Proposed Syllabus for I Semester M.Tech.

(Environmental Engineering)

APPLIED ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

Subject Code: 17PEV11	Credits = 05	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory) +SS – 01Hr		Total Hours: 52

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

1. Fundamentals of chemistry and microbiology.
2. Various components of atmosphere, electro chemistry, heavy metals and minerals, chemistry of fluoride, organic compounds and biochemistry.
3. Qualitative assessment of water and wastewater generated.
4. Solve BOD, pH, Electrochemistry problems using mass balance and equilibrium theory.
5. Various types of microscopes, bacteria, fungi, algae, 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 should be able to

1. Understand the environmental chemistry, atmosphere the knowledge of electrochemistry.(C1)
2. Understand knowledge of water and wastewater analysis, study of minerals like iron manganese, lead and fluoride, classification of organic compounds.(C2)
3. Understand the biochemistry of organic materials, Determination of pollutants concentration by colorimetric and instrumental methods. (C3)
4. Understand the general knowledge of the microbiology, types of microscopes and algae Fungi, Bacteria, and virus.(C4)

References:

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

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: 17PEV12	Credits = 05	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory) + 02 Hrs Tutorial		Total Hours: 52

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, coagulation and tube settlers.
3. Theory and design aspects of filtration, disinfection and water softening.
4. Theory of adsorption, corrosion, fluoridation, industrial water quality, O&M, water supply components and design aspects.

Module - I

Wholesomeness of water, hygiene, aesthetic, and economic requirements, 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, Manning equation, network study, Hardy Cross, Newton – Raphson methods, computer method. **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 color. Equilabria and isotherms, kinetic factors affecting and mode of operation. **2Hrs**

4Hrs

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 defluorosis. **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, 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 quality of water for municipal use.(C1)
2. Understand the types of processes used to treat water for municipal purpose.(C2)
3. Understand the fundamental engineering and science principles that are used to design and operate the processes used in treatment systems. (C3)

References:

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

3. Fair, G.M. Geyer J.C. and Okum – 'Water and Wastewater Engineering', Vol. II- John Wiley, 1969.
4. Weber, Walter J., Physicochemical processes for water quality control., New York; Wiley Interscience; 1972.

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.

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

WASTEWATER TREATMENT ENGINEERING

Subject Code: 17PEV13	Credits = 05	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory) + 2 Hrs (Tutorial)		Total Hours: 52

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

1. Fundamentals of wastewater engineering, treatment, & determination of kinetic coefficients.
2. Fundamentals of process analysis, mass balance analysis and hydraulic characteristics.
3. Design of Sewer Systems, Physical, Chemical & Biological Treatment.
4. 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.(C1)
2. Understand the process analysis, mass balance analysis and hydraulic characteristics.(C2).
3. Understand the design of Sewer Systems, Physical, Chemical & Biological Treatment, Nitrification process, process analysis, and its applications, Nitrogen and Phosphorous Cycles and Waste Treatability studies. (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).

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

ELECTIVE-I ENVIRONMENTAL DISASTER MANAGEMENT AND RISK ASSESSMENT

Subject Code:17PEV141	**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.

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

Module - I

Natural disasters – Floods, landslides, earthquakes, volcanism, avalanche, cyclones, drought and fire. Prediction, perception and adjustment to hazards. **10Hrs**

Module - II

Disaster Management – Environment risk due to project activities. Preparation of on-site and off site disaster management plans. Predisaster actual disaster-post disaster relief camp organization. Role of voluntary organization and armed forces. **10Hrs**

Module - III

Risk analysis and assessment: Basic concept, purpose of risk analysis; analytical techniques; tools of risk assessment-toxicology, epidemiology exposure modeling, and significance of risk, risk characterization, communication and management. **10Hrs**

Module - IV

Evaluation of the likelihood of major accidents in industrial processes, assessing risk to ecosystems and human health from genetically modified organizations, waste water treatment and disposal, epidemiology exposure modeling, assessing risk to human health from chemicals. Psychology of risk, the economic and evaluation of risks. **12Hrs**

Module - V

Risk assessment in developing programs. Experience of world Bank-risk communication framework for sustainable development. **10Hrs**

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

1. Understand the Natural disasters and Disaster Management(C1)
2. Understand Risk analysis and assessment.(C2)
3. Understand Evaluation of the likelihood of major accidents in industrial processes. (C3)

REFERENCES:

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

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

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

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

ELECTIVE-I ECOLOGY AND ENVIRONMENTAL IMPACT ASSESSMENT

Subject Code: 17PEV142	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.

1. Classification, structure and function of Ecosystem, Division of Ecology.
2. Energy flow in Ecosystems, Population, Community and Habitat
3. Types of Ecosystems, Diversity Indices ,Ecosystem Modeling and Problems
4. Developmental Activity and Ecological Factors, EIA Framework.
5. project activity ,Environmental parameters and EIA for water resource development projects

Module - I

Classification of Ecosystem, Terminology, Concepts of Ecology, Sub-divisions in Ecology. 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. Understand Classification, structure and function of Ecosystem, Division of Ecology and related problems.(C1)
2. Understand the Energy flow in Ecosystems.(C2)
3. Understand the types and Modeling of Ecosystem , EIA Studies for water resource development projects (C3)

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.

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

ELECTIVE-I TOXICOLOGY & ENVIRONMENTAL RISK ASSESSMENT

Subject Code: 12PEV143	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.

1. Significance,, Importance, risk assessment of toxicology
2. Epidemiology, public health & risk assessment, Carcinogens
3. Human exposure assessment, characterization of health risks.
4. Hazard identification. risk characterization , communication assessment and characterization

Module - I

Introduction to toxicology: Significance, Applications & Importance. Introduction to risk assessment toxicology- Exposure, toxic effects, dose response relationships. 10Hrs

Module - II

Carcinogens and non –Carcinogens, Toxicology & Epidemiology, public health & risk assessment. 12Hrs

Module - III

Human exposure assessment, characterization of health risks. 10Hrs

Module - IV

Hazard identification exposure and toxicity assessment risk characterization. 10Hrs

Module - V

Risk communication ecological risk assessment – Monte Carlo methods case studies. 10Hrs

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

1. Understand Significance,, Importance, risk assessment of toxicology.(C1)
2. Understand Epidemiology, public health & risk assessment, Carcinogens (C2)
3. Understand Human exposure assessment, characterization of health risks, communication and assessment of Risk, Hazard identification (C3)

REFERENCES:

1. LaGrefa M.D., Buckingham P.L.and Evans J.C.(1994) " hazardous Waste Management'- McGraw hill ,New york
2. David G.M. and Haner N.B., " An Applied Approach to Epidemiology and Toxicology for Engineers" –Instructors Resource Guide, US Department of Health Education And welfare
3. World Health Organization Report., " Recommended Health Based Limits in Occupational Exposure to Heavy Metals".
4. Kamrin S.E., "a Text Book on Primer on toxicology principles & applications" Lewis Publishers.
5. Kalos M.H. and Whitloc P.A ., Monte carlo Methods Vol.1 Basica Wiley Publications.
6. Fan A.M & Chang L.W, (1996) " Toxilogy & Risk Assessment – Principles ., Methods & applications " Informa Health care Pubs.
7. Price F.T., Nancy Lane Briq K.V.(200) " Environeamental Toxicology & risks assessment –Recent advancement in Environmental Fate & transport " ASTM INTERNATIONAL .
8. Landis W.G., Ming-Ho Yu (2004) "Introduction to environmental toxicology- Impacts of Chemicals upon Ecological systems." CRC Press.

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

ELECTIVE-II : ENVIRONMENTAL SANITATION SYSTMES

Subject Code: 17PEV 151	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.

1. Understanding Communicable Diseases.
2. Various components of Food Sanitation, Milk Sanitation, Rural Sanitation, Industrial Hygiene, and 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**

Module - III

MILK SANITATION: -

Essentials of Milk Sanitation, Milk and Bacteria, Milk borne diseases, sanitation, pasteurization, bacteriological standards. **8Hrs**

Module - IV

RURAL SANITATION:

Rural water supplies and different methods of sewage disposal in rural areas. **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 Communicable Diseases.(C2)

2. Understand the Food Sanitation, Milk Sanitation, Rural Sanitation, Industrial Hygiene, and Institutional Sanitation.(C2)

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.

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

ELECTIVE-II : SOLID WASTE MANAGEMENT

Subject Code: 17PEV152	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.

1. Fundamentals of solid waste management, collection transportation, and disposal methods.
2. Treatment methods, sanitary land filling, aerobic and anaerobic composting.
3. Theory and design of incineration, pyrolysis process for specific solid waste.
4. 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 should be able to

1. Understand the estimation of solid waste quantity and its characteristics. (C1)
2. Understand the different methods of treatment and disposal of municipal solid waste and Design aspects .(C2)
3. Understand the reuse and recycle of solid waste, 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.

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

ELELCTIVE-II : REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM IN ENVIRONMENTAL ENGINEERING

Subject Code: 17PEV153	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.

1. Fundamentals of Remote Sensing in Environmental Engineering.
2. Types and Classification of Sensors, scanners and Platforms.
3. Data Acquisition and Interpretation and GIS.
4. Computer Fundamentals of GIS, Hardware and software requirements for GIS

Module - I

Definition, remote Sensing in Environmental Engineering. **4Hrs**

Basics of Remote Sensing Techniques – Radiation Sources, Physics of Remote Sensing – Transmission Paths – Target and Sensors. **4Hrs**

Module - II

Sensors – Types and Classification – Spectral Bands of Sensors. Sensors for UV, IR and visible ranges. **4Hrs**

Multi spectral scanners. **4Hrs**

Platforms – Aircrafts, Satellites **4Hrs**

Module - III

Data Acquisition and Interpretation – Visual and digital Interpretation – Brief Discussion Only. **4Hrs**

Application of remote sensing techniques to management of Water Resources.
Monitoring of Quality of Environment, Land Use Pattern Studies. **4Hrs**

GIS – Concepts and spatial methods – introduction spatial information, temporal information. **4Hrs**

GIS – Functionality – introduction, data acquisition, data processing, storage and retrieval. **4Hrs**

Module - IV

Computer Fundamentals of GIS and data storage character files and binary files, file origination liked list, chains, trees. **4Hrs**

GIS and remote sensing data integration techniques in spatial decision support system, land suitability, New work analysis virtual GIS. **4Hrs**

Module - V

Hardware and software requirements for GIS. **4Hrs**

GIS in solid waste transport, remodeling of distribution systems and ground water vulnerability.

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

1. Understand the Fundamentals of Remote Sensing in Environmental Engineering (C1)
2. Understand the Types and Classification of Sensors, scanners and Platforms.(C2)
3. Understand the Data Acquisition and Interpretation and GIS, Computer Fundamentals of GIS, Hardware and software requirements for GIS. (C3)

Reference:

1. Pater A burraugh Rachal A McDonnas "Principle of GIS" (Oxford)
2. Christopher Jones "GIS and Computer Cartography"
3. Life Sand, "Remote Sensing and Image Interpretation, John Wiley and Sobns.

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 : TRANSPORT PROCESSES AND MODELING OF AQUATIC SYSTEMS

Subject Code: 17PEV 161	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.

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

Module- I

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

10Hrs

Module II

Steady state water quality modeling. Models for decaying pollutants (bacteria, phenol, ammonia) in rivers. 1-D oxygen balance models – Streeter – Phelps equation, critical point method. Data collection – specialized water quality surveys based on statistical average concepts. Estimation of parameters – decay and reareation rates. Calibration and verification of 1-D oxygen model. Error measures. **10Hrs**

Module - III

Mixing zones in rivers – definition, steady state 2-D analysis with pipe and diffuser outfalls using solutions based on method of images for conservative and decaying pollutants field study methodology. Parameter estimation – Lateral Mixing coefficient – critical point method – derivation and examples. **10Hrs**

Module - IV

Dissolved oxygen models for lakes under completely mixed and stratified conditions,

Ocean disposal of wastewater – Silting and design of outfalls. Near field and far field mixing with simple examples. **5Hrs**

Eutrophication models – simplified nutrient loading models for rivers and lakes. **3Hrs**

Module - V

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

7Hrs

Ecosystem model – Description, Schematization and formulation. **2Hrs**

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

1. Understand the dispersion model theory apply to streams.(C1)
2. Understand the lake, river dispersion models and DO model.(C2)
3. Understand the theory and design of ground water and eutrophication models. (C3)

References:

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

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

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

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

ELECTIVE –III : WATER RESOURCES ENGINEERING AND APPLIED HYDRAULICS

Subject Code: 17PEV162	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.

1. Introduction to Water resources of the world, and Hydrology.
2. Understanding Hydrograph Theory and applications of Remote Sensing.
3. Assessment of Distribution Network and Flow measurements.
4. 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 the Water resources and Hydrology.(C1)
2. Understand the Hydrograph Theory and applications of Remote Sensing.(C2)
3. Understand the Distribution Network and Flow measurements, Ground water flow and estimation of 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.

ELECTIVE-III : NON-POINT SOURCES OF POLLUTIONS AND MANAGEMENT

Subject Code: 17PEV163	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.

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

Module - I

Introduction – Non point Pollution, Problem, definitions, magnitude of Nonpoint Pollution, Nonpoint Pollution Control Laws**.** **4Hrs**

Surface Water Problems – Introduction Waste Assimilative Capacity and Stream Standards.**4Hrs**

Module - II

Pollution From the Atmosphere – Atmospheric Inputs. **4Hrs**

Groundwater Pollution – Groundwater (Base Flow) and Nonpoint Pollution Groundwater Movement, Origin of Groundwater Quality Sources of Groundwater Contamination. **12Hrs**

Module - III

Pollution from impervious urban areas – Introduction Deposition and Accumulation of Pollutants on Impervious Surfaces. Removal of Solids from street Surfaces, Porous Pavement. **10Hrs**

Module - IV

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

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

Module - V

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

Planning for Nonpoint Pollution Control – Introduction, Water Quality Planning Process, Selection of Best Management Practices for Non point Source Pollution Control. **4Hrs**

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

1. Understand the Non point pollution problems, magnitude and control Laws, atmospheric pollution and ground water pollution.(C1)
2. Understand the Pollution from impervious urban areas, deposition, accumulation and removal of solids.(C2)
3. Understand the Non point Pollution Simulation Models Land use and non point pollution Effect of Hydrologic Modifications, Management Practices of Nonpoint pollution control. (C3)

REFERENCES:

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

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

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

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

SEMINAR

Subject Code: 17PEV17	Credits = 01	
CIE: 100 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)

Proposed Scheme for II Semester M.Tech.

(Environmental Engineering)

ATMOSPHERIC ENVIRONMENTAL POLLUTION AND CONTROL

Subject Code: 17PEV21	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.

1. Classification of air pollutants, composition of atmosphere, stability condition, flume behavior, stack dispersion equations.
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, 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,

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, and their sources, meteorological parameters, plume behavior and dispersion models.(C1)
2. Effects of pollutants, sampling, analysis and estimation, study of photochemical smog.(C2)
3. Theory and design of control equipments, environmental legislations and noise pollution. (C3)

References:

1. Perkins – Air Pollution.
2. Stern – Air Pollution Vol. I, II, III
3. Kenneth Work and Cecil F Warner – Air Pollution ,its origin and control, Harper and Row, Publishers, New York. 1982
4. Environmental Engineer's Handbook, 2, Chilton Book Co., Radnor, PA (1974),U.S.A
5. PL **Magill**, FR **Holden**, AC **Ackley**(Eds.), **Air Pollution** Handbook McGraw-Hill, New York (1956).
6. Sterm A.C. (ed.) Vol. V – Air Quality Management.
7. 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.

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

INDUSTRIAL WASTEWATER TREATMENT

Subject Code: 17PEV22	Credits = 04	
CIE: 50 Marks	SEE: 50 Marks	SEE: 03 Hrs
Hours / Week: 4 Hrs (Theory) +SS-01hr		Total Hours: 52

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 and waste water treatment method of different Industries.

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. Understand the effects of Industrial waste water and different approaches for treatment.(C1)
2. Understand the continuous monitoring processes for better results.(C2)
3. Understanding various Pretreatment process of Industrial Wastewater.(C3)

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).

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

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

HYDRAULICS OF WATER AND WASTEWATER SYSTMES

Subject Code: 17PEV23	Credits = 05	
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, leak detection methods and water quality in distribution system.
3. Wastewater collection system, flow condition, pipe ,material and roughness co-efficient and design aspects.
4. 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. Understand the pipe networks, evaluation of distribution system, economic analysis of pipelines, and networks, leak detection methods and water quality in distribution system.(C2)
3. Understand the wastewater collection system, flow condition, pipe, material and roughness co-efficient and design aspects, sewer appurtenances, pumping station, sewer networks, economic analysis of pipeline and networks. (C3)

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.

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-IV: OPERATION AND MAINTENANCE OF ENVIRONMENTAL FACILITIES

Subject Code: 17PEV241	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.

1. Fundamentals of Operation and Maintenance and database plan.
2. Understanding working and maintenance of Water Supply Facilities and safety aspects.
3. Operation and maintenance of Sewer network and Air Pollution Control Facilities.
4. Work planning and cost estimates.

Module - I

Importance of Operation and Maintenance, Basic Principles of Operation and Maintenance – corrective and Preventive Maintenance, Database of Facilities for O and M – Detailed Plans, Drawings, Operation Manuals, Computer Applications in O and M. **10Hrs**

Module - II

O and M of Water Supply Facilities**:** Intakes, pumps, rising mains, water treatment process control, water quality and water quality monitoring, loss o carrying capacity of pipes. Causes, Leak – Detection, Projection of pipe break rates, record keeping, appurtenances – valves, hydrants and fittings. Use of Network Models in O and M. Safety aspects. **12Hrs**

Module - III

O and M of Wastewater Facilities**:**

Sewer Network: Inspection Methods for Sewers and Appurtenances – Manual and Television, Cleaning Rehabilitation – Sealing, Repair and Replacement – Safety in Sewer Inspection. O and M of Wastewater Treatment Plant. Monitoring, Operational Problems and Corrective Measures in Different units of Treatment. **10Hrs**

Module - IV

O and M of Air Pollution Control Facilities:

Regular inspection of devices, SPM control equipment, Gravity settlers, Cyclone separators, Bag filters, scrubbers, electrostatic precipitators, gaseous emission control devices – Absorption beds and adsorption columns, thermal oxidizers, incinerators and their trouble shooting, safety measures during O and M. **10Hrs**

Module - V

Operation and Maintenance Planning:

Organizational Structure, Work Planning, Preparation and Scheduling Cost Estimates. **10Hrs**

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

1. Understand Operation and Maintenance and database plan.(C1)
2. Understand the working and maintenance of Water Supply Facilities and safety aspects.(C2)
3. Understand the Work planning and cost estimates. (C3)

References:

1. Water and Wastewater Technology, Hammer MJ – 1985.
2. Water Treatment Plants, Syed R. Quasim, Holt Rinchart and Winston – 1985.
3. Neumann W.L. Industrial Air Pollution Control Systems, 1997, McGraw Hill.
4. CPHEEO Manual on Water Supply and Treatment, GOI Publication, 1991.
5. CPHEEO Manual on Sewerage and Sewerage Treatment, GOI Publication. 1995.
6. Training Manual on O and M for Municipal Staff, Asian Development Bank Project, Government of Karnataka.
7. Walski T.M. Analysis of Water Distribution Systems, CBS, Publications, New Delhi, 1987.

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 : ADVANCED ATMOSPHERIC ENVIRONMENTAL ENGINEERING

Subject Code: 17PEV242	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.

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

Module - I

Atmospheric Processes and Chemical Reactions; Definition of Terms –

Aerosols, particle, photolysis, gas to particle conversion, condensation, evaporation, dissolution, sublimation, specific heat, conduction, radiation. Mechanical turbulence, forced convection, advection, equation of state, first law of thermodynamics. Reaction Rates (Gas Phase Species) Atmospheric gases and their molecular structures, chemical reactions and photo processes, reaction rates, reaction rate coefficients, sets of reactions, stiff systems.

6Hrs

Atmospheric Boundary Layer: Characteristics of atmospheric boundary layer-boundary layer depth, mean velocity power-law profile, Log-Log velocity profile, spectral description of turbulence, turbulence intensity. Reynolds streets parameter, spectral density function, integral length scale, inertial sub range and small scales. Turbulent fluxes of momentum, turbulent fluxes of energy and water vapor, friction velocity, surface roughness lengths, bulk aerodynamic equations for eddy diffusion, monin-obukhov similarity theory, eddy diffusion above the surface layer, ground surface temperature and moisture. **6Hrs**

Module - II

Urban Air Quality Simulation Modeling: General need, alternative approaches, basic model applications, general composition of models,. Numerical modeling approaches-Guassian diffusion models, physical basis of the mass conservation approach, mathematical foundation of the mass conservation approach. **6Hrs**

Inherent problem in air quality simulation modeling: Boundary conditions, spatial resolution and compatibility with available data. Transportation related modeling-street canyon models, highway models, airport models. Air quality simulation models for Quasi-Inert pollutants – sulfur dioxide and particulate models, carbon monoxide models. Air quality simulation models for photochemical pollutants-background, features of photochemical air quality simulation models, model evaluation, model validation. **6Hrs**

Module - III

Dispersion of Heavy Gases: Introduction, characteristics of heavy gas flow, introduction to numerical modeling of heavy gas dispersion, requirements for physical models (non-dimensional parameters, choice of scaling variables). **6Hrs**

Mobile Sources of Pollution: Introduction, emission standards for automobiles, Gasoline, origin exhaust emissions from gasoline engines, crankcase and evaporative emissions, alternative fuels and their utilization. **8Hrs**

Module - IV

Indoor Air Pollution: Introduction, the IAQ problem, diagnosis and remediation of IAQ problems, the interdisciplinary approaches. Industrial hygiene and its application to IAQ, industrial hygiene methodology. Indoor air quality and industrial hygiene, sampling, analysis and interpretation. Industrial hygiene methodology, architectural and construction aspects.

8Hrs

Module - V

Design of Industrial Ventilation Systems: Introduction, ventilation by dilution, hood specification, hoods of simple geometry, experimental velocity contours, complex hood design, duct design, fan selection and performance. **8Hrs**

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

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

REFERENCES:

1. Jacobson. Z A., Fundamental of Atmospheric modeling, Cambridge University press, Cambridge, 1999.
2. Warren B Johnson et. Al. Air Pollution, Arthur C Stern, third edition, Volume I, Academic Press, New York, 1976.
3. Krogstad and Jacobsen. Dispersion of heavy gases, in encyclopedia of environmental control technologies, edited by Cheremioinoff , Volume 2, Rulf publishing company, Houston.
4. Crawford Martin, "Air pollution control theory" – Tata McGraw. Hill publishing company Ltd. New Delhi, 1980.
5. Stull B Roland, Boundary Layer Meteorology, Kluwer Academic Publishers, 1988.
6. Snyder H William, "Guideline for fluid modeling of atmospheric diffusion", U S Environmental Protection Agency research Triangle Park, NC 2711.
7. Wark K Warner C F and Davis. W T., Air Pollution, "its origion and control" third edition, Harper and Row Publication, 1998.
8. Steve M Hays, Ronald V Gobbell 7 Nicholas R Ganick, "Indoor Air Quality" – Tata McGraw-hill, 1995.

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

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

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

ELECTIVE-IV : RECYCLE AND REUSE TECHNOLOGY

Subject Code: 17PEV243	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.

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

Module - I

Waste as a Resource**:** Resource economics, Disposable materials, Recycling Collection, Processing, Governmental Role in Waste Management, and Potential for Reuse. **6Hrs**

Waste Analysis: Sampling, Composition, Categorization, Determination of Waste Properties, Ash and Fines Analysis, Energy Content. **6Hrs**

Module - II

System Design: Design of Recycling Systems, Collection System, Process Train Design and Complexity, Product Design of Recycling, Conveyance, Transport Safety, Efficiency of Operation Systems. **8Hrs**

Module - III

Water Reuse**:** Direct and Indirect Reuse, Intentional Reuse, Groundwater Recharge, Examples of Water Reuse, Close Cycle and Open Cycle Reuse Recreational Reuse. **6Hrs**

Energy Recovery: Combustion, Energy Losses, Energy Recovery Analysis Emission Control, Residue Control, In-plant Operations, Refuse Derived Fuel. **6Hrs**

Module - IV

Metals Recovery**:** Ferrous metals, Properties, Principles of Magnetic Field – Ferrous Material Interactions, Magnetic Separation Equipment, Non-ferrous metal separation, Eddy-Current Separation – Theory and Types, Extraction of Material from a bed. **8Hrs**

Module - V

Reuse of Industrial Effluent, Urban Effluent Reuse for Agriculture in Arid and Semiarid Zones, Uses of Sewage in Pisciculture, Groundwater Recharge of Sewage Effluents, Reuse for Amenity. **6Hrs**

Health Aspects of Water Reuse, Guidelines for Evaluating Recreational Water Reuse, Resource Conservation and Recovery Act. **6Hrs**

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 quality of water for municipal use.(C1)
2. Understand the types of processes used to treat water for municipal purpose.(C2)
3. Understand the fundamental engineering and science principles that are used to design and operate the processes used in treatment systems. (C3)

References:

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

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

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

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

ELECTIVE-V : ENVIRONMENTAL PLANNING AND MANAGEMENT

Subject Code: 17PEV251	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.

1. Environmental management, sustainable development, carrying capacity and resource utilization.
2. Methodology in planning and environmental protection, regional carrying capacity of Delhi region.
3. Engineering economics, management techniques, ISO-14000 series.
4. Cleaner Technologies and their roles in Environmental Protection, environmental audit.

Module - I

Principles of environmental Management; Introducing Environmental Management, Ecosystem concept, Participant in EM, Ethics and the Environment, International Environmental Movement, Environmental concerns in India. Environmental and Sustainable Development.
Concept of Carrying Capacity, Relation among Quality of Life, Carrying Capacity and Resource Utilization. **7Hrs**

Module - II

Engineering Methodology in Planning and its Limitations: Carrying capacity based short and long-term regional planning. **5Hrs**
Environmental Protection**:** Economic development and social welfare consideration in socio-economic developmental policies and planning. **5Hrs**

Module - III

Total cost of development and environmental protection cost. Case studies on Regional carrying capacity – National Capital Region – Delhi Area. **10Hrs**
Engineering Economics – Value Engineering, Time Value of Money, Cash Flows, Budgeting and Accounting. **5Hrs**

Module - IV

Environmental Management techniques. Total Quality Management in Environmental Management and Protection – ISO 14000 series of Standards, Environmental economics: learning objectives, economics in the environment, Environmental valuations, economics of natural resources, environment and regional economics, ecological economics. **10Hrs**

Module – V

Cleaner Technologies and their roles in Environmental Protection. **5Hrs**
Environmental Audit – Air, Water, Solid and its importance in Environmental Management.

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

1. Understand the Environmental management, sustainable development, carrying capacity and resource utilization.(C1)
2. Understand the Methodology in planning and environmental protection, regional carrying capacity of Delhi region.(C2)
3. Understand the Engineering economics, management techniques, ISO-14000 series, Cleaner Technologies and their roles in Environmental Protection, environmental audit . (C3)

5Hrs

References:

1. Danoy G.E. and Warner R.F., "Planning and Design of Engineering Systems". Unwin Hyman Publication, 1969.
2. Chanlett, "Environmental Protection", McGraw Hill Publication.
3. Lohani B.N., "Environmental Quality Management", South Asian Publications.
4. Heinke et al, "A Textbook of Environmental Engineering".
5. Journal of Indian Association for Environmental Management, 1995-1997.
6. MOEF, Government of India, Carrying Capacity based Developmental Planning Stdies for the National Capital Region, 1995-96.
7. NEERI, Nagpur, Annual Reports, 1995 and 1996.
8. Peurifoy R.L., Construction Planning Equipment and Methods, 1979, McGraw Hill.
9. Environmental Engineering and Management, Suresh K. Dhaneja, 2000, S.K.Kataria and Sons.

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-V : ENERGY & ENVIRONMENT

Subject Code: 17PEV252	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.

1. Study of energy resources, needs, crisis and consumption.
2. Fundamentals of renewable sources of energy and other sources of energy.
3. Non renewable sources of energy, global warming, green house effect.
4. Impact of acid rain.

Module - I

Introduction: Global energy, Environmental resources, Energy needs, Energy crisis. **5Hrs**
Indian Scenario: Energy consumption, needs & crisis. **5Hrs**

Module - II

Energy Production, utilization, laws and principles. **5Hrs**
Renewable sources of energy and environmental aspects-Biogas, Biomass. **5Hrs**

Module - III

Hydropower, Ocean energy, solar energy, agricultural waste derived energy. **5Hrs**
Urban waster derived energy, wind energy. **5Hrs**

Module - IV

Non-Renewable sources of energy an environmental aspects-Energy from coal .oil, natural gas. Nuclear energy, geothermal energy. **5Hrs**
Global temperature, Green house effects, Global warming. **5Hrs**

Module - V

Acid rain-Causes, effects and control methods **6Hrs**
Regional impacts of temperature change **6Hrs**

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

1. Understand the global energy, resources, needs, crisis and consumption .(C1)
2. Understand the renewable and other sources of energy.(C2)
3. Understand the phenomena of global warming, green house effect and acid rain. (C3)

References:

1. Wilber L.C " hand book of Energy systems". Engg. Wiley & Sons,1989.
2. Masten G.M. " Introduction to Environmental Engg.And Science".
3. Sincero and Sincero, Environmental Engineering- A design approach, Prentice hall of India(1999).
4. Rao and Parulekar B.B energy Technology –Non-Conventional renewable and Conventional, second edition Khanna Publication, 1997.

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.

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

ELECTIVE-V : OCCUPATIONAL SAFETY AND HEALTH

Subject Code: 17PEV253	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.

1. History and development of safety, health act, health administration, acquiring accident facts, investigation, human error and accident model studies.
2. Ergonomics task analysis hazards programs, hazard analysis, human error, fault tree, emergency response, hazard control measures in specific industries.
3. Fire prevention and protection, safety programs ISO-14000, EMS, TQM and TSM.
4. Occupational health and safety considerations in different environmental fields.

Module - I

Introduction: History and Development, Occupational Safety and Health Act, Occupational Safety and Health Administration, Right to know Laws. **6Hrs**

Accident Causation: Need for Accident Investigation, Accident Investigation Plan, Methods of Acquiring Accident Facts, Correcting Missing Skills, Investigator Tendencies and Characteristics, Supervisory Role in Accident Investigation. Human Error Model, Petersen's Model, Epidemiological Models. **8Hrs**

Module - II

Ergonomics**:** Ergonomics at work place, Ergonomic Task Analysis, Preventing Ergonomic Hazards, Setting up of Ergonomics Program. **6Hrs**

Occupational Hazard and Control**:** Hazard Analysis, Human Error Analysis in Causation with Hazard Analysis, Fault Free Analysis, Emergency Response, Decision for Action, Purpose and Considerations, Right Decision, Wrong Remedy, Hazard Control Measures, Hazards and their Control in Pharmaceutical, Construction, Textiles, Petroleum Refineries and LPG Bottling, Iron and Steel Industries. **10Hrs**

Module - III

Fire Prevention and Protection**:** Fire Development and its Severity Effects. Enclosure, need for early Detection of Fire, Extinguishing Fire Electrical Safety Product Safety, Technical Requirements of Product Safety Programme. **8Hrs**

Module - IV

Environmental Safety and ISO 14000 ISO series of Standards, ISO 14001 Standards, Environmental Management Systems (EMS), Total Quality Management (TQM) and Total Safety Management (TSM). **6Hrs**

Module - V

Occupational Health**:** Health and Safety Considerations, Personal Protective Equipments, Effects of Exposure and Treatment for Metal Working Trades, Municipal Solid Waste, Epoxy Resins, Foundries, Occupational Health and Safety Considerations in Wastewater Treatment Plants. **8Hrs**

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

1. Understand the History and development of safety, health act, health administration, acquiring accident facts, investigation, human error and accident model studies.(C1)

2. Understand the Ergonomics task analysis hazards programs, hazard analysis, human error, fault tree, emergency response, hazard control measures in specific industries.(C2)
3. Understand the Fire prevention and protection, safety programs ISO-14000, EMS, TQM and TSM, Occupational health and safety considerations in different environmental fields. (C3)

References:

1. David L. Goetsch, "Occupational Safety and Health" for Technologists, Engineers and Manaers, 3rd Edition, Prentice Hall.
2. David A Calling – Industrial Safety Management and Technology, Prentice Hall, New Delhi.
3. Della D.E. and Giustina, Safety and Environmental Management. Van Nostrand Reinhold International Thomson Publishing Inc., 1996.
4. Trevethick R.A. Environmental and Industrial Health Hazards, William Heinemann Medical Books Ltd., London (1973).

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.

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

OPEN ELECTIVE-VI : HAZARDOUS WASTE MANAGEMENT

Subject Code: 17PEV261	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.

1. Sources, classification, characteristics and assessment of hazardous sites.
2. Minimization and resource recovery, treatment methods.
3. Transportation, storage, treatment and disposal techniques.
4. 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. Understand the minimization and resource recovery, treatment methods.(C2)
3. Understand the Transportation, storage, treatment and disposal techniques, land fill operations and site remediation. (C3)

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.

OPEN ELECTIVE-VI : GLOBAL WARMING AND CLIMATE CHANGE

Subject Code: 17PEV262	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.

1. Fundamentals of energy Issues, Climate Change, green-House Effect and global warming.
2. Modeling of climate change, ozone layer, impacts of global warming.
3. Kyoto protocol, global and Indian scenario of carbon trading, cleaner technology for reduction of CO_2.
4. Carbon sequestration, role of Countries and Citizens in Containing Global Warming.

Module - 1

Energy Issues and Climate Change**:** Alternate Energy Sources
Green-House Effect: as a Natural Phenomenon, Green House Gases GHGs) and their Emission Sources
Quantification of CO2 Emission, Global Warming Potential (GWP) of GHGs.

10Hrs

Module - II

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. **13Hrs**

Module - III

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

14Hrs

Module - IV

Cleaner Development Mechanisms : Various Projects related to CO2 Emission Reduction**.**

8Hrs

Module - V

Alternatives of Carbon Sequestration: Conventional and non-conventional techniques , Role of Countries and Citizens in Containing Global Warming**.** **7Hrs**

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

1. Understand the energy Issues, Climate Change, green-House Effect and global warming.(C1)
2. Understand the Modeling of climate change, ozone layer, impacts of global warming.(C2)
3. Understand the Kyoto protocol, global and Indian scenario of carbon trading, role of Countries and Citizens in Containing Global Warming (C3)

References:

1. Barry R.G., and Chorley R.L., (1992) **"Atmosphere, Weather and Climate"** 4th Edition, ELBS Publication.
2. Bolin B., (Ed.), (1981), **"Carbon Cycle Modelling"** John Wiley and Sons Publications
3. Corell R.W., and Anderson P.A., (Eds.), (1991), **"Global Environmental Change"** Springler Verlog Publishers.
4. Francis D., (2000) **"Global Warming: The Science and Climate Change",** Oxford University press.
5. Frame B., Medury Y., and Joshi Y., (Eds.), (1992) **"Global Climate Change: Science, Impact and Responses"**
6. Linden E., (2006), **"The Winds of Change: Climate, Weather and the Destruction of Civilizations",** Simon and Schuster Publications.
7. Mintzer I.M., (Ed.), (1982), **Confronting Climate Change, Risks , Implications and Responses"** Cambridge University Press.
8. Srivatsava A.K., (2007), **"Global Warming"** APH Publications.
9. Wyman R.L., (Ed.), (1991), **Global Climate Change and Life on Earth",** Chapman and Hall Publications.
10. Yadav, Chander and Bhan, (2005), **"Global Warming: India's Response and Strategy",** RPH Publications.

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

3) Extent of teaching: Clearly mentioned in the syllabus

OPEN ELECTIVE-VI : ADVANCED COMPUTATIONAL METHODS AND OPTIMIZATION

Subject Code: 17PEV263	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.

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

Module - I

Newton-Raphson method for solution of simultaneous equations. Numerical solutions of partial differential equations. Finite difference, Finite element method and method of characteristics. Explicit and implicit methods to solve simple parabolic differential equations, convergence, Boundary value problems and successive over relaxation methods. Numerical dispersion errors and their prevention, Comparison of solutions by analytical and finite difference techniques for one dimensional instantaneous discharge simple computer program based examples. **20 Hrs**

Module - II

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

Linear Programming: Standard form of problems – pivotal reduction of equations. Single and two phase simplex methods. Piece wise linear approximation of non-linear optimization. **10 Hrs**

Module - III

Numerical search methods for 1-D non-linear problems – Dichotomous, Fibonacci and Golden section methods. Quadratic and cubic interpolation methods, Solutions of linear programming problems using computer programming. **10 Hrs**

Module - IV

Statistics and Probability: Frequency Distribution – Characteristics of Distribution: Central Tendency and Dispersion, Concepts of Probability – Binomial, Poisson and Normal distribution, and their applications. **06 Hrs**

Module - V

Methods of Least Square and regression – Multiple Regression – The Chi Squared Test; F-test, t-test. Analysis of problems using computer programming. **06 Hrs**

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

1. Understand Fundamentals of Numerical solutions.(C1)
2. Understand the Various optimization problems and their importance and learning Linear Programming.(C2)
3. Understand Statistics and Concepts of Probability and analysis of problems using computer programming. (C3)

Reference:

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

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

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

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

ENVIRONMENTAL ENGINEERING LAB-II

Subject Code: 17PEV27	Credits = 02	
CIE: 50 Marks	SEE: 50 Marks	SEE: 3 Hrs
Hours / Week: 4 Hrs (Practical)		Total Hours: 52

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.

1. 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.
2. Demonstration on GC, HPLC, AAS, study of Microscope, MPN test andTotal count
3. Determination of Ambient air quality.
4. 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. Understand the Mineral and heavy metal analysis, suitability of sand for filtration.(C1)
2. Understand the Demonstration on GC, HPLC, AAS. study of Microscope, MPN test and Total count(C2)
3. Understand the Determination of Ambient air quality, Experiment on Auto Exhaust analyzer. (C3)