V.K 1998. Concept of Ecology, S. Chand and company Ltd.,

RENEWABLE AND ALTERNATIVE FUELS			
Course Code	20CEE253	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

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

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

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.

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

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.

Course outcomes:

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

1. Learn need for alternative fuels
2. Learn sources of various alternative flues
3. An understanding limitation of fossil fuels and combustion characteristics fuels

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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. ■

Textbook/ Textbooks

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

TITLE OF THE COURSE			
Course Code	20CEE254	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03
Module-1			
Module-2			
Module-3			
Module-4			
Module-5			
Course outcomes: At the end of the course the student will be able to:			
Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60. • 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 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. ■			
Textbook/ Textbooks			
(1)			
(2)			
Reference Books			
(1)			
(2)			
(3)			

ENVIRONMENTAL ENGINEERING LABORATORY-II			
Course Code	20CEEL26	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

Sl. NO	Experiments
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 ASP, Trickling filter, Waste stabilization pond
5	Oxidation ditch, Sludge digester, Sludge drying beds
6	Design of Sanitary Landfill for Municipal Solid Waste Disposal with leachate & gas collection systems.
7	GIS Operations – Spatial Data Input, Data Management Display.
8	GIS Operations –Exploration analysis & GIS Modeling.
9	Air quality system: Gaussian Plume model for gaseous and particulate dispersion.
10	Air quality system: effective stack height determination and particulate control devices design.

Reference Books:

1. Manual on water supply and Treatment, CPHEEO, Ministry of Urban Development, GoI,New Delhi, 1999.
2. CPHEEO "Manual on Sewerage and Sewage Treatment",, M/s. Jain Book Agency, C-9, Connaught place, 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, AddisonWesley,
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.

TECHNICAL SEMINAR			
Course Code	20CEE27	CIE Marks	100
Number of contact Hours/week	0:0:2	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Each student, under the guidance of a Faculty, is required to

- Choose, preferably through peer reviewed journals, a recent topic of his/her interest relevant to the Course of Specialization.
- Carryout literature survey, organize the Course topics in a systematic order.
- Prepare the report with own sentences.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic 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.

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculties from the department with the senior most acting as the Chairperson.

Marks distribution for CIE of the course 20CEE27 seminar:

Seminar Report: 30 marks

Presentation skill:50 marks

Question and Answer:20 marks

*** END OF II SEMESTER***

ENVIRONMENTAL IMPACT ASSESSMENT			
Course Code	20CEE31	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

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

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

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

Module-4

Attributes, Standards and Value functions: Public participation in EIA. Environmental Management Plan (EMP) and Disaster Management Plan (DMP).

Module-5

EIA Case Studies –Thermal Power Plant, Mining, Fertilizer, Construction Projects, Air port, Water and Wastewater Treatment Plants

Course outcomes:

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

1. Appreciate the purpose and role of EIA in the decision-making process and the factors that assist, and detract, from the usefulness of the EIA Report
2. Understand the strengths of EIA in regard to environmental management and the technical and social/political limitations of EIA
3. Know the administration and procedures that apply in the student's jurisdiction
4. Understand the screening process, the scoping process and how it is applied and the purpose of developing follow-up procedures, and the options for designing these procedures
5. Know the options for estimating environmental and social impacts format of an EIA Report (Environmental Impact Statement, or Environmental Statement)

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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. ■

Textbook/ Textbooks
(1) Anjaneyulu and Valli Manickam, (2010), "Environmental Impact Assessment Methodologies", BS Publications, Hyderabad
(2) Canter L., “Environmental Impact Assessment”, McGraw Hill.
Reference Books
(1) Jain R.K., Urban L.V., Stacey G.S., (1977), "Environmental Impact Analysis-A New Dimension in Decision Making", Van Nostrand Reinhold

CLIMATE CHANGE AND GLOBALIZATION			
Course Code	20CEE321	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Energy Issues and Climate Change ,Warming Earth - Heat and principles of Thermodynamics, Alternate Energy Sources

Module-2

Green-House Effect as a Natural Phenomenon, Green House Gases GHGs) and their Emission Sources Quantificationof CO2 Emission, Global Warming Potential (GWP) of GHGs

Module-3

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

Module-4

Kyoto Protocol: Importance, Significance and its role in Climate Change Carbon Trading - Mechanisms , Various Models

(European, Indian) Global and Indian Scenario

Module-5

Cleaner Development Mechanisms: Various Projects related to CO2

Emission Reduction, Alternatives of Carbon Sequestration:

Conventional and non conventional techniques , Role of Countries and Citizens in Containing Global Warming

Course outcomes:

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

1. Measure climate factors and how they change
2. Understand connections between global warming and human activities
3. Identify effects of climate change on biodiversity and ecosystems in different biomes and aquatic systems
4. Model possible scenarios for future climate change

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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. ■

Textbook/ Textbooks

(1) Corell R.W., and Anderson P.A., (Eds.), "Global Environmental Change", SpringlerVerlog Publishers.

(2) Frame B., Medury Y., and Joshi Y., (Eds.), "Global Climate Change: Science, Impact and Responses".
(3) Wyman R.L., (Ed.), "Global Climate Change and Life on Earth", Chapman and Hall Publications
(4) Farmer G.T and Cook J., "Climate change science: A Modern Synthesis", Springer

Reference Books

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

NATURAL RESOURCES CONSERVATION AND MANAGEMENT

Course Code	20CEE322	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

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

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

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

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)
Module-5
Land Resources Land as a resource, soil – types and degradation, soil conservation
Course outcomes: At the end of the course the student will be able to: 1. Introduce the concept of sustainable development. Discuss the role of Environmental Engineers in sustainable development and conservation of natural resources 2. Differentiate between biotic and abiotic, renewable and non – renewable resources of nature. Describe the flow of resources and resource use problems. 3. Describe the importance of forest, water and mineral resources, their deterioration and effective conservation and management practices. 4. Explain the significance of food, energy and land resources and identify the possible pollution sources and their effective management to conserve these resources. 5. Apply the knowledge of legal frame work and management concepts through host of acts and regulations for natural resources conservation and management.
Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60. • 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 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. ■
Textbook/ Textbooks
(1) Anjaneyulu Y., (2004), Introduction to Environmental Science", B.S. Publications, Hyderabad (2) Misra S.P. and Pandey S.N., (2008), "Essential Environmental Studies", Ane Book Publishers, New Delhi
Reference Books
(1) Asthana D.K and Meera asthana (2005), "Environment-Problems and solutions" S. Chand and company Ltd., New Delhi (2) Suresh K. Dhameja (2007), "Environmental Studies" Kataria and sons, Delhi

NON – POINT SOURCES OF POLLUTION AND MANAGEMENT			
Course Code	20CEE323	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

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, radionuclides Rainfall, General Hydraulics system model, Lumped Overland flow routing of the precipitation excess, River routing by Muskingum Method

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

Module-3

Non point Pollution Simulation Models: Basic Concepts, Nonpoint Pollution Simulation Models- SWAT MODEL

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

Module-5

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

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

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

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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. ■

Textbook/ Textbooks& Reference 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

TITLE OF THE COURSE			
Course Code	20CEE324	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
Module-1			
Module-2			
Module-3			
Module-4			
Module-5			
Course outcomes: At the end of the course the student will be able to:			
Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60. • 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 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. ■			
Textbook/ Textbooks			
(1)			
(2)			
Reference Books			
(1)			
(2)			
(3)			

REMOTE SENSING AND GIS IN ENVIRONMENTAL ENGINEERING			
Course Code	20CEE331	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

FUNDAMENTALS OF REMOTE SENSING Definition, Physics of Remote Sensing, Electromagnetic Radiation and its interactions with atmosphere, Spectral reflectance of earth features, Resolution Spectral Spatial, Temporal and Radiometric.

Module-2

PLATFORMS SENSORS AND IMAGE PROCESSING

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

Module-3

INTRODUCTION TO GIS Data entry, storage and maintenances, Data output. Data analysis, Hardware and software

Module-4

Applications of remotely sensed data for identifying solid waste disposal, forest fire mapping, EIA studies etc. Environmental degradation assessment using RS and GIS.

Module-5

Optimal routing of solid waste using GIS – Case study, Environmental siting of industries and zoning atlas development, Remodeling of water distribution system using GIS

Course outcomes:

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

(1) Understand the Basics of GIS and Terminology associated with it.
(2) To Generate maps and Analyse the Maps
(3) To report the Data after analysis

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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. ■

Textbook/ Textbooks

1. Lilliesand T.M, Kiefer R.W and Chipman J.W., "Remote Sensing and Image Interpretation", John Wiley and Sons, 6th Edition.
2. Goa, J. "Digital Analysis of Remotely Sensed Imagery", McGrill Publishers.
3. Burrough, P.A. and McDonnell, R.A., "Principles of Geographical Information Systems", Oxford University Press,
4. Chang K.T, "Introduction to Geographic information system", McGraw hill Education Pvt Ltd., 4th edition

Reference Books

(1) Bonham-carter, G.F. Geographic information system for Geo scientists: Modelling with GIS, Pergamon,
(2) Lintz, J. and Simonet, "Remote Sensing of Environment", Addison Wesley Publishing Company,
(3) Mishra H.C., "GIS Hand Book", GIS India, Shanthi Nivas, Hyderabad.
(4) Syed R. Qasim , Edward M. Motley & Guang Zhu, "Water Works Engineering: Planning, Design And Operation", Eastern Economy Edition, PHI Learning Private Limited, New Delhi.

TRANSPORT PROCESSES AND MODELING OF AQUATIC SYSTEMS

Course Code	20CEE332	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

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

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 reareation rates

Module-3

1-D Oxygen balance models: Streeter-Phelps equation,critical point method.

Calibration and verification of 1-D oxygen model. Error measures.

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

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

Course outcomes:

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

1. Contaminant transport and fate
2. Ecological and human effects assessment
3. Environmental decision criteria
4. Monitoring strategies
5. Environmental exposure assessment

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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. ■

Textbook/ Textbooks

(1) Rich L.G., "Environmental Systems Engineering", McGraw Hill.
(2) Schnoor J.L., "Environmental Modelling – Fate and Transport of Pollutants in Water, Air and Soil", John Wiley and Sons.

Reference Books

(1) Thomann R.V., and Mueller J.A., "Principles of Water Quality Management and Control", Harper & Row Publications.
(2) Thomann R.V., "Systems Approach to Water Quality Management", McGraw Hill.
(3) Lee C.C., and Lin S.D., "Handbook of Environmental Engineering Calculations", McGraw Hill, New York

OPERATION AND MAINTENANCE OF ENVIRONMENTAL FACILITY			
Course Code	20CEE333	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

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

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.

Module-3

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

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.

Module-5

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

Course outcomes:

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

- Know the need, types, basic principles, organizational structure, work planning and scheduling and cost estimates of O&M
- Explain the importance of drawings, plans, record keeping. Recognize the need for operational manual and SOP. Discuss the advantages and limitations of SCADA based control systems
- Identify and list the operational problems in water treatment and supply facilities. Apply preventive and corrective maintenance measures
- Describe the operational problems in wastewater collection and treatment facilities.
- Enumerate the remedial measures.
- Explain the problems and control measures in Industrial wastewater treatment facilities
- Identify and discuss the troubles in air pollution control systems and suggest the preventive and control measures

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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. ■

Textbook/ Textbooks

(1) Hammer M.J., and Hammer Jr. M.J., (2008), "Water and Wastewater Technology", Prentice Hall of India Pvt. Ltd., New Delhi.
(2) Metcalf and Eddy Inc., (2003), "Wastewater Engineering - Treatment and Reuse", 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

Reference Books

(1) Training Manual on O&M for Municipal Staff, Asian Development Bank Project, Government of Karnataka.

1. CPHEEO Manual., (1991) "Water Supply & Treatment", GOI Publication.
2. CPHEEO Manual., (1995) on Sewerage & Sewerage Treatment, GOI Publication,.
3. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), "Industrial Safety and Pollution Control Handbook".

TITLE OF THE COURSE			
Course Code	20CEE334	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
Module-1			
Module-2			
Module-3			
Module-4			
Module-5			

Course outcomes: At the end of the course the student will be able to:
Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60. • 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 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. ■
Textbook/ Textbooks
(1)
(2)
Reference Books
(1)
(2)
(3)

PROJECT WORK PHASE – 1			
Course Code	20CEE34	CIE Marks	100
Number of contact Hours/Week	2	SEE Marks	--
Credits	02	Exam Hours	--

Course 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.

Course outcomes:

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

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation, and solution.
- Design engineering solutions to complex problems utilising a systems approach.
- Communicate with engineers and the community at large in written an oral forms.
- Demonstrate the knowledge, skills and attitudes of a professional engineer.

Continuous Internal Evaluation

CIE marks for the project report (50 marks), seminar (30 marks) and question and answer (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

MINI PROJECT			
Course Code	20CEE35	CIE Marks	40
Number of contact Hours/Week	2	SEE Marks	60
Credits	02	Exam Hours/Batch	03

Course objectives:

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

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

Course outcomes:

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

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

CIE procedure for Mini - Project:

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

Semester End Examination

SEE marks for the mini-project shall be awarded based on the evaluation of Mini-Project Report, Presentation skill and Question and Answer session in the ratio 50:25:25 by the examiners appointed by the University.

INTERNSHIP / PROFESSIONAL PRACTICE			
Course Code	20CEEI36	CIE Marks	40
Number of contact Hours/Week	2	SEE Marks	60
Credits	06	Exam Hours	03

Course 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 outcomes:

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

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics. ■

Continuous Internal Evaluation CIE marks for the Internship/Professional practice report (20 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with
Semester End Examination SEE marks for the internship report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University. ■

PROJECT WORK PHASE -2			
Course Code	20CEE41	CIE Marks	40
Number of contact Hours/Week	4	SEE Marks	60
Credits	20	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. ■

Continuous Internal Evaluation:

Project Report: 20 marks. The basis for awarding the marks shall be the involvement of the student in the project and in the preparation of project report. To be awarded by the internal guide in consultation with external guide if any.

Project Presentation: 10 marks.

The Project Presentation marks of the Project Work Phase -II shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Question and Answer: 10 marks.

The student shall be evaluated based on the ability in the Question and Answer session for 10 marks.

Semester End Examination

SEE marks for the project report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University. ■