NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL

SCHEME OF INSTRUCTION AND SYLLABI

M.Tech. – Environmental Engineering

(Effective from 2021-22)

NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL

VISION

Towards a Global Knowledge Hub, striving continuously in pursuit of excellence in Education, Research, Entrepreneurship and Technological services to the society

MISSION

- Imparting total quality education to develop innovative, entrepreneurial and ethical future professionals fit for globally competitive environment.
- Allowing stake holders to share our reservoir of experience in education and knowledge for mutual enrichment in the field of technical education.
- Fostering product-oriented research for establishing a self-sustaining and wealth creating centre to serve the societal needs.

DEPARTMENT OF CIVIL ENGINEERING

VISION

To be a knowledge nerve centre in civil engineering education, research, entrepreneurship and industry outreach services for creating sustainable infrastructure and enhancing quality of life.

MISSION

- Generating a specialized cadre of civil engineers by imparting quality education and training.
- Attain international standards in teaching, research and consultancy with global linkages.

Department of Civil Engineering:

Brief about the Department:

The Department of Civil Engineering was established in 1959, along with the setting up of the institute, that is, REC Warangal. The Department offers undergraduate and eight postgraduate programs in addition to Ph.D. The Department has highly committed faculty who are well qualified and are members of several national and international policy making and advisory bodies, including the BIS. The Department is a recognized QIP center since 1978 to offer Ph.D. programs to faculty of other institutes. The Department is known for its cutting-edge research and believes in disseminating the knowledge through publishing in highly reputed journals and patenting the research work.

The Department maintains excellent industry-institute linkages. Most of the students are placed in reputed companies, Government organizations, and Higher Educational Institutes in India and abroad. The alumni who are important stakeholders of the Department actively guide and provide valuable inputs. They constantly peer review the syllabus and curriculum to make students industry-ready.

The Civil Engineering Department, apart from Teaching and R&D, also does an enormous amount of consultancy, which adds up to the institutional internal revenue generation and involves faculty and students in challenging field problems. There are six centers of excellence in the Department, and most laboratories have state-of-the-art equipment.

The faculty of the Department are actively involved in sponsored projects and have prestigious

projects like SPARC, BRICS, IMPRINT, DST, SERB, DBT, ARDB, to name a few. The Department takes pride in having conducted the highest number of GIAN and SPARC programs.

The Civil Engineering Department has MoUs with highly reputed organizations like NAAC, NCCBM, WALAMTARI, SCCL, INVENTA, PSI, among others, and has collaborations with several foreign universities and companies such as – Texas A&M, NCAR-Colorado, PTV Group Germany, etc.

List of Programs offered by the Department:

Program	Title of the Program
B.Tech.	Civil Engineering
M.Tech.	Engineering Structures
	Water Resource Engineering
	Geotechnical Engineering
	Transportation Engineering
	Remote Sensing and Geographical Information Systems
	Environmental Engineering
	Construction Technology and Management
	Waste Management
Ph.D.	Civil Engineering

Note: **Refer to the following weblink for Rules and Regulations of M.Tech. program:**
https://www.nitw.ac.in/main/MTechProgram/rulesandregulations/

M.Tech.– ENVIRONMENTAL ENGINEERING

Program Educational Objectives

PEO1	Apply basic principles of environment and their significance in the socio-economic development
PEO2	Identify, formulate and design engineered solutions to environmental problems related to air, water and land.
PEO3	Apply best management practices for sustainable development.
PEO4	Communicate and manage interdisciplinary teams in solving complex environmental engineering problems.
PEO5	Demonstrate leadership qualities and exhibit professional ethics.

Program Articulation Matrix

Mission Statement	PEO1	PEO2	PEO3	PE04	PEO5
MS1	3	3	3	2	2
MS2	2	3	2	3	3

Program Outcomes (POs)

At the end of the program, the student will be able to:

PO1	Engage in critical thinking and pursue investigations/research and development to solve practical problems.
PO2	Communicate effectively, write and present technical reports on complex engineering activities by interacting with the engineering fraternity and with society at large.
PO3	Demonstrate higher level of professional skills to tackle multidisciplinary and complex problems related to Environmental Engineering
PO4	Analyze and predict environmental parameters /variables using formulated methodologies and techniques.
PO5	Design technically feasible solutions to environmental problems which are legally, ethically, socially and economically acceptable
PO6	Develop strategies for mitigating environmental problems at local, regional and global scales

SCHEME OF INSTRUCTION

M.Tech. (Environmental Engineering) Course Structure

I – Year: I – Semester

S.No	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	CE5301	Environmental Chemistry and Microbiology	3	0	0	3	PCC
2	CE5302	Water Supply Systems	3	0	0	3	PCC
3	CE5802	Solid Waste Management	3	0	0	3	PCC
4		Elective – I	3	0	0	3	PEC
5		Elective - II	3	0	0	3	PEC
6		Elective – III	3	0	0	3	PEC
7	CE5304	Advanced Environmental Engineering Lab	0	1	2	2	PCC
8	CE5505	Geographical Information Systems Lab	0	1	2	2	PCC
9	CE5348	Seminar – I	0	0	2	1	SEM
		Total	**18**	**2**	**6**	**23**	

I – Year: II – Semester

S.No	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	CE5351	Air Pollution and Control	3	0	0	3	PCC
2	CE5352	Wastewater Treatment Systems	3	0	0	3	PCC
3	CE5353	Environmental Impact Assessment and Management	3	0	0	3	PCC
4		Elective – IV	3	0	0	3	PEC
5		Elective – V	3	0	0	3	PEC
6		Elective – VI	3	0	0	3	PEC
7	CE5354	Environmental Monitoring Laboratory	0	1	2	2	PCC
8	CE5355	Environmental Systems Design Lab	0	1	2	2	PCC
9	CE5398	Seminar – II	0	0	2	1	SEM
		Total	**20**	**2**	**6**	**23**	

SCHEME OF INSTRUCTION

B.Tech. (Environmental Engineering) Course Structure

II – Year: I – Semester

S No	Course Code	Course Title	Credits	Cat. Code
		Industrial Training (8-10 Weeks) – Optional		
1	CE6347	Comprehensive Viva Voce	2	CVV
2	CE6349	Dissertation Part A	12	DW
		Total	14	

II – Year: II – Semester

S No	Course Code	Course Title	Credits	Cat. Code
1	CE6399	Dissertation Part B	20	DW
		Total	20	

Credits Distribution

Cat. Code	Sem-I	Sem-II	Sem-III	Sem-IV	Total
PCC	13	13	0	0	26
PEC	9	9	0	0	18
SEM	1	1	0	0	02
CVV	0	0	2	0	02
DW			12	20	32
Total	23	23	14	20	**80**

Abbreviations:

PCC – Program Core Courses
PEC – Program Elective Courses
SEM – Seminar
CVV – Comprehensive Viva Voce
DW – Dissertation Work

Professional Elective Courses:

Semester	Elective Number	Course Code	Course Title
I	I,II,III	CE5311	Ecology and Stream Pollution
I	I,II,III	CE5312	Environmental Regulations and Management System
I	I,II,III	CE5313	Environmental Fluid Mechanics
I	I,II,III	CE5314	Life Cycle Analysis
II	IV,V,VI	CE5361	Industrial Waste Management
II	IV,V,VI	CE5362	Water Quality Modeling and Management
II	IV,V,VI	CE5363	Environmental Systems Engineering
II	IV,V,VI	CE5364	Noise Pollution and Control

Special Notes / Instructions: In addition to the above listed electives, a student can also register one elective per semester from other departments and two electives per semester from other specializations of the same department, based on suitability of timetable.

DETAILED SYLLABUS

M.Tech. (Environmental Engineering)

CE 5301	ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY	3-0-0: 3

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

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	1	1	2
CO2	2	1	2	2	1	2
CO3	2	1	2	-	1	2
CO4	1	1	2	2	1	2

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/

CE 5302	WATER SUPPLY SYSTEMS	3-0-0: 3

Pre-requisites: NONE

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

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	2	1
CO2	3	2	2	3	1	-
CO3	3	2	3	1	3	1
CO4	3	2	3	1	3	1
CO5	3	2	2	3	1	-
CO6	3	2	1	1	2	1

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, ViessmanJr, 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

CE 5802	SOLID WASTE MANAGEMENT	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

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	1	1	3
CO2	3	1	3	2	2	3
CO3	3	2	3	2	3	3
CO4	3	2	3	2	3	3
CO5	3	2	3	2	3	2
CO6	2	1	2	1	1	2

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 land fills – 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/

CE 5304	ADVANCED ENVIRONMENTAL ENGINEERING LABORATORY	0-1-2:2

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

CO1	Sample and store water, wastewater and soil samples
CO2	Perform physicochemical treatment processes on lab scale
CO3	Perform environmental monitoring using sophisticated analytical instruments
CO4	Determine pollutant concentrations in air samples

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	2	1	2
CO2	3	2	1	1	2	2
CO3	2	2	1	2	3	1
CO4	3	2	2	1	2	3

Syllabus:

Experiment No.1: Estimation of Solids (TDS, DS, TSS, VS), Acidity, Alkalinity, Hardness, Chlorides and Fluorides

Experiment No.2: Determination of pH and Conductivity

Experiment No.3: Determination of Dissolved Oxygen

Experiment No.4: Estimation of Biochemical Oxygen Demand

Experiment No.5: Estimation of Chemical Oxygen Demand

Experiment No.6: Estimation of Nitrogen (Different Forms like Ammonia, Nitrite, Nitrate)

Experiment No.7: Estimation of Phosphates and Sulphates

Experiment No.8: Estimation of Residual Chlorine

Experiment No.9: Determination of Available Chlorine in bleaching powder

Experiment No.10: Conducting Break Point Chlorination Test

Experiment No.11: Conducting Jar test for determining optimum dosage of coagulant

Experiment No.12: Estimation of Organic Compounds Using HPLC

Experiment No.13: Analysis of air samples using Gas Chromatograph

Experiment No.14: Determination of Heavy metals using spectrophotometer/MPAES

Experiment No.15: Estimation of suspended particulate matter, SO_x, NO_x and VOC in air

Learning Resources:

Text Books:

1. Standard methods for the examination of water and wastewater, 21st Edition, Washington: APHA., 2012
2. Chemistry for Environmental Engineering and Science, Sawyer, C. N., McCarty, P. L., and Perkin, G.F., 5th edition McGraw-Hill Inc., 2002
3. Environmental Engineering Laboratory Manual, B. Kotaiah and Dr. N. Kumara Swamy, Charotar Publishing House Pvt. Ltd., 1st Ed., 2007

Reference Books:

1. Industrial Waste Resource Guidelines Sampling and Analysis of Waters, Wastewaters, Soils and Wastes, EPA Victoria, 2009

2. A Guide to the Sampling and Analysis of Waters, Wastewaters, Soils and Wastes, Environment Protection Authority State Government of Victoria March 2000

Online Resources:

1. www.vlab.co.in

CE 5505	GEOGRAPHICAL INFORMATION SYSTEMS LABORATORY	0-1-2: 2

Pre-requisites: NONE

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

CO1	Prepare different geospatial layers
CO2	Compute geometric measurements and perform spatial analysis
CO3	Create high-quality maps and associated graphics
CO4	Integrate different geospatial layers

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	2	2	1	1
CO2	1	2	1	3		1
CO3	1	2	2	2	1	1
CO4	2	3	2	2	1	1

Detailed Syllabus:

1. Digitization of Points and Lines
2. Editing Map Elements
3. Attribute Data Entry and Manipulation
4. Cleaning, Building and Transformation
5. Data Analysis – Overlay, Buffer
6. Map Generation with Patterns and Legends
7. Buffer Analysis
8. Network Analysis

Learning Resources:

1. ArcGIS user manuals,
2. QGIS User Manuals

CE 5351	AIR POLLUTION AND CONTROL	3-0-0 :3

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

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	3	1	1
CO2	3	1	2	3	2	2
CO3	3	2	2	2	1	1
CO4	1	3	2	1	3	3

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. Stern, A.C., Fundamentals of Air Pollution, Academic Press, 1984
4. *Air pollution meteorology and dispersion*, *Arya, S.P., 1999.* Oxford University Press, UK.
5. *Principles of Air Pollution Meteorology,* Lyons and Scott, 1990.,CRC Press.

Reference Books:

1 *Computerized Environmental Modelling,*Hardisty, J. et al (1993), Wiley.
2 *A Basic Introduction to Pollutant Fate and Transport,* Dunnivant, F.M. and Anders Elliot (2006), Wiley Interscience.
3 *Fundamentals of air pollution*, Boubel, R.W., Fox, D.L., Turner, D.B. and Stern, A.C., 1994. 3rd Edition, Academic Press, New York
4 Fundamentals of Stack Gas Dispersion, Beychok, Milton. (2005). American Institute of Chemical Engineers, ISBN: 0-9644588-0-2

Online Resources:

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

CE 5352	WASTEWATER TREATMENT SYSTEMS	3-0-0: 3

Pre-requisites: NONE

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.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1	-	2	-
CO2	3	3	1	-	1	-
CO3	2	2	-	-	1	1
CO4	3	3	1	-	1	2

Syllabus:

Introduction: 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, Tchobanoglous, G., et al., Fifth Edition, Metcalf & Eddy, Inc., McGraw-Hill Publishers, New York, 2013.
4. Water Treatment Principles and Design, Crittenden, J.C., et al., 2nd Ed., Montgomery, Inc., John Wiley and Sons, New York, 2005.
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

CE 5353	ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT	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.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	2	3	-
CO2	2	1	1	1	3	-
CO3	2	2	3	1	3	-
CO4	2	2	2	2	2	2

Syllabus:

Introduction: Definitions – Environmental Inventory, Standards, Indices – Environmental attributes—Air, Water Noise, Land Economic; Cultural and detailed discussions of individual parameters of each attribute; 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. Environmental Impact Assessment & Management, Hosetti, B. B., Kumar A, Eds, Daya Publishing House, 1998
5. UNESCO, Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development, UNESCO/UNEP, Paris, 1987
6. EIA Notification 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

CE5354	ENVIRONMENTAL MONITORING LABORATORY	0 – 1 – 2:2

Pre-requisites: NONE

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

CO1	Microscopic examination of microbes from soil, water and air
CO2	Isolation of microorganisms, understanding bacterial staining and cultural techniques
CO3	Apply fundamental principles of microbiology to wastewater treatment
CO4	Quantitative estimation of microbes, report writing on microbial analysis of the samples

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	2	1	3
CO2	2	2	1	1	2	3
CO3	2	2	1	2	1	2
CO4	2	1	3	1	2	2

Syllabus:

1. Preparing a Culture Medium and Culturing Bacteria
2. Bacterial Strain Isolation by Using Plate Streaking
3. Microscopy and Environmental Strain Isolation 2
4. Bacterial staining techniques
5. Culturing techniques
6. Plate count test and MPN test
7. Bacterial Genomic DNA Extraction
8. DNA Measurement & PCR of Bacterial 16S Rrna
9. Gel Electrophoresis, Purification of 16S rRNA Genes
10. Repeating DNA extraction, PCR or Gel Electrophoresis
11. Analysis of the above parameters (1 to 10) and preparation of Report on
12. Soil samples
13. Water samples
14. Wastewater samples
15. Anaerobic digestate
16. Composting
17. Industrial wastewater (tannery wastewater, textile wastewater)

Learning Resources:

Text Books

1. Environmental Microbiology: A Laboratory Manual, Burns, Richard G, 2nd Ed.
2. Environmental Microbiology: A Laboratory Manual (Maier and Pepper Set) 2nd Edition,

Reference Books

1. Standard methods for the examination of water and wastewater, 21st Edition, Washington: APHA., 2012

Online material

1. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-89-environmental-microbiology-fall-2004/lecture-notes/
2. https://microbenotes.com/category/environmental-microbiology/
3. https://www.uni-due.de/imperia/md/content/water-science/ss16/4521_script_agsiebers.pdf
4. https://emmb.engin.umich.edu/lab-protocols/
5. https://www.youtube.com/playlist?list=PLPVPYDP5_7b_UojO6bRupAmVnpIfYXXt3
6. https://cosmolearning.org/video-lectures/chapter-1-main-themes-microbiology-13
7. https://www.uni-due.de/imperia/md/content/water-science/ss16/4521_script_agsiebers.pdf

CE 5355	ENVIRONMENTAL SYSTEMS DESIGN LABORATORY	0-1-2 :2

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

CO1	Design stormwater sewers
CO2	Design water supply mains and distribution system
CO3	Estimate the effect of water hammer in water supply pipelines and design the appurtanances
CO4	Determine kinetic parameters related to chemical and biological processes
CO5	Design air pollution control systems

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	3	2	2
CO2	3	1	2	3	2	1
CO3	3	2	1	2	1	2
CO4	3	1	2	3	2	1
CO5	3	1	1	3	2	2

Syllabus:

1. Design problem 1: Analysis of Precipitation Data
2. Design problem 2: Analysis of Distribution Networks
3. Design problem 3: Design of water Treatment plant
4. Design problem 4: Design of Wastewater Treatment plant
5. Design problem 5: Design of Air Pollution Control Devices
6. Design problem 6: Determination of Rate Constants and Ultimate BOD
7. Design problem 7: Kinetics of Biological Processes
8. Design problem 8: Kinetics of Chemical Processes
9. Design problem 9: Design integrated solid waste management system

Learning Resources:

Text Books:

1. Waste water Engineering Treatment and Reuse, Metcalf & Eddy, Inc., McGraw Hill Inc., New Delhi., 2003
2. Environmental Engineering, Peavy, H.S, Rowe, D.R., and G. Tchobanoglous , McGraw Hill Inc., New York., 1995

Reference Books:

1. Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, McGraw Hill Education, 2017, 4th Edition
2. Solid Waste Technology & Management, Thomas Christensen, John wiley& sons, USA, 2011.

Online Resources:

1. www.epa.gov.in

CE 5311	ECOLOGY AND STREAM POLLUTION	3-0-0: 3

Course Outcomes:

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

CO1	Identify components of ecosystems and their interrelationships.
CO2	Comprehend importance of stream water chemistry in assessment of fate of pollutants.
CO3	Assess self-purification capacity of receiving waters.
CO4	Model the pollutant transport processes in water bodies

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	2	2	1	2
CO2	2	2	3	2	1	3
CO3	1	3	2	3	2	2
CO4	1	2	3	2	3	3

Syllabus:

Introduction To Ecosystems: Development and evolution of ecosystems – Principles and concepts – Energy flow and material cycling – Nutrient cycles- productivity – Classification of ecotechnology – ecological engineering- Classification of systems – Structural and functional interactions of environmental systems – Mechanisms of steady-state maintenance in open and closed systems Modeling and ecotechnology – Classification of ecological models – Applications- Ecological economics- Self-organizing design and processes. Introduction To

Fluvial Ecosystems: Fluvial Ecosystem Diversity- The Water Cycle – Stream flow- Flow Variation- The Stream Channel- Sediments and their Transport- Fluvial Processes along the River Continuum Stream water Chemistry: Dissolved Gases -Major Dissolved Constituents of River Water-Variability in ionic concentrations -The dissolved load -Chemical classification of river water-The Bicarbonate Buffer System-Influence of Chemical Factors on the Biota-Variation in ionic concentration-Salinization -Effects of acidity on stream ecosystems

Water Quality: Water quality models – Historical development – Non point source pollution-Mass balance equation – Streeter – Phelps Equation – Modification to Streeter – Phelps Equation – Waste load allocations – Dissolved oxygen in Rivers and estuaries; Lake Water Quality Models; Models for Nitrogen, Bacteria, Phosphate and toxicants – Ground Water Quality Modeling – Contaminant solute transport equation, Numerical methods- legislations for water quality

Learning Resources:

Text Books:

1. Principles of Water Quality Control, Tebutt T.H.Y., 5th Ed., Pergamon Press, 1998
2. Principles of Surface Water Quality Modelling and Control, Thomann V. R., and Mueller A. J., Prentice Hall, 1997
3. Ecology and the Environment, Monson, Russell K. (Ed.), Springer Publications, 2014.

Reference Books:

1. Stream Ecology and Self Purification: An Introduction, Frank R. Spellman and Joanne

Drinan, 2nd Ed., CRC Press, 2001
2. Environmental Engineering, Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, McGraw Hill Education, 2017, 1st Indian Edition
3. Ecological Effects of Wastewater, Welch, E.D., Cambridge University Press, 1992

Online Resources:

1. https://nptel.ac.in/courses/127/106/127106004//
2. https://nptel.ac.in/content/storage2/courses/122103039/pdf/mod6.pdf
3. https://www.jstor.org/stable/25030232

CE 5312	ENVIRONMENTAL REGULATIONS AND MANAGEMENT SYSTEM	3-0-0: 3

Pre-requisites: NONE

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

CO1	Identify the importance of Management System and the process
CO2	Develop the strategic Environmental Management System to achieve cleaner production and pollution control
CO3	Identify the requisites for Environmental auditing and Documentation
CO4	Formulate environmental management System for various industries

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	2	3	-
CO2	2	1	1	1	3	-
CO3	2	2	3	1	3	-
CO4	2	2	2	2	2	2

Syllabus:

Environmental Management System

Environmental management system - What is an EMS? Costs and Benefits of an EMS, Principles, problems and strategies; Review of political, ecological and remedial actions. Future strategies; multidisciplinary environmental strategies, the human, planning, decision-making and management dimensions. EMS in India

Develop an EMS

Plan, Do, Check and Act. Plan - Planning, including identifying environmental aspects and establishing goals, Do - Implementing, including training and operational controls, Act Reviewing, including progress reviews and acting to make needed changes to the EMS, Check Checking, including monitoring and corrective action

Preventive Environmental Management

Pollution control vis a vis Pollution Prevention - Opportunities and Barriers – Cleaner production and Clean technology, closing the loops, zero discharge technologies - source reduction, raw material substitution, toxic use reduction and elimination, process modification – Cleaner Production Assessment- Material or resource balance – CP option generation and feasibility analysis

Standardization

Introduction to ISO and ISO 14001-2004, 2015, ISO 9001-2015, EMAS regulations, Wider application of system based approach. Local infrastructure development and environmental management: A system approach, Regional environmental management system, Conversion plan development and implementation strategies, Environmental management systems in local government. Twelve-step transition process from ISO 14001:2004 to 2015 revision

Environmental Audit and Applications

Environmental management system audits as per ISO 19011-2011 vs 2018 – Principles of auditing, Types of Audits, objective of Audit, Principle areas of environmental auditing, Benefits of Environmental Audit Environmental Audit Activities Roles and qualifications of auditors - Environmental performance indicators and their evaluation – Nonconformance – Corrective and preventive actions -compliance audits – waste audits and waste minimization planning – Environmental statement - Due diligence audit , Applications of EMS.

Case Studies

Waste Audits and Pollution Prevention opportunities in Textile, Sugar, Pulp & Paper, Electroplating, Mining, petroleum refining, Tanning industry, Dairy, Cement, Chemical industries, etc.

Learning Resources:

Text Books:

1. Environmental Management, Vijay Kulkarni and Ramachandra T.V., 2006. Commonwealth of Learning, Canada and Indian Institute of Science, Bangalore.
2. Parvesh, A newsletter from ENVIS Centre, Environmental Management System- February 2001, CPCB, India

Reference Books:

1. Environmental Management Systems and Cleaner Production, Hillary, R., Wiley Publishers, 1997
2. Installing Environmental management Systems – a step by step guide, Christopher Sheldon and Mark Yoxon, Earthscan Publications Ltd, London, 1999
3. ISO 14001/14004, ISO 9001, ISO 19011: Environmental management standards, International Organisation for Standardisation,
4. https://www.epa.gov/ems - Environmental Management Systems (EMS)
5. Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, Second Edition, NSF International, Ann Arbor, Michigan, January 2001

Online resources:

1. https://nptel.ac.in/courses/120/108/120108004/

CE 5313	ENVIRONMENTAL FLUID MECHANICS	3-0-0: 3

Pre-requisites: NONE

Course Outcomes:

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

CO1	Formulate momentum, energy and mass transport models
CO2	Solve diffusion-dispersion equations
CO3	Derive and solve basic equations of flow through porous medium
CO4	Solve analytically transport equations of momentum, heat, gases, and volatile organic chemicals across the air/water interface
CO5	Design multiport diffusers and submerged discharges

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	3	3	3
CO2	2	1	3	3	3	3
CO3	2	1	3	3	3	3
CO4	2	1	3	3	3	3
CO5	2	1	3	3	3	3

Syllabus:

Basic concepts of fluid mechanics, conservation laws, continuity equation, momentum equation, Application of momentum and energy equations

Transport processes, diffusion phenomena, Fick's Ist and IInd Laws of diffusion, Advection diffusion equation, Turbulent diffusion and dispersion mixing in rivers

Porous medium flow, Approximation of Dupuit, Contaminant transport, Saltwater intrusion into aquifers, Non-aqueous phase liquid (NAPL) in groundwater, aspects of numerical modelling

Exchange Processes at the Air/Water Interface, Exchange of Gases, Measurement of Gas Mass Transfer Coefficients.

Topics in Stratified Flow: Buoyancy and Stability Considerations, Internal Waves, Mixing, Double-Diffusive Convection, Mixed-Layer Modeling.

Dynamics of Effluents: Jets and Plumes, Submerged Discharges and Multiport Diffuser Design, Surface Buoyant Discharges

Sediment Transport: Hydraulic Properties of Sediments, Bed-Load Calculations, Suspended Sediment Calculations, Particle Interactions, Particle-Associated Contaminant Transport.

Remediation Issues: Soil and Aquifer Remediation, Bioremediation, Remediation of Surface waters

Learning Resources:

Text Books:

1. Environmental Fluid Mechanics, Rubin, H and Atkinson, J, Marcel and Deckker, 2001.
2. Diffusion: Mass transfer in fluid systems, Cussler, E. L, Cambridge University Press, 3rd Ed., , 2007.

Reference Books:

1. Fluid Mechanics of Environmental Interfaces, Gualtieri and Mihailovic, Taylor and Francis, 2008
2. Fluid Mechanics, Kundu and Cohen, Academic Press, 2012
3. Open Channel Flows, Chow, V.T., McGraw Hill, 2010

Online Resources:

1. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-061-transport-processes-in-the-environment-fall-2008/lecture-notes/

CE 5314	Life Cycle Analysis	3-0-0 : 3

Pre-requisites**:** NONE

Course Outcomes:

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

CO1	Interpret the concept of Life cycle thinking and framework of Life cycle assessment.
CO2	Assimilate the computational structure behind LCA software packages
CO3	Write report/paper based on a LCA study
CO4	Predict the environmental impacts of a product

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	2	2	3
CO2	3	1	3	3	3	3
CO3	3	3	2	3	1	2
CO4	3	1	3	3	3	3

Syllabus:

Introduction, Life Cycle Assessment concepts.

A brief history of Life-cycle Inventory analysis, overview of methodology, three components, Identifying and setting boundaries for life-cycle stages, issues that apply to all stages, Applications of inventory analysis

Procedural framework of Life-cycle inventory: Introduction, define the purpose and scope of inventory

General issues in Inventory analysis: Introduction, Using Templates, Data issues, special case boundary issues

Issues Applicable to specific life cycle stages: Introduction, Raw Material acquisition stage, Manufacturing stage, Use/Reuse/Maintenance stage, Recycle/Waste Management stage.

Term Project Proposal, Process Based LCA, Software Demo: SimaPro Part-1, LCA Software Demo: SimaPro Part 2, LCA Software Demo: GREET, LCA Software Demo: BEES (Construction Materials)

Learning Resources:

Text Books:

1. Environmental Life Cycle Analysis, Ciambrone , D.F., (2019)., Taylor and Francis Group, UK.
2. Handbook on Life Cycle Assessment: Operational guide to the ISO standards, JeroenGuinee, (2014) Springer, USA.

Reference Books:

1. Life Cycle Assessment - Theory and Practice, Hauschild, M. Z., Rosenbaum, R. K., & Olsen, S. I. (Eds.) (2018). Springer. https://doi.org/10.1007/978-3-319-56475-3

Online Resources:

1. www.openlca.org
2. www.ecoinvent.org
3. www.gabi-software.com

CE 5361	INDUSTRIAL WASTE TREATMENT	3-0-0: 3

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

CO1	Assess characteristics of industrial wastewaters and their impacts when disposed
CO2	Explore suitable pre-treatment techniques
CO3	Identify suitable advanced wastewater treatment options
CO4	Evaluate wastewater characteristics and suggest treatment strategies for different industries

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	2	2	2	1
CO2	2	2	1	2	2	3
CO3	2	2	1	3	2	3
CO4	1	2	3	2	3	3

Syllabus:

Introduction: General Characteristics of Industrial Effluents, Effects on Environment - ISI tolerance limits for discharging industrial effluents into surface water, into public sewers, onto land for irrigation and marine environment- Toxic chemicals from industry, Zero waste approach.

Pre-treatment of Industrial Wastewater: Necessity of pre-treatment – Strength Reduction – Volume Reduction – Equalization and Proportioning- Neutralization - Segregation - Process Changes - Salvaging - By product Recovery.

Advanced Wastewater Treatment: Necessity – Treatment Techniques - Removal of Solids - Reverse Osmosis, Ion Exchange, Electro dialysis, Solvent Extraction, Floatation - Removal of Refractory Organics - Removal of Nitrogen and Phosphorus – Wastewater disinfection

Major Industrial Effluents: Sources, Characteristics and Treatment Strategies.
Food Industries: Sugar, Dairy, Distilleries
Chemical and other Industries: Paper and Pulp, Tanneries, Textiles, Fertilizers, Pharmaceuticals, Cement, Steel and refineries.

Learning Resources:

Text Books:

1. Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, McH Edn, 2017,
2. Numerow, N.L., Liquid Waste from Industry – Theories, Practice and Treatment, AddisonWesley, 1971
3. Rao, M.N., and Dutta, A.K., Wastewater Treatment, IBH Publ., 1995

Reference Books:

1. Industrial Wastewater Management, Treatment and Disposal, WEF Manual of practice No. FD-3, 3rd Ed., WEF Press and McGraw Hill, 2008
2. Industrial Waste Water Treatment, Patwardhan, A.D., PHI Learning, 2009
3. Industrial Wastewater Treatment, Recycling and Reuse, Vivek Ranade, Vinay Bhandari, Elsevier Publications, 2014.

Online Resources:

1. https://nptel.ac.in/courses/105/106/105106119/
2. http://nptelvideos.com/video.php?id=1118
3. https://www.youtube.com/watch?v=in3GSRuooRs

CE 5362	WATER QUALITY MODELING AND MANAGEMENT	3-0-0: 3

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

CO1	Assess water quality parameters and their importance
CO2	Identify water quality monitoring strategies and suitable approaches for monitoring water quality
CO3	Formulate mathematical models to assess water quality
CO4	Assess water quality indices and formulate water quality management/ plans for restoration

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	2	2	2	2
CO2	2	1	1	2	2	1
CO3	3	2	2	2	2	2
CO4	2	2	1	2	2	2

Syllabus:

Introduction: Water Quality, Objectives and Standards, Water quality characteristics, sampling and analysis, Analytical methods, Automated analysis and remote monitoring.

Water quality monitoring: Water Pollution, Sources of Pollution, Nature of pollutants, Existing Approaches for Control/Abatement of Water Quality Degradation, Water Quality Monitoring in River Basins and lakes.

Water quality modeling: Modelling and Monitoring, Evolution of Water Quality Models, Types of Water Quality Models, Streeter Phelps Model, Non-Point Source Pollution, Modelling Approaches For Modeling Non-point Sources, River Water Quality Models and Lake Quality Models, Water quality indices

Water Quality Management: Overview of Water Quality Management, Water Quality degradation, Flow Augmentation, environmental flows in rivers, water quality restoration, , Regulatory Provisions Pertaining to Water Quality Management, Water quality indices and Legal Aspects of Water quality management, Public and Private Sector Involvement

Management Practices for pollution control - Technology based approach - Water quality based approach - Control of point sources - Control of nonpoint sources- BMPs to control NPS Pollution, Optimization in Water Quality Management, Management plan case studies, Rivers, Lakes, reservoirs and Ground water.

Learning Resources:

Text Books:

1. Water Quality Engineering in Natural Systems, Chin, David A., (2006), Wiley – Interscience.
2. Environmental Engineering - A Design Approach, Sincero, A.P. and Sincero, G.A. (1999) Prentice Hall of India, N Delhi
3. Principles of Surface Water Quality Modelling and Control, Thomann, R.V., Mueller, J.A., (1987),Harper and Row Publishers

Reference Books:

1. Surface Water Quality Modelling, Chapra, S.C. ISBN-13: 978-1577666059; ISBN-10: 1577666054, Waveland Press, 2008
2. Water Quality Modelling for Rivers and Streams, Marcello Benedini, George Tsakiris. Springer Science & Business Media, 2013.
3. Principles of Water Quality Management, Eckenfelder, ISBN 978-94-011-7117-5, Elsevier, 1980

OnlineResources:

1. https://www.epa.gov/waterdata/surface-water-quality-modeling
2. https://www.youtube.com/watch?v=sItfGlg4sz0

CE 5363	ENVIRONMENTAL SYSTEMS ENGINEERING	3-0-0: 3

Pre-requisites: NONE

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

CO1	Analyse physical, chemical and biological processes in environmental systems
CO2	Formulate and solve governing equations for pollutant transport
CO3	Analyse engineered transport system
CO4	Plan and analyse treatment systems

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	3	2	3
CO2	2	1	2	3	2	3
CO3	3	1	2	3	2	3
CO4	2	1	2	3	2	3

Syllabus:

Basic concepts of mole and mass concentration: notations and conventions, Review of mass balance concepts.

Diffusive transport: Diffusion and Fick's first law, Calculation of molecular diffusion coefficients in air and water

The constitutive transport equation: Derivation of general transport equation and special forms ie continuity and NS equations and similarity between equations of mass momentum and heat dispersion laws.

Theories of mass transport: two film theory, penetration and surface renewal theory, Boundary layer theory. Mass transport correlations

Transport in sheared reactors: Fluid shear and turbulence, transport in steady sheared fluids, turbulent sheared fluids, shear rates in mixed reactors

Particles and fractals: Introductions, particle size spectra, solid particles and fractal aggregate geometries, measuring and calculating fractal dimensions from particle size distributions.

Coagulation in natural and engineered systems: Introduction, general coagulation equations, factors affecting the stability of aquasols, coagulation kinetics, fractal coagulation models.

Finite difference and Finite volume procedures for solutions of partial differential equations of Mass, Momentum and Energy transport phenomenon

Learning Resources:

Text Books:

1. Environmental Transport Processes, Bruce E. Logan, 2nd Ed., Wiley, 2012
2. Introduction to chemical transport in the environment, John S. Gulliver, Cambridge University Press, 2007

Reference Books:

1. Diffusion: Mass transfer in fluid systems, E.L. Cussler, 3rd Ed., Cambridge University Press, 2007.
2. Chemodynamics and Environmental Modeling S. Trapp and M. Matthies, , Springer, 1998
3. Mathematics of Diffusion, Crank, J., 2nd Edition, Oxford University Press, 1975

Online Resources:

1. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-061-transport-processes-in-the-environment-fall-2008/lecture-notes/

CE5364	Noise Pollution and Control	3-0-0: 3

Course Outcomes:

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

CO1	Classify the type and sources of noise pollution in urban areas
CO2	Assess and analyse noise levels from different sources
CO3	Identify suitable noise control measures to reduce noise
CO4	Plan strategies for control of noise from different sources to meet regulatory standards

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	-	1	-
CO2	1	2	1	-	2	1
CO3	2	1	1	1	-	-
CO4	2	1	-	1	-	-

Introduction - Sources of noise pollution – Properties and Measurements of Noise – Noise Propogation; sound measurement; Noise level meters – types, components, Noise Power level, Intensity level, Pressure level – Relationships -– Weighted networks – Combined Noise – Octave Band – Noise spectrum – Equivalent Noise – Day and night time – Standards, Equations and Application.

Characteristics and Effects of noise - Characterization of Noise from Construction, Mining, Transportation and Industrial Activities, Airport Noise – General Control Measures – Effects of noise pollution – auditory effects, non-auditory effects - Performance effects - Behavioral Effects.

Noise Abatement and Control - Noise Menace – Noise mitigation – Prevention and Control of Noise Pollution in Industries– Control of noise at source, control of transmission - Personal protection - Control of other types of Noise Sound Absorbent – Noise Pollution Analyzer

ACOUSTICS OF NOISE - Acoustic materials – Industrial Noise Control – effects of noise on workers efficiency -Acoustic quieting - mechanical isolation technique, acoustical absorption, constrained layer damping – OSHA Noise standards – public education – other non-legislative measures – Auditorium Designing – Anti Noise Devices.

REGULATION - Legislation of Noise and the Administrative Function – Planning for Noise Reduction – Noise levels standards in India - Acceptable Noise levels in Residential Areas - IS Standards - Vehiclular Nosie levels and the Law –The Aircraft Act 1934 (Related to noise only), Factories Act 1948 (Related to noise only), The Environmental Protection Act 1986 – Noise pollution (regulation and control) Rules, 2000.

Learning Resources:

Text Books:

1. Noise Pollution and Control Strategy, S.P. Singal -, Alpha Publishers, 2005

2. Hand Book of Noise Measurement, Peterson and Gross. E Jr., “”, 7th Edn, 2003.

Reference Books:

1. Noise Pollution: Impact and Counter Measures, Antony Milne, David & Charles PLC, 2009.
2. Noise Control Manual - Guidelines for Problem-Solving in the Industrial / Commercial Acoustical Environment, **Harris**, David A, Spinger 1991
3. Advanced Air and Noise Pollution Control: Volume 2 (Handbook of Environmental Engineering), Lawrence K. Wang (Editor), Norman C. Pereira, Yung Tse Hung, Humana Press, 2004.

Online Resources:

1. https://nptel.ac.in/courses/112/104/112104227/
2. https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-me32/
3. https://onlinecourses.nptel.ac.in/noc19_me72/preview
4. https://www.legalserviceindia.com/articles/noip.htm
5. https://cpcb.nic.in/noise-pollution/
6. http://cpcbenvis.nic.in/noisepollution/noise_rules_2000.pdf

CE5348	Seminar – I	0 – 0 – 2:1

Pre-Requisites:NIL

Course Outcomes:

At the end of the course, students will be able to

CO1	Identify and chose appropriate topic of relevance.
CO2	Assimilate literature on technical articles.
CO3	Write technical report.
CO4	Design and develop presentation on a given technical topic.
CO5	Deliver technical presentation on a specified topic.

Course Articulation Matrix:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2		1		
CO2	3	2		2		
CO3	2	3		2		
CO4	2	2		2		
CO5	2	3		2		

Syllabus:

There is no specific syllabus for this course. However, student can choose any topic, of his choice, pertaining to Environmental Engineering. Topic should be a relevant and currently researched one. Students are advised to refer articles published in current journals in the area of Environmental Engineering for choosing their seminar topics. Student should review minimum of 5 to 6 research papers relevant to the topic chosen, in addition to standard textbooks, handbooks, etc. Students are required to prepare a seminar report, in the standard format and give presentation to the Seminar Assessment Committee (SAC) in the presence of their classmates. It is mandatory for all the students to attend the presentations of their classmates.

Learning Resources:

Text Books:

Reference Books:

1. Research Articles / Reports available on Internet
2. Environmental Engineering Journals
3. Environmental Engineering Textbooks and Handbooks

Online Resources:

1. Guidelines for the Preparation and Delivery of a Seminar Presentation: http://www2.cs.uregina.ca/~hilder/cs499-900/Presentation%20Guidelines.pdf
2. Guidelines on Seminar Presentation:http://foodsci.rutgers.edu/gsa/SeminarGaudelines.pdf
3. http://onlinepubs.trb.org/onlinepubs/circulars/ec194.pdf
4. Instructor Resources: Seminar Proposal Guidelines, SAE International; http://www.sae.org/training/seminars/instructorzone/proposalguidelines.pdf

CE5398	Seminar – II	0 – 0 – 2:1

Pre-Requisites: NIL

Course Outcomes:

At the end of the course, students will be able to

CO1	Identify and chose appropriate topic of relevance.
CO2	Assimilate literature on technical articles.
CO3	Write technical report.
CO4	Design and develop presentation on a given technical topic.
CO5	Deliver technical presentation on a specified topic.

Course Articulation Matrix:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2		1		
CO2	3	2		2		
CO3	2	3		2		
CO4	2	2		2		
CO5	2	3		2		

Syllabus:

There is no specific syllabus for this course. However, student can choose any topic, of his choice, pertaining to Environmental Engineering. Topic should be a relevant and currently researched one. Students are advised to refer articles published in current journals in the area of Environmental Engineering for choosing their seminar topics. Student should review minimum of 5 to 6 research papers relevant to the topic chosen, in addition to standard textbooks, handbooks, etc. Students are required to prepare a seminar report, in the standard format and give presentation to the Seminar Assessment Committee (SAC) in the presence of their classmates. It is mandatory for all the students to attend the presentations of their classmates.

Learning Resources:

Text Books:

Reference Books:

1. Research Articles / Reports available on Internet
2. Environmental Engineering Journals
3. Environmental Engineering Textbooks and Handbooks

Online Resources:

1. Guidelines for the Preparation and Delivery of a Seminar Presentation: http://www2.cs.uregina.ca/~hilder/cs499-900/Presentation%20Guidelines.pdf
2. Guidelines on Seminar Presentation:http://foodsci.rutgers.edu/gsa/SeminarGaudelines.pdf
3. http://onlinepubs.trb.org/onlinepubs/circulars/ec194.pdf
4. Instructor Resources: Seminar Proposal Guidelines, SAE International; http://www.sae.org/training/seminars/instructorzone/proposalguidelines.pdf

CE6347	Comprehensive Viva	0 – 0 – 0:2

Pre-requisites: Both I & II Semester course work of I Year should be completed.

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

CO1	Assimilate knowledge of different courses studied.
CO2	Develop overall comprehension about Environmental Engineering.
CO3	Analyse real life environmental problems with theoretical knowledge learned.
CO4	Interpret and Articulate solutions to real life environmental problems.

Course Articulation Matrix:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2			1
CO2	2	2	2			1
CO3	2	3	2			2
CO4	1	2	3			1

Syllabus:

Entire course of study (All the required courses studied) up to II Semester of I Year.

Learning Resources:

Text Books:

1. Reading Material of all the courses.

Reference Books:

1. Case Studies / Consultancy Reports.

CE6349	Dissertation Part – A	0 – 0 – 0:12

Pre-Requisites: Both I & II Semester course work of I Year should be completed.

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

CO1	Appraise Research Problem Statement.
CO2	Evaluate literature critically in chosen area of research & establish Scope of work.
CO3	Develop Study Methodology.
CO4	Plan and carryout pilot study.

Course Articulation Matrix:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1			1	3		3
CO2			1	3		3
CO3	2	2	2	3		3
CO4	3	3	1	3		3

Syllabus:

There is no prescribed syllabus. Students are required to search, collect and review various research articles published in chosen area of research. A student has to select a topic for his/her dissertation, based on his/her interest and the available facilities at the commencement of dissertation work. A student shall be required to submit a dissertation report on the research work carried out by him/her.

Learning Resources:

Text Books:

1. Writing Your Dissertation, Derek Swetnam, Oxford, UK, 2004, Third Edition.

Reference Books:

1. Conference / Seminar Proceedings.
2. Handbooks / Research Digests.
3. Journal Publications.

CE6399	Dissertation Part – B	0 – 0 – 0: 20

Pre-requisites:

1. Both I & II Semester course work of I Year should be completed.
2. CE6349: Dissertation Part A

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

CO1	Appraise Research Problem Statement.
CO2	Evaluate literature critically in chosen area of research & Establish Scope of work.
CO3	Formulate Study Methodology.
CO4	Compile data base with appropriate field studies/laboratory tests.
CO5	Develop appropriate models and discuss solutions.

Course Articulation Matrix:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1			1	3		3
CO2			1	3		3
CO3	2	2	2	3		3
CO4		1		3		
CO5	2	3	3	3		3

Syllabus:

There is no prescribed syllabus. Students are required to search, collect and review various research articles published in chosen area of research. A student has to select a topic for his/her dissertation, based on his/her interest and the available facilities at the commencement of dissertation work. A student shall be required to submit a dissertation report on the research work carried out by him/her.

Learning Resources:

Text Books:

1. Writing Your Dissertation, Derek Swetnam, Oxford, UK, 2004, Third Edition.

Reference Books:

1. Conference / Seminar Proceedings.
2. Handbooks / Research Digests.
3. Journal Publications.

NOTE: Refer to the following link for the guidelines to prepare dissertation report: https://www.nitw.ac.in/main/PGForms/NITW/