NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL

HONORS in

ENVIRONMENTAL ENGINEERING

SCHEME OF INSTRUCTION AND SYLLABI

(for students of B.Tech., Civil Engineering)

(Effective from 2021-22)

DEPARTMENT OF CIVIL ENGINEERING

SCHEME OF INSTRUCTION

Honours Program – Environmental Engineering

S. No.	Course Code	Name of the Course	L	T	P	Credits	Sem.
1	CE5301	Environmental Chemistry and Microbiology	3	0	0	3	V
2	CE5351	Air Pollution and Control	3	0	0	3	VI
3	CE5353	Environmental Impact Assessment and Management	3	0	0	3	VI
4	CE5302	Water Supply Systems	3	0	0	3	VII
5	CE5802	Solid Waste Management	3	0	0	3	VII
6	CE5352	Wastewater Treatment Systems	3	0	0	3	VIII
		Total				**18**	

DETAILED SYLLABUS

Honors

Environmental Engineering

Course Code: CE5301	ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY	Credits 3-0-0: 3

Pre-requisites: None

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

CO1	Solve environmental engineering problems using basic concepts of chemistry and microbiology
CO2	Apply the principles of chemistry in the treatment processes of water and wastewater
CO3	Identify and classify and the type of microorganisms
CO4	Explain the microbial metabolism and growth kinetics

Syllabus:

General Chemistry: Basic principles – chemical equations – types of chemical reactions - calculations from chemical equations; gas laws; Equilibrium and Le Chatelier's Principle – factors affecting chemical equilibrium - activity and activity coefficient - ionic strength.

Physical Chemistry: Thermodynamics – heat and work – enthalpy – entropy – free energy – temperature dependence of equilibrium constant; membrane processes; principles of solvent extraction; electrochemistry; chemical kinetics; adsorption.

Equilibrium Chemistry: Variations of Equilibrium relationships; ways of shifting chemical equilibrium; solutions to equilibrium problems -acid base equilibrium – solubility equilibrium – oxidation reduction equilibrium.

Organic Chemistry and Biochemistry: Organic compounds of interest to environmental engineers, general properties of the functional groups of organic compounds; Enzymes, classification enzymes catalyzed reaction, energy considerations coupling of reaction; Breakdown and synthesis of carbohydrates, fats, proteins under aerobic and anaerobic reactions; CNP cycles under aerobic and anaerobic reactions; Concepts of BOD, COD, TOC.

Environmental Chemistry: Fundamentals of surface and colloidal chemistry; chemistry involved in water treatment; Atmospheric chemistry; soil chemistry; emerging pollutants and sources of pollution for water, air and soil

Environmental Microbiology: Introduction of microbiology, classification and characterization of microorganisms, viruses; Morphology and structure of bacteria, nutrient requirement, growth of bacteria; Basic microbiology of water and sewage; Basic principals involved in the analysis of fecal indicator bacteria – coli forms and streptococci, plankton analysis, analysis of pseudomonas & streptococci; Pathways of aerobic and anaerobic metabolism, Energy transfer in metabolism; Kinetics of microbial growth. Microbiology of water, wastewater, soil and air.

Learning Resources:

Text Books:

1. Chemistry for Environmental Engineering and Science, Sawyer, C. N., McCarty, P. L., and Perkin, G.F., McGraw Hill Education, 2017, 5th Edition
2. Process Chemistry for Water and Wastewater Treatment, Benefield D. L., Judkins F. J., Weand L. B., Prentice Hall, 1982, 1st Edition
3. Microbiology, Pelczar, M.J.Michael, Chan, E.C.S., and Krieg, N.R., The McGraw-Hill Education, 2021, Indian edition

Reference Books:

1. Applications of Environmental Chemistry - A Practical Guide for Environmental Professionals, Eugene Weiner R., Lewis Publishers, 2000, 1st Edition
2. Environmental Engineering, Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, McGraw Hill Education, 2017, 1st Indian Edition
3. Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, McGraw Hill Education, 2017, 4th Edition
4. Wastewater Microbiology, Bitton, G., Wiley-Blackwell, 2011, 4th Edition
5. Environmental Microbiology, Mitchell, R., and Gu, J.D., Wiley-Blackwell, 2010, 2nd Edition
6. Microbiology: An Introduction, Tortora GJ, Funke BR, and Case CL, Pearson Education, 2019, 4th Edition

Online Resources:

1. https://nptel.ac.in/courses/102/105/102105087/
2. https://nptel.ac.in/courses/122/106/122106030/

Course Code: CE5351	AIR POLLUTION AND CONTROL	Credits 3-0-0: 3

Pre-requisites: None

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

CO1	Identify air sampling techniques and model air quality.
CO2	Identify different atmospheric stability conditions for plume dispersion
CO3	Assess concentration of pollutant at different receptor locations using plume dispersion modelling
CO4	Design air pollution control systems and evaluate their efficiency

Syllabus:

Air Pollution: Definition of Air Pollution – Sources & Classification of Air Pollutants – Effects of air pollution – Global effects – Air Quality and Emission standards – Sampling of Pollutants in ambient air – Stack sampling.

Meteorology And Air Pollution: Factors influencing air pollution, Wind rose, Mixing Depths, Lapse rates and dispersion – Atmospheric stability, Plume rise and dispersion, Prediction of air quality, Box model – Gaussian model – Dispersion coefficient – Application of tall chimney for Pollutant dispersion.

Control of Particulate Pollutants: Properties of particulate pollution – Particle size distribution – Control mechanism – Dust removal equipment – Design and operation of settling chambers, cyclones, wet dust scrubbers, fabric filters & ESP.

Control of Gaseous Pollutants: Process and equipment for the removal by chemical methods – Design and operation of absorption and adsorption equipment – Combustion and condensation equipment, fugitive gas emissions and control.

Automobile Pollution And Control: Sources, Theoretical Considerations, Operating conditions Vs Emissions, Pollution control Measures, Emission Standards.

Air Quality Modelling: Importance of Air quality Modelling, Components of air quality Modelling, Types of air quality models, Dispersion based models and Receptor based models, Deterministic and Stochastic models. Lagrangian and Eulerian Models.

Control of Air Pollution: Zoning and site selection – Other Management controls, AP Legislation. CEMS and its Types

Learning Resources:

Text Books:

1. Air Pollution: Measurement, Modeling and Mitigation, Colls, J., CRC Press, 2009
2. Air Pollution Control Engineering, Noel, D. N., Tata McGraw Hill Publishers, 1999
3. Fundamentals of Air Pollution, Stern, A.C., Academic Press, 1984
4. Air pollution meteorology and dispersion, Arya, S.P., Oxford University Press, UK, 1999.
5. Principles of Air Pollution Meteorology, Lyons and Scott, CRC Press, 1990

Reference Books:

1 Computerized Environmental Modelling, Hardisty, J. et al., Wiley, 1993
2 A Basic Introduction to Pollutant Fate and Transport, Dunnivant, F.M. and Anders Elliot Wiley Interscience, 2006
3 Fundamentals of air pollution, Boubel, R.W., Fox, D.L., Turner, D.B. and Stern, A.C., Academic Press, New York, 1994, 3rd Edition

Online Resources:

1. www.indair-neeri.res.in
2. www.epa.gov.in

Course Code: CE5353	ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT	Credits 3-0-0: 3

Pre-requisites: None

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

CO1	Identify environmental attributes for the EIA study.
CO2	Identify methodology and prepare EIA reports.
CO3	Specify methods for prediction of the impacts.
CO4	Formulate environmental management plans.

Syllabus:

Introduction: Definitions – Environmental Inventory, Standards, Indices – Environmental attributes—Air, Water Noise, Land Economic; Cultural and detailed discussions of individual parameters of each attributes; methods for Prediction and assessment of impacts air – water – soil – noise – biological – cultural – social – economic environments - Standards and guidelines for evaluation.

EIA: EIA Terminology – Need for EIA – Evolution of EIA – Concepts of EIA – Merits and demerits of EIA – Procedures – Screening, Scoping baseline data, Impact prediction – Stake holders of EIA – Public Participation in Decision making – Projects requiring Environmental Clearance

EIA methodologies: Criteria for Selection -Impact identification, measurement, interpretation and Evaluation – Impact Communication – Adhoc Methods, Checklists Methods, matrices , Networks and Overlays Methods – Cost-Benefit Analysis – Rapid EIA and Comprehensive EIA – General Framework for Environmental Impact Assessment, Characterization and site assessment.

EMP and Monitoring: Document Planning – Scope and Baseline conditions – Construction Stage Impacts – Environmental Management Plan – Identification of significant or Unacceptable Impacts – Environmental Mitigation Plans – Relief and rehabilitation – Environmental Legislation and Audit – Concept of Environmental Risk Analysis and Life Cycle Assessment – Legal and regulatory Aspects in India.

EIA Case Studies of Developmental Projects : Preparation of EIA for developmental projects - Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Mining, Nuclear fuel complex, Highway project, Sewage treatment plant, CETP, Treatment Storage Disposal Facility, Municipal Solid waste processing plant, Tannery industry. Software for rapid EIA.

Learning Resources:

Text books:

1. Environmental Impact Assessment, Canter, L.W., McGraw Hill Pub. Co., 1997
2. Environmental Impact Analysis, Jain, R.K., Urban, L.V., Stracy, G.S., Van Nostrand Reinhold Co., New York, 1991.
3. Environmental Impact Assessment Methodologies, Anjaneyulu.Y., and Manickam. V., B.S. Publications, Hyderabad, 2007.

Reference Books:

1. Environmental Impact Assessment, Barthwal, R. R., New Age International Publishers, 2002

2. Environmental Impact Assessment, Rau, J.G. and Wooten, D.C., McGraw Hill Pub. Co., New York, 1996.
3. Environmental Impact Assessment- Theory and Practice, Wathern. P., Routledge Publishers, London, 2004.
4. Hosetti, B. B., Kumar A, Eds, Environmental Impact Assessment & Management, Daya Publishing House, 1998
5. UNESCO, Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development, UNESCO/UNEP, Paris, 1987
6. EIA Notifications 2016

Online Resources:

1. MEVE-001: Environmental Impact Assessment for Environmental Health – Course (swayam2.ac.in)
2. 120108004.pdf (nptel.ac.in)
3. environmentclearance.nic.in/writereaddata/Form-1A/HomeLinks/ommodel2.html
4. environmentclearance.nic.in/writereaddata/Form-1A/HomeLinks/ommodel3.html

Course Code: CE5302	WATER SUPPLY SYSTEMS	Credits 3-0-0: 3

Pre-requisites: Environmental Engineering-1

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

CO1	Plan water supply systems for a community
CO2	Analyze water quality and propose water treatment train
CO3	Design various components of a water treatment plant
CO4	Design advanced treatment systems for the removal of specific contaminants
CO5	Analyze and design water distribution systems
CO6	Plan an appropriate water reuse system

Syllabus:

Need for Transport of water- Water quality- Planning of water supply systems

Intake structures, Selection of pipe materials, Water transmission main design- Gravity and pumping main; Selection of Pumps- Characteristics-Economics; Jointing, Laying and Maintenance, Water hammer analysis; Water distribution pipe networks- Design, analysis and optimization –Appurtenances –Corrosion prevention – Minimization of water losses – Leak detection- SCADA systems- Storage reservoirs-

Water treatment: Screening – Mixing- Equalization – Sedimentation – Coagulation, Flocculation- Filtration– Back washing –Membrane separation- Reverse Osmosis- Nano filtration, Ultra filtration-Electro dialysis- -Specific contaminant removal systems- Disinfection

Water reuse/recycle- Sludge thickening-Sludge dewatering systems-Sludge drying beds-Recent Advances.

Use of computer software in water transmission and water distribution–
LOOP, BRANCH, Canal ++ and GIS based software

Learning Resources:

Text books:

1. Water and Wastewater Engineering: Design Principles and Practice, Mackenzie L. Davis, McGraw Hill, 2010.
2. Environmental Engineering, Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, McGraw Hill., 2017

Reference Books:

1. Water Supply and Pollution Control, Viessman Jr, Hammer J. M, Perez, E.M, and Chadik, P. A, PHI Learning, New Delhi, 2009
2. Water Quality& Treatment, AWWA Hand book, McGraw Hill, 2011.
3. Urban Water Supply Handbook, Larry W. Mays, McGraw Hill, 2002.
4. Computer modelling of water distribution system, AWWA manual of water supply practice, 2005.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ce23/preview
2. https://ocw.mit.edu/courses/urban-studies-and-planning/11-479j-water-and-sanitation-infrastructure-in-developing-countries-spring-2007/readings/hwts_paper.pdf
3. http://www.who.int/water_sanitation_health/dwq/WSH02.07.pdf

Course Code: CE5802	SOLID WASTE MANAGEMENT	Credits 3-0-0: 3

Pre-requisites: None

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

CO1	Identify various types of solid wastes and their sources
CO2	Examine the physical and chemical composition of wastes
CO3	Analyze the activities associated with the management of solid waste
CO4	Evaluate the techniques and methods used in recovery of materials and energy from solid wastes
CO5	Design a sanitary landfill for disposal of solid waste
CO6	Categorize and manage the hazardous waste

Syllabus:

Solid Waste: Definitions, Characteristics, and Perspectives: Types of solid wastes, sources of solid wastes, properties of solid wastes, solid waste management: an overview

Engineering Systems for Solid Waste Management: Solid waste generation; on-site handling, storage and processing; collection of solid wastes; transfer and transport; processing techniques; ultimate disposal; Integrated SW Management concepts

Engineering Systems for Resource and Energy Recovery: Processing techniques; RRR approach, materials-recovery systems; recovery of biological conversion products; recovery of thermal conversion products; recovery of energy from conversion products; materials and energy recovery systems.

Engineering Disposal of SW: Dumping of solid waste; sanitary landfills – site selection, design and operation of sanitary landfills – Leachate collection & treatment. Identify methods of solid waste disposal during a site visit and follow safety precautions.

Hazardous Waste Management: Introduction; Concern about Hazardous Waste Management; Characteristics of Hazardous Waste; Transportation and Disposal of Hazardous Waste; Industrial/biomedical waste, E- waste management

Learning Resources:

Text Books:

1. Integrated Solid Waste Management, Engineering Principles and Management Issues, Tchobanoglous G, Theisen H and Vigil SA, McGraw Hill Education, 2014, Indian Edition
2. Waste Management Practices: Municipal, Hazardous and Industrial, John Pichtel, CRC Press, 2014, 2nd Edition
3. Solid Waste Engineering, Vesilind PA, Worrell W and Reinhart D, Brooks/Cole Thomson Learning Inc., 2010, 2nd Edition

Reference Books:

1. Environmental Engineering, Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, McGraw Hill Education, 2017, 1st Indian Edition
2. Handbook of Solid Waste Management, Tchobanoglous G and Kreith F, McGraw-Hill Education, 2002, 2nd Edition
3. Geotechnical Aspects of Landfill Design and Construction, Qian X, Koerner R M and Gray D H, Prentice Hall, 2002, 1st Edition
4. Hazardous Waste Management, LaGrega M.D., Buckingham P.L. and Evans J.C., Waveland Pr Inc., 2010, Reissue Edition

5. Hazardous Wastes - Sources, Pathways, Receptors, Richard J. Watts, John Wiley and Sons, 1998, 1st Edition.

Online Resources:

1. http://cpheeo.gov.in/cms/manual-on-municipal-solid-waste-management-2016.php
2. https://nptel.ac.in/courses/105/103/105103205/
3. https://nptel.ac.in/courses/120/108/120108005/
4. https://nptel.ac.in/courses/105/106/105106056/
5. https://nptel.ac.in/courses/105/105/105105160/
6. https://nptel.ac.in/courses/103/107/103107125/

Course Code: CE5352	WASTEWATER TREATMENT SYSTEMS	Credits 3-0-0: 3

Pre-requisites: Environmental Engineering - 2

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

CO1	Identify and assess the characteristics of wastewater and their impacts
CO2	Plan and design the components of wastewater treatment systems
CO3	Comprehend the underlying principles of processes involved in secondary wastewater treatment systems.
CO4	Design sludge treatment and disposal methods.

Syllabus:

I**ntroduction:** Wastewater Sources and flow rates, Characteristics, Standards of Disposal, Treatment Objective and Strategies, Sanitary sewer design, Head works and Preliminary design, Layouts of Primary, Secondary and Advanced Treatment Units, Quantity estimation

Design Of Preliminary and Primary Treatment Operations: Screens, Grit Chambers, Skimming Tank, Primary and Secondary Sedimentation Tanks.

Biological Treatment Processes: Types, Kinetics of Plug Flow and Completely Mixed Systems for aerobic and anaerobic systems.

Attached Growth Processes: Trickling Filters (Standard Rate, High Rate), Biofilters, Practices, Features and Design, Operational Difficulties and Remedial Measures, Rotating Biological Contactors.

Suspended Growth Processes: Activated Sludge Process, Modifications and Design Equations, Process Design Criteria, Oxygen and Nutrient Requirements – Classification and Design of Oxidation Ponds, Lagoons, Root Zone Treatment Systems, Membrane bio reactors, fluidized bed reactors, Hybrid Systems.

Sludge Treatment and Disposal: Sludge Thickening, Aerobic and Anaerobic Sludge Digestion Processes, Design of Digester Tank, Sludge Dewatering, Ultimate Disposal, Other Methods of Sludge Treatment.

Learning Resources:

Text books:

1. Wastewater Engineering – Collection, Treatment, Disposal and Reuse, Metcalf and Eddy, 5th Ed., McGraw Hill Pub. Co., 2014
2. Water and Wastewater Engineering: Design Principles and Practice, Mackenzie L. Davis, McGraw Hill, 2010.

Reference Books:

1. Biological Process Designs for Wastewater Treatment, Benefield L.D. and Randall C.D., Prentice Hall Pub. Co., 1980
2. Fundamentals of Biological Wastewater Treatment, UdoWiesmann, In Su Choi and Eva-Maria Dombrowski,1st Ed., Wiley, 2007
3. Wastewater Engineering: Treatment, Disposal, and Reuse, George Tchobanoglous, Frank Burton QC, Metcalf and Eddy, Metcalf & Eddy, McGraw-Hill Publishers, 2013, 5th Edition
4. MWH's Water Treatment: Principles and Design John C. Crittenden, R. Rhodes Trussell, David W. Hand, Kerry J. Howe, George Tchobanoglous, John Wiley & Sons, Inc., 2012, 3rd Edition
5. Unit Operations and Processes in Environmental Engineering, Reynolds, T.D., Richards, P.A., PWS Publishing Company, Boston, 1996

Online Resources:

1. https://nptel.ac.in/courses/105/105/105105178/
2. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-85-water-and-wastewater-treatment-engineering-spring-2006/lecture-notes/
3. https://onlinecourses.nptel.ac.in/noc21_ce25/preview