M.TECH . ENVIRONMENTAL ENGINEERING
PROPOSED SCHEME OF TEACHING AND EXAMINATION FOR M.TECH. DEGREE (2019-2020)

Year-I Proposed Scheme for I Semester M.Tech. (Environmental Engineering)										
Master of Technology (Environmental Engineering)			**Semester: I**						**Year:I**	
Sl. No	**Subject**		**Contact Hrs**				**Evaluation Scheme**			**Credits**
			L	T	SS	P	CIE	SEE	Total	
1	19PEV11	Applied Environmental Chemistry and Microbiology	04	00	-	00	50	50	100	04
2	19PEV12	Water Treatment Technology	04	00	-	00	50	50	100	04
3	19PEV13	Wastewater Treatment Engineering	04	-	01	00	50	50	100	04
4	19PEV14	Research methodology	04	00	-	00	50	50	100	04
5	19PEV151	Elective-I	04	00	-	00	50	50	100	04
6	19PEV161	Elective II	04	00	-	00	50	50	100	04
7	19PEV17	Environmental Engineering Lab-I	-	-	-	04	50	50	100	02
		Total	24	00	01	04	350	300	700	26

Note: **L**-Lecture, **T**-Tutorial, **P**-Practical, **CIE** -Continuous Internal Evaluation, **SEE**- Semester End Examination, **SS**-Self Study Component

Electives

Elective –1			**Elective -II**		
Sl. No	**Subject Code**	**Subject**	**Sl. No**	**Subject Code**	**Subject**
1.	19PEV151	Solid Waste Management	1.	19PEV161	Water Resources Engineering & Applied Hydraulics .
2.	19PEV152	Toxicology and Environmental risk assessment	2.	19PEV162	Transport Process and Modeling in Aquatic Systems
3.	19PEV153	Remote Sensing & GIS in Environmental Engineering	3.	19PEV163	Energy & Environment.

Year-I Proposed Scheme for II Semester M.Tech. (Environmental Engineering)										
Master of Technology (Environmental Engineering)			**Semester: II**						**Year I**	
Sl. No	**Subject Code**	**Subjects**	**Contact Hrs**				**Evaluation Scheme**			**Credits**
			L	T	SS	P	CIE	SEE	Total	
1	19PEV21	Air Pollution and Control	04	00	-	00	50	50	100	04
2	19PEV22	Industrial Wastewater Treatment	04	00	01	00	50	50	100	04
3	19PEV23	Elective –III	04	00	-	00	50	50	100	04
4	19PEV24	Elective –IV	04	00	-	00	50	50	100	04
5	19PEV25	Elective –V	04	00	-	00	50	50	100	04
6	19PEV26	Open Elective -VI	04	-	-	00	50	50	100	04
7	19PEV27	Environmental Engineering Lab-II	00	-	-	04	50	50	100	02
		Total	24	00	01	04	350	350	700	26

Note: **L**-Lecture, **T**-Tutorial, **P**-Practical, **SS**-Self Study component, **CIE** -Continuous Internal Evaluation, **SEE**- Semester End Examination,

Electives

Elective –III		**Elective –IV**		**Elective –V**		**Open Elective-VI**	
Subject Code	**Subject**	**Subject Code**	**Subject**	**Subject Code**	**Subject**	**Subject Code**	**Subject**
19PEV231	Ecology and environmental impact assessment	19PEV241	Environmental sanitation Systems	19PEV251	Hydraulics of Water and Wastewater Systems	19PEV261	Hazardous Waste Management
19PEV232	Non-point sources of pollutions and management	19PEV242	Advanced Atmospheric Environmental Engineering	19PEV252	Environmental Planning and Management	19PEV262	Global Warming and Climate Change
19PEV233	Environmental disaster management and risk assessment	19PEV243	Recycle and Reuse Technology	19PEV253	Occupational Safety & Health.	19PEV263	Advanced Computational Methods and Optimization.

Year-II Proposed Scheme for III Semester M.Tech. (Environmental Engineering)										
Master of Technology (Environmental Engineering)			**Semester: III**				**Year-II**			
Sl. No	**Subject Code**	**Subjects**	**Contact Hrs**				**Evaluation Scheme**			**Credits**
			L	T	SS	P	CIE	SEE	Total	
1	19PEV31	Industrial Internship	-	-			50	50	100	6
2	19PEV32	Project Phase –I	-	-	-	-	50	50	100	7
3	19PEV33	certificate course								2
4	19PEV34	Seminar	-	-	-	-	50	-	50	01
		Total	00	00	00	0	150	100	250	16

Note: **L**-Lecture, **T**-Tutorial, **P**-Practical, **SS**-self study component, **CIE** -Continuous Internal Evaluation, **SEE**- Semester End Examination

EXPERT COMMITTEE: CONSISTS OF MINIMUM OF 3,AND MAXIMUM OF 5 FACULTY MEMEBERS IN THE RELEVANT FIELD..

INDUSTRIAL INTERNSHIP: STUDENT HAS TO VISIT AT LEAST ONE INDUSTRY FOR STIPULATIED PERIOD OF FOUR MONTHS AND SUBMIT A REPORT OF THEIR EXPOSURE IN RESPECTIVE FIELD & PRESENT TWO SEMINARS (MID AND END) BEFORE **THE EXPERT COMMITTEE** FOR EVALUATION OF **CIE** MARKS **. SEE** WILL BE EVALUATED BY EXTERNAL & INTERNAL EXAMINARS.

PROJECT PHASE-I: PROJECT WORK WILL BE FOR A PERIOD OF 8 MONTHS OUT OF WHICH 3 MONTHS WILL BE DURING THIRD SEMESTER (PHASE-I). DURING THIS SEMESTER STUDENT HAS TO CARRY OUT LITERATURE SURVEY AND FINALISE THE OBJECTIVES OF THE PROJECT WORK .**CIE** WILL BE EVALUATED BY CONCERNED GUIDE ALONG WITH THE EXPERT COMMITTEE ON THE BASIS OF THE LITERATURE COLLECTION (15-20 JOURNAL PAPERS) & TWO SEMINARS (MID & END) DELIVERED BY THE CANDIDATE**.**

SEE WILL BE EVALUATED BY EXTERNAL & INTERNAL EXAMINARS.

SEMINAR : STUDENT HAS TO PREPARE THE SEMINAR REPORT AND DELIVER THE SEMINAR IN FRONT OF THE COMMITTEE.THEY HAVE TO COLLECT 20 NATIONAL AND INTERNATIONAL JOURNAL PAPERS .

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CIE: WILL BE EVALUATED BY CONCERNED GUIDE ALONG WITH THE EXPERT COMMITTEE ON THE BASIS OF POWER POINT PRESENTATION DELIVERED BY THE CANDIDATE ALONG WITH THE EVALUATION OF SEMINAR REPORT.

CERTIFICATE COURSE: THE SAID NPTEL/MOOCS/SWAYAM COURSES OF TWO CREDIT IS COMPULSORY AND EVERY STUDENT MUST COMPLETE THIS PROFESSIONAL CERTIFICATION COURSE,OF DURATION 12 WEEKS, ANYWHERE FROM 1ST TO 3RD SEM AND SUBMIT THE COPY OF THE COURSE COMPLETION CERTIFICATE TO COE FOR REFLECTION OF THE SAME IN THE GRADE CARD THROUGH PROPER CHANNEL. THIS COMPLETION OF CERTIFICATION COURSE IS MADE REFLECTED ONLY IN 3RD SEM GRADE CARD.

THE ABOVE SAID NPTEL/MOOCS/SWAYAM CERTIFICATION COURSE IS TO BE SELECTED FROM THE WEB PORTAL. THE SUBJECT WHICH IS NOT IN THE CURRICULUM SHALL BE SELECTED AND FINALIZED WITH THE CONSENT OF THE RESPECTIVE HOD/COURSE COORDINATOR/FACULTY MEMBER.

Year-II Proposed Scheme for IV Semester M.Tech. (Environmental Engineering)										
Master of Technology (Environmental Engineering)					**Semester: IV**				**Year-II**	
Sl. No	**Subject Code**	**Subject**	**Contact Hrs**				**Evaluation Scheme**			**Credits**
			L	T	SS	P	CIE	SEE	Total	
1	19PEV41	Project Phase-II Internal Assessment	---	---	--	---	50+50	125*+75**	300	20
Total			00	00	00	00	100	200	300	20
Grand Total (I to IV Semester)									1950	88

Note: **L**-Lecture, **T**-Tutorial, **P**-Practical, SS-self study component, **CIE** -Continuous Internal Evaluation, **SEE**- Semester End Examination

EXPERT COMMITTEE: CONSISTS OF MINIMUM OF 3 AND MAXIMUM OF 5 FACULTY MEMEBERS IN THE RELEVANT FIELD.

CIE DURING FOURTH SEMESTER STUDENT,HAS TO PRESENT TWO SEMINARS (ONE AT THE MID SEM, ANOTHER AT THE END OF SEM) ON **PROJECT PHASE-II** BEFORE THE EXPERT COMMITTEE FOR EVALUATION OF CIE MARKS.

* **SEE**: EVALUATION OF PROJECT THESIS BY INTERNAL AND EXTERNAL EXAMINERS. CANDIDATE HAS TO APPEAR VIVA-VOCE EXAMINATION IN THE PRESENCE OF INTERNAL AND EXTERNAL EXAMINER

** **SEE**:CANDIDATE HAS TO APPEAR VIVA- VOCE EXAMINATION IN THE PRESENCE OF INTERNAL AND EXTERNAL EXAMINER ALONG WITH HOD, FACULTY AND STUDENTS.

Proposed Syllabus for I Semester M.Tech.

(Environmental Engineering)

APPLIED ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

Subject Code: 19PEV11	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory) +SS – 01Hr		Total Hours: 52

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

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

Module - I

Introduction to Environmental Chemistry, concept and scope of environmental chemistry: environmental segments-Atmosphere, hydrosphere, lithosphere and biosphere. Oxidation and Reduction reactions, and potentials, oxidation-reduction of water bodies,. **5Hrs**

Electro chemistry, conductivity, Electronic pH measurement, Calomel, Glass and other electrodes, Basic concepts from Equilibrium Chemistry, Acids and Bases, Buffers index. **5Hrs**

Module – II

Determination of Iron, Manganese and Lead, Mineral analysis of water, BOD, COD, DO and TOC determinations, interferences and modifications, Chemistry of aqueous chlorine. **5Hrs**
General Considerations, Chemistry of Fluoride and Fluoride Compounds, Determination methods. **2Hrs**

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

Module – III

Basic concepts from Biochemistry Introduction, enzymes, cofactors, temperature relationships, effect of pH, major and trace elements, Biochemistry of carbohydrates, proteins, fats and oils, general Biochemical pathways, energetic and bacterial growth, Biochemistry of man (carbohydrates, fats, proteins and vitamins) **5Hrs**

Colorimetric, Beer's and Lambert's Law, Photoelectric colorimeters, spectrophotometers, Nephelometry, Absorption methods, ultra violet spectrophotometry, infrared spectrophotometry, flame photometry, Atomic Absorption spectrophotometry, Emission spectrophotometry, Fluorimetry, Gas chromatography and mass spectrometry, X-ray analysis. **5Hrs**

Module - IV

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

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

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

Module - V

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

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

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

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

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

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

References:

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

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

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

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

WATER TREATMENT TECHNOLOGY

Subject Code: 19PEV12	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory) + 02 Hrs Tutorial		Total Hours: 52

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

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

Module - I

Wholesomeness of water, hygiene, aesthetic, and economic requirements(water demand), physical, chemical and bacteriological standards for raw and treated water, limnology, thermal stratification, lake over turns. Objectives of various water uses. **2Hrs**

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

Principles of aeration, solubility of gases, Henry's Law, Vapor pressure, gas transfer coefficient, Methods of aeration. **2Hrs**

Module – II

Principles of sedimentation, General equation for settling or rising of discrete particles. Hindered settling, Effect of temperature, viscosity, efficiency of an ideal settling basin. Reduction in efficiency by currents and other factors. Short circuiting, design of inlets and outlets, sludge and sedimentation zones. Tube settlers. Design of settling tank. **7Hrs**

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

Module - III

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

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

Module -IV

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

Minor methods of disinfection Principles of disinfection, Theory of disinfection, disinfection with Halogens (Chlorine, Iodine, Bromine), Chicks Law, Factors affecting disinfection-concentration, time, temperature, Effects of pH, different methods of disinfections. Free and combined available chlorine, residual chlorine, Breakpoint chlorination, Superchlorination, Chlorine dioxide**,** distruction of virus, dosage control, safety measures,emergency chlorination, disinfection of new mains, **4Hrs**

Effects of Fluoride, Fluoridation and defluoridation, Methods of defluoridation. **2Hrs**

Theory of corrosion, Principle of galvanic, electrolytic, stress and biochemical corrosions, Factors influencing corrosion such as oxygen concentration, over voltage, pH, temperature. Corrosion inhibition- use of non metallic pipes, lining, coatings, protective films, cathodic protection **3Hrs**

Module - V

Special problems of industrial water supply like sugar, paper and pulp, Textile, Breweries, Petrochemical industries, etc. **2Hrs**

Trace organic contaminants in water supplies and their removal. **2Hrs**

Distribution system, Water quality in distribution system. Design of distribution system, Hardy cross method, Newton raphson method, Computer method.

Operation and maintenance of distribution system. Operation and maintenance of treatment systems.Scale-up Aspects **3Hrs**

,Rural Water Supply Systems. Borwell Water supply system(BWSS), Municipal Water supply system(MWSS) and Piped water supply system(PWSS) **3Hrs**

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

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

References:

AWWA,Water quality and treatment; a handbook of public water supplies
American Water Works Association - 1971.

Fair, G.M. Geyer J.C. and Okum – 'Water and Wastewater Engineering', Vol. II- John Wiley, 1969.

Weber, Walter J., Physicochemical processes for water quality control., New York; Wiley Interscience; 1972.

Water and Wastewater Technology, Mark J Hammer, Prentice Hall of India; 6th edition, June 15, 2007.

Basic Water Treatment, C. Binnie, M. Kimber, G. Smethurst, Royal Society of Chemistry; 3rd edition, March 15, 2002.

Water Supply, A. C. Twort, F. M. Law, F. W. Crowley, D. D. Ratnayaka, Wiley, 1994.
Environmental Engineering, Howard S. Peavy (Author), Donald R. Rowe (Author), George Tchobanoglous, McGraw Hill Education; First edition, 1 July 2017.
New Concepts in Water Purificattion (Von Nostrand Reinhold environmental engineering series), Culp, Gordon L., Culp, Russell L, Van Nostrand Reinhold Company, 1974.
Manual on Water Supply and Treatment by Ministry of Works and Housing.
Water Supply Engineering, S.K. Garg, Khanna Publishers, New Delhi 110002, 2016.

List of Journals:

- Journal of Water Research
- Journal of Indian Water Works Association
- Water Quality International
- ASCE Journal of Environmental Engineering
- Indian Journal of Environmental Health.
- Journal of Institution of Engineers (India), Environmental Division.

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

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

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

WASTEWATER TREATMENT ENGINEERING

Subject Code: 19PEV13	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory) + 2 Hrs (Tutorial)		Total Hours: 52

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

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

Fundamentals of wastewater engineering, treatment, & determination of kinetic coefficients.

Fundamentals of process analysis, mass balance analysis and hydraulic characteristics.

Design of Sewer Systems, Physical, Chemical Treatment.

Biological Treatment , Aerobic , Anaerobic Biological Treatments and Design Aspects.

Nitrification process, process analysis, and its applications, Nitrogen and Phosphorous Cycles, Waste Treatability studies and Design problems.

Module - I

Objectives of wastewater treatment. Composition, Properties and analysis of wastewater.

6Hrs

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

8Hrs

Module - II

Fundamentals of process analysis, reaction kinetics, mass balance analysis, reactors and their hydraulic characteristics, reaction kinetics and reactor selection. Batch, plug flow, completely stirred tank reactor and packed and fluidized bed reactor. **8Hrs**

Module – III

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

8Hrs

Module - IV

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

Module - V

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

6Hrs

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

Nitrogen sulfur and phosphorous cycles.

Waste treatability studies – Bench scale and pilot scale, Effluent standards for discharge to water bodies and land applications – state and central norms & standards. **6Hrs**

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

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

Reference:

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

List of Journals:

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

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

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

3) Extent of teaching: Clearly mentioned in the syllabus

RESEARCH METHODOLOGY

Subject Code: 19PEV14	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory)		Total Hours: 52

Module 1

Meaning, Objectives and Characteristics of research - Research methods Vs Methodology - Types of research - Descriptive Vs. Analytical, Applied Vs. Fundamental, Quantitative Vs. Qualitative, Conceptual Vs. Empirical - Research process - Criteria of good research - Developing a research plan.

10hrs

Module 2

Defining the research problem - Selecting the problem - Necessity of defining the problem - Techniques involved in defining the problem - Importance of literature review in defining a problem - Survey of literature - Primary and secondary sources - Reviews, treatise, monographspatents - web as a source - searching the web - Identifying gap areas from literature review - Development of working hypothesis.

10hrs

Module 3

Research design and methods – Research design – Basic Principles- Need of research design — Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models - Developing a research plan - Exploration, Description, Diagnosis, and Experimentation - Determining experimental and sample designs**.**

12hrs

Module 4:

Sampling design - Steps in sampling design - Characteristics of a good sample design - Types of sample designs - Measurement and scaling techniques - Methods of data collection - Collection of primary data - Data collection instruments **10hrs**

Module 5

Testing of hypotheses - Basic concepts - Procedure for hypotheses testing flow diagram for hypotheses testing - Data analysis with Statistical Packages – Correlation and Regression - Important parametric test - Chi-square test - Analysis of variance and Covariance **10hrs**

REFERENCES:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Anderson, T. W., An Introduction to Multivariate Statistical Analysis, Wiley Eastern Pvt., Ltd., New Delhi
4. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
5. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
6. Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
7. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
8. Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
9. Intellectual Property Rights in the Global Economy: Keith Eugene Maskus, Institute for International Economics, Washington, DC, 2000
10. Subbarau NR-Handbook on Intellectual Property Law and Practice-S Viswanathan Printers and Publishing Private Limited.1998

ELECTIVE-I: SOLID WASTE MANAGEMENT

Subject Code: 19PEV151	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory)		Total Hours: 52

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

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

Module - I

Definition and Scope, necessity and importance of solid waste, Sources, Types, Classification, and composition of MSW, Data Collection, collection and Reduction at source.

6Hrs

Collection equipments, systems of collection, garbage, chutes, transfer stations, bailing and compacting, route optimization.
Disposal methods- selection of site, open dumping, ocean disposal, feeding to hogs – merits and demerits.

6Hrs

Module - II

Treatment Methods: Various methods of refuse processing, fertilizer, fuel and food values.

6Hrs

Sanitary Land Filling: Definition, methodology, trench, area, ramp, pit method, site selection, basic steps involved, cell design, prevention of site pollution, leachate treatment, gas collection and recirculation. Control of land fill gases, design problems **6Hrs**

Module - III

Composting: Aerobic and anaerobic composting, factors affecting composting, Indore and Bangalore processes of composting. And Design Problems **6Hrs**

Module - IV

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

6Hrs

Module - V

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

Recycle and Reuse: Material and energy recovery operation, reuse in other industries. Recovery of biological conversion products, recovery of thermal conversion products **8Hrs**

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

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

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

Reference:

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

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

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

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

ELECTIVE –II: WATER RESOURCES ENGINEERING AND APPLIED HYDRAULICS

Subject Code: 19PEV161	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory)		Total Hours: 52

Pre-requisites- 1. Hydrology and Water Resource Engineering

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

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

Module - I

Water resources of the world**.** Surface and ground water resources of India and Karnataka National Water Policy Act. Multiple uses of water resources. **5Hrs**

Hydrology Introduction, Hydrologic Cycle including quantity and quality, estimation of precipitation and rain gauge density. **6Hrs**

Module - II

Hydrograph theory – Unit hydrograph, assumptions, derivation of unit hydrographs,
S-hydrograph and synthetic hydrograph, flow routing – Muskingam method, Low flow analysis. **6Hrs**

Urban Hydrology – Run-off estimation, design of storm water drains.
Basics and applications of Remote Sensing in Water Resources. **6Hrs**

Module - III

Distribution Network – Hardy Cross Method and Newton Raphson method, Raising Main Design. **6Hrs**
Unsteady flow through conduits: Water hammer analysis – Analytical and graphical methods, Water hammer protection methods. **6Hrs**

Module - IV

Flow measurements: Stream gauging, weir method, end-depth method, chemical method, tracer method, ultrasonic method, flumes, etc. **6Hrs**

Module - V

Groundwater Basic equations of flow. Flow into wells in unconfined and confined aquifers for steady and unsteady conditions, Sea water intrusion. Artificial recharge, groundwater pollution. **6Hrs**
Bore wells – Types and design principles. **5Hrs**

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

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

References:

1. Ven T. Chow – Handbook of Applied Hydrology.
2. Todd – Ground water hydrology

3. Ranganath H.M. – Advanced hydrology
4. Subramanya K.S. – Advanced hydrology
5. Ven T. Chow – Open Channel Hydraulics
6. Hammer M.J. and Mackichan K.A. – Hydrology and Quality of Water Resources.
7. Sabins – Remote Sensing.
8. Thomann and Muller – Principles of Water Quality Modeling, Estuary Section 3.1.
9. Ram S.Gupta – Hydrology and Hydraulic System, S.
10. John Permankian, Water Hammer Analysis.

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

ENVIRONMENTAL ENGINEERING LAB-I

Subject Code: 19PEV17	Credits = 02	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Practical)		Total Hours: 52

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

Following Experiments to be done on both water & wastewater samples:
1. Chloride Test
2. Hardness Test.
3. Alkalinity Test.
4. Solids Test.
5. pH Test.
6. Dissolved Oxygen Demand.
7. Bio Chemical Oxygen Demand.
8. Sulphate test
9. Study of microscope.
10. Sterilisation Technique.
11. Total count.
12. M.P.N.Test.
13. Effect of temperature, pH, antibiotics on microbes.
14. Isolation of Bacteria

Note: - 1. A laboratory report has to be submitted at the end of the semester and Lab exam is Teacher optional.
2. A standard methods for examination of water & wastewater 20^{th} edition has to be followed for test procedures.

Proposed syllabus for II Semester M.Tech.

(Environmental Engineering)

AIR POLLUTION AND CONTROL

Subject Code: 19PEV21	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory)		Total Hours: 52

Pre-requisites- 1. Air Pollution

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

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

Module - I

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

Meteorology – Composition and structure of the atmosphere, Meteorological factors influencing air pollution, wind circulation, solar radiation, adiabatic lapse rate, ELR, Atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), Temperature inversions, Measurements of meteorological variables, wind rose diagram, General characteristics of stack effluent, plume behavior, Stack effluent dispersion theories, dispersion equations, **5Hrs**

Module -II

dispersion models, fixed box model, Gaussian dispersion model, stack design, maximum ground level pollutants concentration, Concentrations along plume line, Calculation of effective stack height, down wind pollutant concentrations under temperature inversion. Heat island effect, Effect of terrain on plume behaviors. **5Hrs**

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

Module -III

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

Laboratory analytical methods used for analysis of atmospheric samples (chemical, instrumental and biological methods)
Photochemical air pollution: Theory of formation of PAN, factors effecting, measurement and effects of photochemical smog **4Hrs**

6Hrs

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

Module - IV

Particulate Pollution Control Equipment – Design considerations of setting chambers, Cyclone separators, Wet collectors, Fabric filters and Electrostatic precipitators. **6Hrs**
General Control of gases and vapours**:** Combustion, Adsorption and Absorption (and their kinetics), closed collection and recovery systems, masking and counter action, Basic design of packed bed absorption water. **4Hrs**

Module - V

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

3Hrs

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

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

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

References:

Perkins – Air Pollution.
Stern – Air Pollution Vol. I, II, III
Kenneth Work and Cecil F Warner – Air Pollution ,its origin and control, Harper and Row, Publishers, New York. 1982
Environmental Engineer's Handbook, 2, Chilton Book Co., Radnor, PA (1974),U.S.A
PL **Magill**, FR **Holden**, AC **Ackley**(Eds.), **Air Pollution** Handbook McGraw-Hill, New York (1956).
Sterm A.C. (ed.) Vol. V – Air Quality Management.
RC Flagan, JH Seinfeld , Fundamentals of air pollution engineering,2012

List of Journals:

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

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

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

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

INDUSTRIAL WASTEWATER TREATMENT

Subject Code: 19PEV22	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory) +SS-01hr		Total Hours: 52

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

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

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

Module - I

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

- Joint treatment of raw industrial waste with domestic sewage.
- Joint treatment of partially treated industrial waste and domestic wastes.
- Ill effects of discharge of raw waste on soil, environmental auditing. .**8Hrs**

Module - II

Industrial Waste Survey – Process flow charts, condition of waste stream. Material balance, Sampling – Grab, Composite and integrated samples. Continuous monitoring – pH, conductivity, biomonitoring, computation of organic waste loads on streams,steeter-Phelps formulations,Thimas method for determing pollutiom-loads on capacity of streams, Churchill method of multiple linear correlations. **8Hrs**

Module - III

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

8Hrs

Module - IV

Wastewater Treatment in Specific Industries**:** Distillery, Dairy, Sugar, Cannery, Pulp and Paper, Cement, Textile, Dairy, Fertilizer, oil refinery, Pesticides, Pharmaceutical, tannery. Radio Active Wastes Treatment – Low Activity and high activity wastewaters Ultimate disposal of Industrial Wastewater Sugar, Refinery and Diary Industries. **12Hrs**

Module - V

Effects of Waste additions on physical and chemical properties of soil, Bio-Remediation ,Design of Complete treatment system disposal for industries: Distillery, Diary, Sugar, Refinery, Textile, Paper and Pulp mill to meet P.C.B. norms. **8Hrs**

Environmental auditing- introduction, Cost of pollution, Environmental audit solutions, Financial and Managerial opportunities. Criminal and Regulatory liabilities, site selection-Evaluation of cost of product basis, Tangible and Intangible factors,Importance of long term planning,Waste disposal and water supply as a critical factor,. **8Hrs**

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

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

References:

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

List of Journals:

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

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

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

ELECTIVE III:ECOLOGY AND ENVIRONMENTAL IMPACT ASSESSMENT

Subject Code: 19PEV231	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory)		Total Hours: 52

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

Classification, structure and function of Ecosystem, Division of Ecology.

Energy flow in Ecosystems, Population, Community and Habitat

Types of Ecosystems, Diversity Indices ,Ecosystem Modeling and Problems

Developmental Activity and Ecological Factors, EIA Framework.

project activity ,Environmental parameters and EIA for water resource development projects

Module - I

Classification of Ecosystem, Terminology, Concepts of Ecology, Sub-divisions in Ecology. Biotic and Abiotic components, Structure and functions of ecosystems. **4Hrs**

Module - II

Energy flow in Ecosystems. Measurement of Primary productivity. Ecological Niche and Succession. Population Ecology, Community Ecology, Habitat Ecology. Biogeochemical cycles, Ecological pyramids. **4Hrs**

Module - III

Aquatic and Terrestrial Ecosystems, Dominance and Diversity Indices(problems) Adaptations, Biogeography, Systems Ecology and Ecosystem Modeling. **6Hrs**

Oligotrophy, Eutrophic status, Nutrient Enrichment – Analysis of Eutrophication – Vollenweider and Dillon Models of Phosphorous loading on lakes. Control of Eutrophication. **8Hrs**

Module - IV

Developmental Activity and Ecological Factors. EIA, EIS, FONSI, Need for EIA Studies, Baseline information, Step-by-step procedure for conducting EIA, Limitations of EIA. **6Hrs**

Framework of Impact Assessment, Developmental projects in environmental setting. Objectives and scope of EIA. Contents of EIA, Methodologies, Techniques of EIA. Assessment and Prediction of impacts on Attributes: air, water, noise, land, ecology soil, cultural and socio-economic environment, EIA guidelines for development projects, REIA-CEIA. **8Hrs**

Module - V

Public participation in environmental decision making. Practical considerations in preparing Environmental Impact Assessment and Statements. **6Hrs**

Salient features of the project activity – Environmental parameters – Activity relationships – matrices. **6Hrs**

EIA for water resource development projects, Nuclear power plant project, mining project (coal, aluminum, iron ore, bauxite), Thermal Power Plant (coal based) project, pharmaceutical industries, etc. **6Hrs**

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

1. Classify and explain the structure and function of Ecosystem, list the Division of

Ecology.(C1)

2. Evaluate the Energy flow in Ecosystems, Population, Community and Habitat(C2)
3. List the Types of Ecosystems, explain Diversity Indices ,study of Ecosystem Modeling and related Problems(C3)
4. understand the Developmental Activity and Ecological Factors, EIA Framework.(C4))
5. summerise project activity ,Environmental parameters and EIA for water resource development projects(C5)

References:

1. Odum – Fundamentals of Ecology – Addition Co.
2. Kormondy – Concepts of Ecology – Prentice Hall Publicaton.
3. Anantakrishnaan T.N. – Bio-resources Ecology – Oxford and IBM.
4. Krebs J – Ecology – The experimental analysis of distribution and abundance-II Edition Harper International.
5. **Mommy REEd** Environmental Impact Assessment John wiley.
6. Canter L – Environmental Impact Assessment McGraw Hill, 1977.
7. Clark B.C., Bisett and Tomlinsan P – Perspective on environmental impact assessment – Allied Publishers – 1985.
8. Mall C.A.S. and Day J.W. – Ecosystem Modeling in Theory and Practice: An Introduction with Case NI Stories – John Wiley.
9. Heer and Hagerty, Environmental Impact Assessment and Statements. Van Nostrand and Reinhold Co. 1977.
10. Jain et al – Environmental Impact Assessment, Van Nostrand.

List of Journals:

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

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

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

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

ELECTIVE-IV : ENVIRONMENTAL SANITATION SYSTMES

Subject Code: 19PEV 241	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory)		Total Hours: 52

Pre-requisites: Applied Environmental Chemistry and Microbiology

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

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

Module - I

COMMUNICABLE DISEASES: -

Definitions, Microorganisms, disease communicated, General methods of communicable disease control, control of epidemics. **6Hrs**

Module - II

FOOD SANITAION:-

Food born disease, food and drug laws, food and bacteria, legal control of food safety, dried foods, frozen foods. Sanitation of eating and drinking establishment. **10Hrs**

MILK SANITATION: -

Essentials of Milk Sanitation, Milk and Bacteria, Milk borne diseases, sanitation, pasteurization, bacteriological standards. **10Hrs**

Module - III

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

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

8Hrs

Module - IV

RURAL SANITATION:

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

Cleaning and Disinfection, Emergency Water Supply and Treatment **8Hrs**

INDUSTRIAL HYGIENE:

Occupational hazards sources, effects and control measures, sanitation programmes. **8Hrs**

Module - V

INSTITUTIONAL SANITATION:

Schools, Hospitals-Location planning- Lighting and ventilation, disposal of wastes. **8Hrs**

Radioactive wastes – Sources – effects – disposal methods. **6Hrs**

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

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

REFERENCES:

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

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

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

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

ELECTIVE-V : HYDRAULICS OF WATER AND WASTEWATER SYSTMES

Subject Code: 19PEV251	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory)+Tutorial-02hrs		Total Hours: 52

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

1. Fundamentals of water supply, population forecasting, design periods, pipe materials, storage reservoirs, design aspects.
2. Pipe networks, evaluation of distribution system, economic analysis of pipelines, and networks,
3. leak detection methods and water quality in distribution system.
4. Wastewater collection system, flow condition, pipe ,material and roughness co-efficient and design aspects.
5. Sewer appurtenances, pumping station, sewer networks, economic analysis of pipeline and networks.

Module - I

Water Supply System – Introduction – types of systems, population forecasting methods, water demand, pressure, design period, pipe materials and roughness coefficient.

4Hrs

Storage Reservoirs – Need, different types, capacity determination and evaluation of pumping systems.

6Hrs

Module -II

Pipe Networks – Peak Factors for intermittent and continuous distribution system. Branch and Grid Iron systems. Nodal demand, Design Layouts of distribution systems,

Evaluation of distribution system – Computer Analysis of Pipe Networks for different options, Economic Analysis of Pipelines and Networks.

10Hrs

Module - III

Leak Detection – Prediction, Prevention and Control.

6Hrs

Water Quality in Distribution System – factors affecting water quality predictive tools and intermediate disinfections.

6Hrs

Module - IV

Wastewater Collection System – Separate and combined sewer Systems, relevant equations for flow condition, pipe materials and roughness coefficient, design guidelines and examples. Sewer Appurtenances.

8Hrs

Module - V

Sewer Network – Estimation of Nodal Flows,, Pumping Stations, Evaluation of Different Network Options.

6Hrs

Storm Sewers – flooding and water quality problems, run-off calculations, storm water inlets, open drains and sewer pipes and design for different layouts.

6Hrs

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

1. understand the Fundamentals of water supply, population forecasting, design periods, pipe materials, storage reservoirs, design aspects.(C1)
2. Analyse the Pipe networks, evaluate distribution systems, economic analysis of pipelines, and networks,(C2)
3. analyse leak detection methods and water quality in distribution system.(C3)
4. Evaluate Wastewater collection system, flow condition, pipe material and roughness co-efficient ,design aspects. (C4)
5. analyse Sewer appurtenances, pumping station, sewer networks, economic analysis of pipeline and networks.(C5)

REFERENCES:

1. Sincero A P., and Sincero G A., "Environmental Engineering – A Design Approach", Prentice Hall of India Pvt, Ltd, New Delhi. (1999)
2. Hammer M J Jr. M J."Water and Wastewater Technology", Prentice Hall of India Pvt. Ltd., New Delhi. (2008)
3. Walski T M, "Analysis of Water Distribution Systems", CBS Publications, New Delhi. (1987),
4. CPHEEO Manual on Water Supply and Treatment, (1991), GOI Publications.
5. CPHEEO Manual on Sewerage and Sewage Treatment, (19950, GOI Publications.

OPEN ELECTIVE-VI : HAZARDOUS WASTE MANAGEMENT

Subject Code: 19PEV261	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory)		Total Hours: 52

Pre-requisites- 1. Solid Waste Management, 2. Municipal and Industrial Wastewater treatment.

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

Sources, classification, characteristics and assessment of hazardous sites.

Minimization and resource recovery, treatment methods.

Physical Chemical and Biological Treatment

Transportation, storage, treatment and disposal techniques.

Land fill operations and site remediation.

Module - I

Definition, Sources and Classification, Landmark episodes, RCRA Regulations for Hazardous Waste Management, Superfund. Hazardous Waste Characterization and Site Assessment: Ignitability, Corrosivity, Reactivity, Toxicity, EPA-designated hazardous wastes, Assessment of hazardous sites, Hazardous waste generator requirements. **12Hrs**

Module - II

Minimization and Resource Recovery**:** Approaches to waste reduction, Benefits of hazardous waste reduction, properties of hazardous waste management. Development of tracking system, Selection of the Waste Minimization Process – Case study on byproduct recovery from incineration,. **8Hrs**

Module - III

Physical Chemical and Biological Treatment: Stabization and solidification .Description of unit operation and process. Case study oil field waste treatment with mobile system. **6Hrs**

Thermal Process**:** Advantages and disadvantages of incineration, chemistry of incineration, thermodynamics of incineration, design of an incineration system. Incineration standards. Types of incinerators – liquid injection, rotary kiln and fluid bed, multiple-hearth furnaces, fluidized and catalytic incinerators. **8Hrs**

Module - IV

Hazardous Waste: Transportation Regulations (State and local),Transportation requirements(Shipping papers, the uniform hazardous waste manifest, Hazard communications) containers for hazardous materials, bulk and non-bulk transport, hazardous substances emergency response Hazardous waste transport industry, Treatement,Storage and disposal facility requirements. **6Hrs**

Module - V

Introduction, Land-fill operations, Site selection, Liner and lea chart collection systems, Cover systems, Materials, contaminant transport through landfill barriers, landfill stability, surface impoundments and Deep well injections, closure and post closure care,. **6Hrs**

Site Remediation: Risk, Hazard identification, exposure assessments, Toxicity assessment, Risk characterization and communication, Ecological risk assessment, Monte Carlo method, case study,Site and subsurface characterization,Remidial technologies. **6Hrs**

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

1. understand the Sources, classification, characteristics and assessment of hazardous sites.(C1)
2. Evaluate theMinimization and resource recovery, treatment methods.(C2)
3. Evaluate Physical Chemical and Biological Treatment.(C3)
4. understand Transportation, storage, treatment and disposal techniques.(C4)
5. AnalyseLand fill operations and site remediation.(C5)

References:

1. Wentz C.A., "Hazardous Waste Management", McGraw Hill, 1989.
2. LaGrega M.D., Mercer, "Hazardous Waste Management", 2nd Edition, McGraw Hill 2001.
3. Davis, Cornwell, "Introduction to Environmental Engineering", 3rd Edition, McGraw Hill, 1998.

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

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

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

ENVIRONMENTAL ENGINEERING LAB-II

Subject Code: 19PEV27	Credits = 02	
CIE: 50 Marks	SEE: 50 Marks	SEE: 3 Hrs
Hours / Week: 4 Hrs (Practical)		Total Hours: 52

Pre-requisites- 1. UG Environmental Lab.

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

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

Determination of Sulphate,Phosphate, Jar Test (optimum pH and dosages), Total Nitrogen, Amonical nitrogen, Nitrite, Nitrate, Kjaldhal Nitrogen, Heavy Metals(As,Cr,Cu,Pb,Hg etc), and Mineral analysis (Sodium, Potassium, Magnesium, calcium,, and Fluoride) .Uniformity coefficient, Effective size ,silt content, Organic content, Acid solubility test of filter sand.

Demonstration on GC, HPLC, AAS.

Determination of Ambient air quality.

Experiment on Auto Exhaust analyzer.

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

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

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

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

Proposed Scheme for III Semester M.Tech.

(Environmental Engineering)

INDUSTRIAL INTERNSHIP

Subject Code: 19PEV31	Credits = 06
CIE: 50 Marks	SEE: -50

INDUSTRIAL INTERNSHIP: STUDENT HAS TO VISIT AT LEAST ONE INDUSTRY FOR STIPULATIED PERIOD OF FOUR TO SIX MONTHS AND SUBMIT A REPORT OF THEIR EXPOSURE IN RESPECTIVE FIELD & PRESENT TWO SEMINARS (MID AND END) BEFORE **THE EXPERT COMMITTEE** FOR EVALUATION OF **CIE** MARKS **. SEE** WILL BE EVALUATED BY EXTERNAL & INTERNAL EXAMINARS.

PROJECT PHASE-I

Subject Code: 19PEV32	Credits = 07
CIE: 50 Marks	SEE: -50

PROJECT PHASE-I: PROJECT WORK WILL BE FOR A PERIOD OF 8 MONTHS OUT OF WHICH 3 MONTHS WILL BE DURING THIRD SEMESTER (PHASE-I). DURING THIS SEMESTER STUDENT HAS TO CARRY OUT LITERATURE SURVEY AND FINALISE THE OBJECTIVES OF THE PROJECT WORK .**CIE** WILL BE EVALUATED BY CONCERNED GUIDE ALONG WITH THE EXPERT COMMITTEE ON THE BASIS OF THE LITERATURE COLLECTION (15-20 JOURNAL PAPERS) & TWO SEMINARS (MID & END) DELIVERED BY THE CANDIDATE**.**
SEE WILL BE EVALUATED BY EXTERNAL & INTERNAL EXAMINARS.

CERTIFICATE COURSE-19PEV33

Subject Code: 19PEV33	Credits = 02

MANDATORY: THE SAID NPTEL/MOOCS/SWAYAM COURSES OF TWO CREDIT IS COMPULSORY AND EVERY STUDENT MUST COMPLETE THIS PROFESSIONAL CERTIFICATION COURSE, ANYWHERE FROM 1ST TO 3rd SEM AND SUBMIT THE COPY OF THE CERTIFICATE OF THE COURSE COMPLETION TO COE FOR REFLECTION OF THE SAME IN THE GRADE CARD THROUGH PROPER CHANNEL. THIS COMPLETION OF CERTIFICATION COURSE IS MADE REFLECTED ONLY IN 3rd SEM GRADE CARD.
THE ABOVE SAID NPTEL/MOOCS/SWAYAM CERTIFICATION COURSE IS TO BE SELECTED FROM THE WEB PORTAL. THE SUBJECT WHICH IS NOT IN THE CURRICULUM SHALL BE SELECTED AND FINALIZED WITH THE CONSENT OF THE RESPECTIVE HODS/COURSE COORDINATOR

SEMINAR

Subject Code: 19PEV34	Credits = 01	
CIE: 50 Marks	SEE: -	SEE: -
Hours / Week: -		Total Hours: -

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

1. They have to collect 15 to 20 journal papers on the latest Environmental Research topics.
2. They have to prepare the seminar report and deliver the seminar in front of expert committee.

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

1. Understand how to prepare the seminar report.(C1)
2. Understand how to deliver the seminar.(C2)
3. Get stage courage. (C3)

SEMINAR:CANDIDATE HAS TO COLLECT 20 JOURNAL PAPERS ON THE SELECTED TOPIC AND PREPARE A REPORT .

CIE: WILL BE EVALUATED BY CONCERNED GUIDE ALONG WITH THE EXPERT COMMITTEE ON THE BASIS OF POWER POINT PRESENTATION DELIVERED BY THE CANDIDATE ALONG WITH THE EVALUATION OF SEMINAR REPORT.

Proposed Scheme for IV Semester M.Tech.

(Environmental Engineering)

Project Phase-II Internal Assessment

Subject Code: 19PEV41	Credits = 20
CIE: 50+50 Marks	SEE: 125*+75**

CIE DURING FOURTH SEMESTER STUDENT,HAS TO PRESENT TWO SEMINARS (ONE AT THE MID SEM, ANOTHER AT THE END OF SEM) ON **PROJECT PHASE-II** BEFORE THE EXPERT COMMITTEE FOR EVALUATION OF

***SEE**: EVALUATION OF PROJECT THESIS BY INTERNAL AND EXTERNAL EXAMINERS.

****SEE:** CANDIDATE HAS TO APPEAR VIVA- VOCE EXAMINATION IN THE PRESENCE OF INTERNAL AND EXTERNAL

EXAMINER