ERODE SENGUNTHAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University)

PERUNDURAI, ERODE - 638 057

PG Curriculum and Syllabus

(1 to 4 Semesters)

M.E. ENVIRONMENTAL ENGINEERING

Choice Based Credit System (CBCS)

REGULATION 2019

ERODE SENGUNTHAR ENGINEERING COLLEGE

(Approved by AICTE, New Delhi, Permanently Affiliated to Anna University - Chennai
& Accredited by NAAC & National Board of Accreditation (NBA), New Delhi.)

PERUNDURAI, ERODE 638 057

INSTITUTION VISION & MISSION

VISION

Erode Sengunthar Engineering College strives with determination and commitment to provide and promote world-class Technical Education, in particular to the students of backward rural areas, transforming them into holistic personalities embedded with discipline, skill and responsibility that make them patriotic, successful, and self-developed professionals ready to accomplish any job in their career and life.

MISSION

- Provide an idyllic study atmosphere, fine infrastructure, qualified and dedicated faculty and standardized systems for a strong career foundation.
- Aid and motivate the students and faculty alike for maximum utilization of facilities, making them innovative and creative in thinking and research, in order to provide technical service to industry and society.
- Develop multi-skilled personalities to make ESEC, a world leader in Technical Education.

DEPARTMENT OF CIVIL ENGINEERING

VISION

- Department of Civil Engineering of Erode Sengunthar Engineering College are committed to provide students latest learning techniques and full-fledged knowledge base in related sectors to make them globally recognizable Civil Engineers.

MISSION

- To inculcate knowledge through laboratory and field study, apart from effective teaching – learning process.
- To utilize the infrastructure of the college to a maximum extent.
- To synergize the efforts of both students and staff to meet the ever – growing construction – the needs of the industry.
- To expose the faculty and students in research and consultancy works.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEOs1:PREPARATION AND CORE COMPETENCE: To prepare the students with strong fundamental knowledge in mathematics, science and engineering, communication, to identify the design concept, analyze and to execute a project.

PEOs2:BREADTH: Providing opportunities to work with related fields of engineering viz computer science and engineering, electrical engineering and mechanical engineering, so that the students can able to understand the different industrial environments.

PEOs3:PROFESSIONALISM: To develop high proficiency in computer-based engineering knowledge, developing soft skills, design and development, and the use of computational tools.

PEOs4:LEARNING ENVIRONMENT: To promote continuous learning, research and social development activities among the students with strong, professional, moral and ethical values. Thereby they can achieve successful carriers to meet the needs of Indian and multinational organizations.

ERODE SENGUNTHAR ENGINEERING COLLEGE, ERODE

DEPARTMENT OF CIVIL ENGINEERING

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM

I TO IV SEMESTERS CURRICULUM

M.E. ENVIRONMENTAL ENGINEERING
Minimum credits to be earned : 69

SEMESTER I

THEORY

Code No	Course	Objective & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19EV101	Probability and Statistics for Environmental Engineers	I ,III	1,2,10 ,11	1	3	1	0	4	40	60	100	BS
19EV102	Environmental Chemistry	I ,III	1,2,3	1	3	0	0	3	40	60	100	PC
19EV103	Environmental Microbiology	I ,III	1,2,3	1	3	0	0	3	40	60	100	PC
19EV104	Physico-Chemical Treatment of Water and Wastewater	III	1,2,10 ,11	1	3	0	0	3	40	60	100	PC
19EV105	Air Pollution and Control Technologies	I ,III	1,2,10 ,11	1	3	0	0	3	40	60	100	PC
19EV106	Transport of Water and Wastewater	I ,III	1,2,10 ,11	1	3	0	0	3	40	60	100	PC
PRACTICAL												
19EV107	Environmental Chemistry & Microbiology Laboratory	II	1,2,3, 5,	2	0	0	4	2	60	40	100	PC
TOTAL					18	2	4	21	300	400	700	-

SEMESTER II

THEORY

Code No	Course	Objective & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19EV201	Design of Biological Treatment Systems	I ,III	2,10, 11	1	3	1	0	3	40	60	100	PC
19EV202	Environmental Auditing and New	I ,III	1,2,3	1	3	0	0	3	40	60	100	PC

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	Product Management											
19EV203	Industrial Wastewater Management	I ,III	1,6,7,8	1	3	0	0	3	40	60	100	PC
	Professional Elective I	III	1,2,10, 11	1	3	0	0	3	40	60	100	PE
	Professional Elective II	II	1,2,3,5 ,8,9,10 ,	1	3	0	0	3	40	60	100	PE
	Professional Elective III	II	1,2,3,7 ,9	1	3	0	0	3	40	60	100	OE
PRACTICAL												
19EV204	Unit Operations and Processes Laboratory	II	1,2,3,5	2	0	0	4	2	60	40	100	PC
Total					18	1	4	20	300	400	700	-

SEMESTER III

THEORY

Code No	Course	Objective & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19EV301	Solid and Hazardous Waste Management	I ,III	2,10, 11	1	3	0	0	3	40	60	100	PC
	Professional Elective IV	I, III	1,2,3, 6,12	1	3	0	0	3	40	60	100	PE
	Professional Elective V	I, III	1,2,3, 6,12	1	3	0	0	3	40	60	100	PE
PRACTICAL												
19EV302	Industrial Training	I ,IV	1,2,3, 5,6	3	0	0	0	1	60	40	100	EEC
19EV303	Project Work (Phase - I)	I ,II, IV	1,2,3, 5,6	3	0	0	12	6	60	40	100	EEC
Total					9	0	12	16	240	260	500	-

SEMESTER IV

THEORY

Code No	Course	Objective & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19EV401	Project Work (Phase II)	I ,III	2,10, 11	1	0	0	24	12	60	40	100	EEC
Total					0	0	24	12	60	60	100	-

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PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVES								
Code No.	Course	Objective & Outcomes			L	T	P	C
		PEOs	POs	PSOs				
PROFESSIONAL ELECTIVE - I								
19EVX01	Instrumentation, Selection and Management of Environmental Engineering Equipment	I	1,2,3,6,7	1	3	0	0	3
19EVX02	Remote Sensing and GIS Applications in Environmental Engineering	I,III	1,2,3,4,5,6	1	3	0	0	3
19EVX03	Ecology and Environmental Quality Management	I,III	1,2,3,4,5,6	2	3	0	0	3
19EVX04	Urban and Rural Sanitation	I	1,2,4,5,6,7	1	3	0	0	3
19EVX05	Computing Techniques in Environmental Engineering	I	7,8,10,12	1	3	0	0	3
PROFESSIONAL ELECTIVE - II								
19EVX06	Environmental Impact Assessment	I	1,6,9,10,11	1	3	0	0	3
19EVX07	Environmental Policies and Legislations	I	1,6,9,10,11	1	3	0	0	3
19EVX08	Environmental Bio-Technology	I	1,2,3,5,7	1,2	3	0	0	3
19EVX09	Environmental Structures	I	1,5,7	1	3	0	0	3
19EVX10	Environmental Reaction Engineering	I	1,5,6,7,8	1	3	0	0	3
PROFESSIONAL ELECTIVE - III								
19EVX11	Environmental System Analysis	I	1,2,3,4,5,6	1	3	0	0	3
19EVX12	Role of Environmental Legislations in Industries	I,III	1,6,7,8,9	1	3	0	0	3
19EVX13	Cleaner Production and Sustainable Development	I,II	1,2,3,5,7	1	3	0	0	3
19EVX14	Solar Energy Technologies	I	1,2,3	1	3	0	0	3
PROFESSIONAL ELECTIVE - IV								
19EVX15	Environment, Health and Safety in Industries	I,II	1,2,3,4,5,6	1	3	0	0	3
19EVX16	Climate Change and Adaptation	I	1,2,3,4,5,6	1	3	0	0	3
19EVX17	Air and Noise Quality Modeling	I	1,2,3,4,5,6	1	3	0	0	3
19EVX18	Water Quality Modeling	I,III	1,6,9,10,11	1	3	0	0	3
19EVX19	Advanced Wastewater Treatment and Reuse.	I,III	1,2,3,5,7	1	3	0	0	3

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PROFESSIONAL ELECTIVE - V								
19EVX20	Operation and Maintenance of Water and Waste Water Treatment Plants	I	1,2,11,12	1	3	0	0	3
19EVX21	Soil Structure Interaction	I	1,2,3,5,7	1	3	0	0	3
19EVX22	Geotechnical Earthquake Engineering	I,III	1,6,7,8,9	1	3	0	0	3

S.No.	Category	Credits Per Semester				Total Credit	Credits in %	Range of Total Credits	
		I	II	III	IV			Min	Max
1	**BS**	04	-	-	-	04	6	15%	20%
2	**ES**	-	-	-	-	-	0	0%	15%
3	**HS**	-	-	-	-	-	0	0%	10%
4	**PC**	17	12	10	12	32	46	35%	50%
5	**PE**	-	09	06	-	15	21	5%	25%
6	**EEC**	-	-	-	-	19	27	5%	30%
Total		21	21	16	12	70	100	-	-

BS - Basic Science **ES** - Engineering Science **HS** - Humanities and Social Science
PE - Professional Elective **OE** - Open Elective **PC** - Professional Core
MC - Mandatory course **CA** - Continuous Assessment
ES -End semester Examination **EEC**- Employability Enhancement Course

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Department	CIVIL ENGINEERING					R 2019	Semester I	BS
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV101	PROBABILITY AND STATISTICS FOR ENVIRONMENTAL ENGINEERS	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- Acquire knowledge to understand the solutions to system of equations, algebraic equations and interpolation methods. basics of Probability
- Develop an understanding of probability concepts and distributions including some decision-making problems.
- Acquire knowledge to understand the statistical quality control problems and correlation analysis.

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

- Understand the numerical solutions to algebraic, exponential, logarithmic and linear system of equations, axioms of probability, discrete and continuous probability distributions.
- Understand test of hypothesis for both small and large samples based on normal distribution and evaluate control limits using control charts to examine whether the product is within control.
- Understand multivariate correlation analysis and forming Regression plane.

Unit I	PROBABILITY THEORY	12

Random experiments-Sample space– Axiomatic definition of Probability – Conditional Probability – Addition, Multiplication theorems-Total Probability and Baye's Theorem – Problems

Unit II	RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS	12

Discrete Random variable-Probability Function- Continuous Random variable- Probability density function-Two Dimensional Random Variables- Joint probability mass function – Marginal and conditional probability density functions. Distributions: Binomial, Poisson, Normal, Gamma – Chebyshev's in equality (Simple problems).

Unit III	CURVE FITTING	12

Correlation –Multiple Correlation-Regression –Multiple Regression –Linear fit- Quadratic fit-Cubic Splines

Unit IV	TESTING OF HYPOTHESIS	12

Large samples: Tests for Means, Variances and Proportions – Small samples: Tests for Means, Variances and Attributes using t, F, Chi square distribution– Goodness of fit using Chi Square distribution.

Unit V	STATISTICAL QUALITY CONTROL AND CORRELATION ANALYSIS	12

Statistical basis for Control charts– Control limits – Control charts for variables: $\bar{X}$, R– charts, Control chart for defectives and defects: p, np charts, c chart-Correlation –Regression – Multiple and Partial Correlation.

REFERENCES:

1. Miller and Freund "Probability and Statistics for Engineers", Prentice Hall of India Ltd, New Delhi 2015
2. Sheldon M. Ross — "Introduction To Probability And Statistics For Engineers And Scientists"-Elsevier
3. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012.
4. C. Ray Wylie and C. Louis Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd, 2003.

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Department	CIVIL ENGINEERING					R 2019	Semester I	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV102	ENVIRONMENTAL CHEMISTRY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Impart knowledge on basic analytical chemistry and instrumental methods of analysis.
- Educate about chemical kinetics and colloids and surface chemistry
- Give knowledge on biochemical activity of organic pollutants

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

- Understand on basic analytical chemistry and instrumental methods of analysis.
- Learn about chemical kinetics and colloids and surface chemistry
- Understand on biochemical activity of organic pollutants

Unit I	BASIC PRINCIPLES OF ANALYTICAL CHEMISTRY	9

Concentration of solutions-Calculations- Ionic equilibrium of weak electrolytes, – common ion effect - Buffer solutions-Change of pH with salt concentrations, Buffer index-Solubility product, Hydrolysis of salts, Problems- EMF and Electrode potential–Applications of potentiometry in pH measurements, glass electrodes, ion selective electrodes- Fluoride and Nitrate

Unit II	INSTRUMENTAL METHODS OF ANALYSIS	9

Spectroscopy-Atomic and Molecular-Difference – Flame emission spectroscopy, and Atomic Absorption Spectroscopy– principle, Instrumentation, Application in determination of metals – Pre concentration techniques in AAS – solvent extraction – Co precipitation – Chelating resins. Molecular spectroscopy – UV– visible spectrophotometer - principle, Instrumentation, Application in determination of mercury, lead and cadmium in water samples. Chromatography – Gas chromatography – simple instrumentation and application

Unit III	CHEMICAL KINETICS	9

Rate constants of first and second order reactions – problems – effect of temperature on reaction rates – Derivation of Arrhenius equation – problems – consecutive reactions – basic concepts of enzymes, cofactors – enzyme catalyzed reactions – Temperature dependence of enzyme activity– Enzyme kinetics- Michalei's Menton equation – significance

Biochemical activity of carbohydrates, proteins, vitamins, oils and fats – Bacterial decomposition under aerobic and anaerobic conditions.

Unit IV	COLLOIDS AND SURFACE CHEMISTRY	9

Colloids – types, properties (electrical origin of changes and optical) – Electro kinetic properties – Applications. Schulz Hardy rule - Destabilization and destruction of colloids. Hydrophilic colloids-Liquid-liquid systems, Gas in liquid systems-Colloidal electrolytes – surfactants, soaps and detergents – types of detergents, ingredients – Biodegradation of detergents and environmental significance.

Unit V	BIOCHEMICAL ACTIVITY OF ORGANIC POLLUTANTS	9

Dyes – Azodyes – Biodegradation environmental effects – Insecticides – Chlorinated pesticides – Organic phosphorus, Pb, Cd, Hg, As pesticides – biodegradation – environmental effects-Trace metals in water-Chemical speciation, Lead, Mercury, Arsenic and chromium-removal by chemical precipitation and adsorption.

TEXT BOOK(S):

1. Douglas A. Skoog and Donald M. West, Analytical chemistry: An introduction, CBS publishing Japan Ltd. New york, 1986.
2. Sawyer .C.N. and Mc Carty P. L. Chemistry for environmental engineering, McGraw Hill

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	Publications, 4th edition, 1994.
REFERENCES:	
3.	A. K. De, Environmental Chemistry, New Age international (Pvt.) Ltd. New Delhi, 1996.
4.	Arthur I. Vogel, A text book of Qualitative inorganic analysis, The English Language Book Society, 1977

Department	**CIVIL ENGINEERING**					**R 2019**	**Semester I**	**PC**
Course Code	**Course Name**	**Hours / Week**			**Credit**	**Total Hours**	**Maximum Marks**	
		L	**T**	**P**	**C**			
19EV103	**ENVIRONMENTAL MICROBIOLOGY**	**3**	**0**	**0**	**3**	**45**	**100**	

Course Objective (s): The purpose of learning this course is to

- Provide basic knowledge on microbiology.
- Enable the students to identify and enumerate bacteria from samples.
- Understand the morphology and characteristics fungi, protozoa and algae .
- Understand the role of microbes in environmental Issues.

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

- The candidate will be having a basic understanding of microbiology.
- The candidate will be posses the knowledge to analyse then samples for the presence of various microbes
- The candidate able to understand role of understand the impacts of microbes on the environment and will possess the knowledge to tackle the environmental issues

Unit I	**INTRODUCTION TO MICROBIOLOGY**	**10**

Classification of microorganisms. Culture of micro-organisms- media preparation, sterilization, pure culture, maintenance of cultures. Growth curve - factors affecting growth, nutritional requirements of micro-organisms. Micro-organisms in Air, water and soil. Aerobic and anaerobic microbiology.

Unit II	**IDENTIFICATION CHARACTERIZATION OF BACTERIA**	**10**

Structure and morphology of bacteria - Gram staining, microscopy. Differential and selective medium. Differentiation of faecal & non-faecal coliforms-tests for the presence of coliform organisms-presumptive, confirmed and completed test, MPN index, use of Millipore filter technique, tests for faecal *streptococci* and *clostridium welchi*-their sanitary significance, standards for bacteriological quality.

Unit III	**ALGAL, FUNGAL & PROTOZOAN MICROBIOLOGY**	**10**

Brief classification of Algae - Structural organization and multiplication of Chalmydomonas, Volvox and Spirogyra. Brief classification of Fungi- Structural organization and multiplication of Yeast, Aspergillus. Brief classification of Protozoa. Structural organization and multiplication of Amoebae and Hydra.

Unit IV	**IMPACT OF MICROBES ON ENVIRONMENT & HEALTH**	**7**

Waterborne diseases and their causative organisms. Eutrophication. Role of Microbes in Carbon, Phosphorus, Nitrogen and Sulphur cycles. Nutrients Removal – BOD, Nitrogen, Phosphate. Microbiology of Sewage Sludge. Microbe induced Corrosion and Leaching.

Unit V	**BIOREMEDIATION & BIODEGRADATION**	**8**

Xenobiotics, Classification of pollutants. Biotransformation - important factors, Biodegradation - Enzymatic processes in Biodegradation, Bioconcentration, Bio magnification, Bio monitoring, Ecotoxicology. Case studies

TEXT BOOK(S):

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1.	Pelczar .Jr .M.J., Chan, E.C.S., Krieg.R.Noel., and Pelczar MernaFoss, Microbiology, 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2004.
2.	Joanne Willey and Linda Sherwood and Christopher J. Woolverton., Prescott's Microbiology, 10th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2016.
REFERENCES:	
1.	S.C.Bhatia, Hand Book of Environmental Microbiology, 3rd Edition, Atlantic Publishers and Distributors, 2008.
2.	Ian L. Pepper, Charles P. Gerba, Terry Gentry and Raina M. Maier , Environmental Microbiology, 3rd Edition, Academic Press, 2014.
3.	S. V. S. Rana, Essentials Of Ecology & Environmental Science, 5th Edition, PHI Learning Press, 2013.

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Department	CIVIL ENGINEERING					R 2019	Semester I	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV104	PHYSICO-CHEMICAL TREATMENT OF WATER AND WASTE WATER	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate the students on the principles and process designs of various treatment systems for water and wastewater and students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.
- Elucidate the recent developments in the treatment technologies

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

- Identification and assessment of the characteristics of water and wastewater along with their environmental impacts
- Design of the various unit processes in wastewater treatment plants
- Understanding the principles and mechanisms involved in advanced wastewater treatment

Unit I	GENERAL	9

Water Quality-Physical, chemical and biological parameters of water- Water Quality requirement - Potable water standards -Wastewater Effluent standards -Water quality indices. Water purification systems in natural systems -Physical processes-chemical processes and Biological processes – Significance of physico- chemical treatment- Requirements of successful operation - Operational problems – Trouble shooting.

Unit II	PRIMARY TREATMENT- WASTE WATER	9

Preliminary treatment: Screening, Principles of screening– different types of screens – description, analysis and design – Flow equalization-Types - skimming tank – grit removal and disposal – velocity control in the grit chamber - Floatation – types – Theory of analysis and design.

Unit III	PRIMARY TREATMENT- WATER	9

Mixing, Clarification - Sedimentation; Types; Aeration and gas transfer – Coagulation and Flocculation, coagulation processes- Design - stability of colloids - destabilization of colloids Clariflocculation-Design.

Unit IV	FILTRATION	9

Filtration - theory of granular media filtration; Classification of filters; Theory and design of slow sand filter and Rapid sand filter; mechanism of filtration; modes of operation and operational problems; Negative head and air binding; dual and multimedia filtration.

Unit V	TERTIARY TREATMENT	9

Adsorption, adsorption equilibriam- adsorption isotherms, - Ion Exchange-processes, Photocatalytic degradation. Applications of Membrane Processes - Reverse osmosis, Ultrafiltration, Nanofiltration, and Electrodyalisis -Electrocoagulation. Disinfection and its significance – Physical and Chemical disinfection. – description of various methods

TEXT BOOK(S):

1. METCALF & EDDY, "Wastewater Engineering Treatment Disposal Reuse",Tata McGraw-Hill, New York, 2003.
2. HOWARD S. PEAVY, DONALD R. ROWE & GEORGE TCHOBANOGLOUS, "Environmental Engineering", McGraw-Hill, 1988.

REFERENCES:

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1.	QASIM. S.R., "Wastewater Treatment Plant – Planning, Design and operation, Holt Rinchart and Winston, New York, 2002.
2.	WEBER, W.J. Physicochemical processes for water quality control, John Wiley and sons, Newyork, 1983.

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Department	CIVIL ENGINEERING					R 2019	Semester I	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV105	AIR POLLUTION AND CONTROL TECHNOLOGIES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Explore the aspects of the science of atmospheric pollution
- Learn atmospheric composition, monitoring, acidic deposition, urban air quality and global changes in the atmosphere
- Study the use of models in air pollution studies

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

- To describe the main chemical components and reactions in the atmosphere
- To review established methods for monitoring and modeling spatial and temporal patterns of pollution
- To assess the environmental impacts of atmospheric pollution
- To evaluate the scientific basis underlying in controlling of air pollutants

Unit I	SOURCES AND CLASSIFICATION OF AIR POLLUTANTS	9

Sources and classification of Air Pollutants: Natural contaminants-aerosol-gases and vapour. Air qualitystandards - Meteorology and Air pollution: Atmospheric stability and inversions-mixing height-plume behaviour-plume rise estimation-effluent dispersion theories-Isokinetic sampling-Modeling.

Unit II	AIR QUALITY MEASURES	9

Objectives-Filters, gravitational, centrifugal-multiple type cyclones, prediction of collection efficiency, pressure drop, wet collectors, Electrostatic Precipitation theoryparticle charging collection-ESP design procedure.

Unit III	THEORY OF ADSORPTION	12

Absorption: principles, description of equipment-packed and plate columns, design and performance equations. Adsorption: principles adsorbents, equipment descriptions-PSA-adsorption cycle-solvent recovery system continuous rotary bedfluidized bed, Design and performance equations. Condensation: contact condensers-shell and tube condensers, design and performance equation. Incineration: hydrocarbon incineration kinetics, equipment description, design and performance equations.

Unit IV	CONTROL METHODS	9

Control methods-Processes based control mechanisms-mineral products-asphaltic concrete, cement plants and glass manufacturing plants; Thermal power plants, Petroleum refining and storage plants, Fertilizers, Pharmaceuticals and wood processing industry. Field study.

Unit V	NOISE STANDARDS	6

Noise Standards; measurement, control and preventive measures.

TEXT BOOK(S):

1. Richard W.Boubel et al, "Fundamentals of Air Pollution", Academic Press, New York, 2004.
2. Noel de Nevers, "Air Pollution control Engg." McGraw-Hill, New York,2005.

REFERENCES:

1. M.N. Rao et al, "Air Pollution", Tata McGraw Hill, 2009.
2. Fundamentals of Air Pollution' authored by Daniel Vallero, 4th Edition, Elsevier's Science & Technology, 2008 (ISBN: 978-0-12-373615-4).
3. 'Environmental Noise Pollution: Noise Mapping, Public Health, and Policy' authored by Enda

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	Murphy and Eoin A. King, 1st Edition, Elsevier's Science & Technology, 2014 (ISBN: 978-0-12-411595-8).

Department	CIVIL ENGINEERING					R 2019	Semester I	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV106	TRANSPORT OF WATER AND WASTE WATER	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain, with emphasis on computer application

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

- Be able to select various pipe materials for water supply main, distribution network and sewer
- Be able to design water supply main, distribution network and sewer for various field conditions
- Troubleshooting in water and sewage transmission be able to use various computer software for the design of water and sewage network

Unit I	FLUID PROPERTIES	10

Fluid properties; fluid flow - continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, major and minor heads loss, formula for estimation of head loss - pumping of fluids - selection of pumps - Flow measurement.

Unit II	POPULATION FORECASTING	10

Forecasting of population - Arithmatic Increase - Geometrical Increase - Incremental Increase - Graphical Methods - Logistic Curve Method - Per capita consumption - Design period - Variation in demand - Factors Affecting per capita consumption.

Unit III	DISTRIBUTION	9

Water transmission main design - pipe materials - economics - water distribution pipe networks - methods for analysis and optimization - Laying and maintenance, insitu lining - appurtenances.

Unit IV	DESIGN OF SEWERS	8

Design of sanitary sewer; partial flow in sewers, economics of sewer design; sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

Unit V	STORM WATER	8

Planning - run-off estimation, rainfall data analysis, storm water drain design - rain water harvesting.Use of computer software in water transmission, water distribution and sewer design.

TEXT BOOK(S):

1. "Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, GoI, New Delhi, 2009.

REFERENCES:

1. "Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, GoI, New Delhi, 2003.
2. Hammer.M.J., "Water and Wastewater Technology",Regents/ Prentice Hall, New Jercy, 2001.

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Department	CIVIL ENGINEERING					R 2019	Semester I	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV107	ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY LABORATORY	0	0	4	2	60	100	

Course Objective (s): The purpose of learning this course is to

- Train in the analysis of physico-chemical parameters with hands on experience
- Train the students in the analysis of various biological and microbiological techniques, enzymes assay, pollutant removal and bioreactors.

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

- Determine the physico-chemical parameters
- Do various biological and microbiological techniques, enzymes assay, pollutant removal and bioreactors.

Exp No.	Name of Experiments
	ENVIRONMENTAL CHEMISTRY
1	Good Laboratory Practices, Quality control and calibration.
2	Sampling and Analysis of water (pH, alkalinity, hardness, chloride, Sulphate , turbidity EC, TDS,TS, nitrate, fluoride)
3	Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals).
4	Sampling and characterization of soil (CEC & SAR, pH and K).
	ENVIRONMENTAL MICROBIOLOGY
1	Preparation of culture media
2	Isolation, culturing and Identification of Microorganisms
3	Microorganisms from polluted habitats (soil, water and air)
4	Assay of enzymes involved in biotransformation.
5	Biodegradation of organic matter in waste water
6	Analysis of air borne microorganisms,
7	Staining of bacteria.
8	Effect of pH, temperature on microbial growth
9	Pollutant removal using microbes from industrial effluent.
10	Effect of pesticides on soil microorganisms
11	Bacteriological analysis of wastewater (Coliforms, *E.coli, Streptococcus*) – MPN

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12	Bacteriological analysis of wastewater (Coliforms, *Streptococcus)* - MF techniques, Effect of Heavy metals on microbial growth.
13	Detection of Anaerobic bacteria (*Clostridium* sp.)
14	Bioreactors(cultivation of microorganisms)
TEXT BOOK(S):	
1.	APHA, "Standard Methods for the Examination of Water and Wastewater", 22nd Ed. Washington, 2012.
2.	"Laboratory Manual for the Examination of water, wastewater soil Rump", H.H. and Krist, H. – Second Edition, VCH, Germany, 3rd Edition, 1999.
3.	. "Methods of air sampling & analysis" ,James P.Lodge Jr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.
REFERENCES:	
1.	Charles P. Gerba, "Environmental Microbiology: A laboratory manual", Elsevier Publications, 2012.
2.	Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, and Linda D. Stetzenbach, "Manual of Environmental Microbiology", 3rd Edition, ASM Press, 2007.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV201	DESIGN OF BIOLOGICAL TREATMENT SYSTEMS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate the students on principles and design of various biological treatment units used for wastewater treatment.

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

- Developed conceptual schematics required for biological treatment of wastewater
- Translate pertinent criteria into system requirements

Unit I	INTRODUCTION TO BIOLOGICAL TREATMENT	9

Objectives of biological treatment - significance - aerobic and anaerobic treatment - kinetics of biological growth - Factors affecting growth - attached and suspended growth - Determination of Kinetics coefficients for organics removal - Biodegradability assessment - selection of process.

Unit II	DESIGN OF TREATMENT UNITS	9

Design of sewage treatment plant units - screen chamber, Grit chamber with proportional flow weir, sedimentation tank - Trickling filters, Rotating Biological contactor, activated sludge process & variations, aerated lagoons, waste stabilization ponds - nutrient removal systems - natural treatment systems - Disinfected disposal options - reclamation and reuse - Flow charts, layout, hydraulic profile - Recent advances.

Unit III	CONCEPT OF ANAEROBIC DIGESTION	9

Attached and suspended growth, Design of units - UASB, up flow filters, Fluidised beds - septic tank and disposal - Nutrient removal systems - Layout and Hydraulic profile - Recent advances.

Unit IV	SLUDGE MANAGEMENT	9

Design of Sludge management facilities, sludge thickening, sludge digestion, Biogas generation, sludge dewatering (mechanical and gravity) - upgrading existing plants - ultimate residue disposal - Recent Advances.

Unit V	MISCELLANEOUS METHODS OF TREATMENT	9

Operational problems - Trouble shooting, Planning, Organising and Controlling of plant operations - capacity building, Case studies on sewage treatment plants - sludge management facilities.

TEXT BOOK(S):

1. Arceivala, S.J., "Wastewater treatment for pollution control", TMH, New Delhi, 2008.
2. Manual on "Sewerage and Sewage Treatment" CPHEEO, Ministry of Urban Development, GoI, New Delhi, 2009.

REFERENCES:

1. METCALF & EDDY, INC. "Wastewater Engineering", Treatment and Reuse. Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003.
2. Qasim, S.R, "Wastewater Treatment Plant", Planning, Design & Operation Technomic Publications, New York, 2004.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV202	ENVIRONMENTAL AUDITING AND NEW PRODUCT MANAGEMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Introduce about auditing and environmental Assessment tools
- Introduce about cleaner production
- Introduce about New product development and sustainable development

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

- Do Environmental Auditing for the industries and able to do the Assessment on Environmental Impact
- Carry out cleaner production tools in the Industries.
- Apply environmental management tools for developing new product and able to act in achieving Sustainability

Unit I	ENVIRONMENTAL AUDITING	6

Environmental Policies and Legislations - Industrial activities and Environment – Prevention versus Control of Industrial Pollution – Regulation to Encourage Pollution Prevention and Cleaner Production – Environmental Auditing – Types-Environmental Reporting
Environmental statement- Role of Industry, Government and Institutions – Environmental Management Hierarchy - Regulatory versus Market Based Approaches.

Unit II	EA TOOLS	10

Environmental Impact Assessment - Life Cycle Assessment - Elements of LCA – Life Cycle Costing – Eco Labeling – Environmental Management Systems- Standards – ISO 14001,19000 – Environmental audit –Environmental Risk Assessment – Technology Assessment - Tools with case studies

Unit III	CLEANER PRODUCTION	10

Definition – methodology – Historical evolution – Benefits – Promotion – Barriers Overview of CP - Assessment Steps and Skills - Preparing for the Site, Visit, Information gathering, and Process Flow Diagram - Material Balance - CP Option Generation – Technical and Environmental Feasibility analysis – Economic valuation of alternatives – Total Cost Analysis – CP Financing – Establishing a Program – Organizing a Program – Preparing a Program Plan – Measuring Progress – Pollution Prevention and Cleaner Production Awareness Plan.

Unit IV	ENVIRONMENTAL ASPECTS OF NEW PRODUCT,DEVELOPMENT	10

New Product Development Process(NPDP) –Objectives- opportunities in Product Design –Product Life cycle Management – PRO launch –basics, benefits, Phase gate, Design for Environment, Design for Six Sigma(DFSS), Best Available Technology concept (BAT) -Project Management - goals and Life cycle

Unit V	SUSTAINABLE DEVELOPMENT	9

Sustainable development – Indicators of Sustainability – Sustainability Strategies - Barriers to Sustainability – Industrialization and sustainable development – Industrial Ecology – SHE – Six-Age Model- Cleaner Production (CP) in Achieving Sustainability – Business opportunities and Success for sustainable future

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TEXT BOOK(S):	
1.	World Bank Group 'Pollution Prevention and Abatement Handbook – Towards Cleaner Production', World Bank and UNEP, Washington D. C., 1998.
2.	Prasad modak C. Visvanathan and Mandar parasnis , 'Cleaner Production Audit', Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok, 1995.
REFERENCES:	
1.	Robert.G.Cooper,'Winning at NewProducts' Third Edition, Basic Books, A member of the Perseus Books Group,2001
2.	Richard Welford and Richard Starkey , Business and the Environment, University Press 2010

Department	CIVIL ENGINEERING					R 2019	Semester II	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV203	INDUSTRIAL WASTE WATER MANAGEMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.
- Understand principles of various processes applicable to industrial wastewater treatment
- Identify the best applicable technologies for wastewater treatment from the perspective of yield production.

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

- Define the Principles of pollution prevention and mechanism of oxidation processes.
- Suggest the suitable technologies for the treatment of wastewater.
- Discuss about the wastewater characteristics and design the treatment systems

Unit I	INTRODUCTION	9

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling - generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management.

Unit II	INDUSTRIAL POLLUTION PREVENTION & WASTE MINIMISATION	9

Prevention vis a vis Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing & Promoting Pollution Prevention Programs in Industries.

Unit III	INDUSTRIAL WASTEWATER TREATMENT	9

Flow and Load Equalisation – Solids Separation – Removal of Fats, Oil & Grease- Neutralisation – Removal of Inorganic Constituents – Precipitation, Heavy metal removal, Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Eletrodialysis & Evaporation – Removal of Organic Constituents – Biological treatment Processes, Chemical Oxidation Processes, Advanced Oxidation processes – Treatability Studies.

Unit IV	WASTEWATER REUSE AND RESIDUAL MANAGEMENT	10

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Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects.		
Unit V	**CASE STUDIES**	**8**
Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining– Pharmaceuticals–Sugar and Distilleries		

TEXT BOOK(S):

1. "Industrial wastewater management, treatment & disposal, Water Environment" Federation Alexandria Virginia,3rd Edition, 2008.
2. Lawrance K.Wang, Yung Tse Hung, Howard H.Lo and Constantine Yapijakis "handlook of Industrial and Hazardous waste Treatment", Second Edition, 2004
3. Metcalf & Eddy/ AECOM, "Water reuse Issues, Technologies and Applications", The Mc Graw- Hill companies, 2007.

REFERENCES:

1. Nelson Leonard Nemerow, " Industrial waste Treatment", Elsevier, 2007.
2. Paul L. Bishop, "Pollution Prevention: - Fundamentals and Practice", Mc-Graw Hill International, Boston, 2000.
3. Waste water Treatment for pollution control and reuse by Soli. J. Arceivala, Shyam. R. Asolekar, Tata Mcgraw Hill, 2007

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Department	CIVIL ENGINEERING					R 2019	Semester II	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV204	UNIT OPERATIONS AND PROCESSES LABORATORY	0	0	4	2	60	100	

Course Objective (s): The purpose of learning this course is to

- Develop the skill for conducting Treatability studies of water and wastewater treatment and monitoring of ambient air and noise quality

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

- Design and analyse various treatability options for water and wastewater and monitor ambient air and noise quality.

Exp No.	Name of Experiments
1	Coagulation and Flocculation
2	Batch studies on settling
3	Studies on Filtration- Characteristics of Filter media
4	Water softening
5	Adsorption studies/Kinetics
6	Langelier Saturation Index and Silt Density Index- For Membrane Filtration
7	Kinetics of suspended growth process (activated sludge process) and Sludge volume Index
8	Sludge Filterability Test
9	Anaerobic Reactor systems / kinetics (Demonstration)
10	Advanced Oxidation Processes – (Photo catalysis)
11	Disinfection for Drinking water (Chlorination)
12	Ambient Air Sampling-Determination of PM10, PM2.5, SO2 and NO2
13	Noise Monitoring-Determination of Equivalent Noise Level

Name of the Equipments

1. pH meter	16. Autoclave
2. COD Digester	17. Magnetic stirrer
3. EC & TDS meter	18. Deionizer
4. Bench top pH, EC and TDS meter	19. Jar test apparatus

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5. Turbidity Meter (Bench Top)	20. Refrigerator
6. Flame photometer	21. Orbital Shaking Incubator
7. BOD incubator	22. Air compressor
8. Deep freezer	23. Distillation unit
9. Centrifuge	24. High speed emulsifier
10. Microprocessor controlled centrifuge	25. DC power supply
11. Analytical Balance	26. Peristaltic Pump
12. Digital Water Bath	27. Fume Hood
13. Hot plate	28. Ultrapure Water Unit
14. Hot Air Oven	29. Vacuum pump
15. Muffle Furnace	

TEXT BOOK(S):

1.	Metcalf and Eddy. Inc.„ „Wastewater Engineering, Treatment, Disposal and Reuse" Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2.	Lee, C.C. and Shundar Lin. "Handbook of Environmental Engineering Calculations", Mc Graw Hill, New York, 1999.
3.	AEESP Environmental Processes Laboratory Manual, Association of Environmental Engineering and Science Professors Foundation, Washington, 2002.

REFERENCES:

1.	Aery N C., "Manual of Environmental Analysis", Ane Books Pvt. Ltd. New Delhi, 2014
2.	CPCB, Guidelines for the Measurement of Ambient Air Pollutants, Volume I, Central Pollution Control Board, Ministry of Environment and Forests, Government of India, 2001

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Department	CIVIL ENGINEERING					R 2019	Semester III	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV301	SOLID AND HAZARDOUS WASTE MANAGEMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipments.

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

- Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation
- Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste
- Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges
- Design the different elements of waste management systems

Unit I **SOLID WASTE GENERATION, STORAGE AND MANAGEMENT SYSTEM** **9**

Definition of solid wastes – types of solid wastes –solid Waste Management - Goals and objectives – Functional elements in a solid waste management system – Interrelationships - public awareness. Generation of solid waste - Sources and types of solid wastes – sampling - Composition – Generation rates – Factors affecting generation rates.
Onsite handling, Storage and Processing of solid wastes - necessary equipments.

Unit II **COLLECTION AND TRANSFER OF SOILD WASTES** **9**

Collection of solid waste - Collection services - collection system, equipments – Time and frequency of collection - labour requirements – Factors affecting collection – Analysis of collection systems – collection routes – Preparation of Master schedules.
Transfer and Transport – Need for transfer operations - Transfer stations – types Transport means and methods - location of transfer stations.

Unit III **PROCESSING TECHNIQUES AND RECOVERY OF ENERGY** **9**

Processing Techniques – purposes – Mechanical volume reduction – necessary equipments – Chemical volume reduction – incinerators – Mechanical size reduction – Selection of equipments - Component separation – Methods – Drying and Dewatering.
Incineration of solid wastes – Disposal in landfills: site selection, design, and operation of sanitary landfills – Leachate and landfill gas management; landfill closure and post-closure environmental monitoring landfill remediation – Regulatory aspects of municipal solid waste management.
Composting – anaerobic and aerobic composting – Vermi composting – unit operations associated with composting anaerobic digestion of municipal solid waste – Pyrolysis – reduction methods- Mechanical and Biological Treatment and landfilling

Unit IV **HAZARDOUS WASTES** **9**

Hazardous waste definition – Physical and biological routes of transport of hazardous substances – sources and characterization categories and control. Sampling and analysis of hazardous wastes – analytical approach for hazardous waste characterization – proximate analysis – survey analysis – directed analysis – analytical methods.

Unit V **HAZARDOUS WASTE MANAGEMENT** **9**

Biomedical waste: Definition, sources, classification, collection, segregation Treatment and

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Disposal – Radioactive waste: Definition, Sources, Low level and high level radioactive wastes and their management, Radiation standard by ICRP and AERB – E-waste characteristics, generation, collection, transport and disposal.

TEXT BOOK(S):	
1.	Techbanoglous Thiesen Ellasen : Solid waste Engineering Principles and Management, McGraw Hill, 1977.
2.	Hagerty D.J., Pevani J. L., and Heer J. E., Solid Waste Management , Van Nostrand Reinhld, 1979.
3.	Vesilind P.A. and Rimer A.E. Unit operations in resources recovery engineering, Prentice Hall, 1981.
4.	S. K. Shukla, P. R. Srivastava, Waste Management and control Commonwealth Publishers, New Delhi, 1991.
REFERENCES:	
1.	B. B. Sundaresan, A. D. Bhide – Solid Waste Management, Collection, Processing and Disposal, Mudrashilpa Offset Printers, 2001.
2.	Manual on Solid Waste Management, CPHEEO, Ministry of Urban Development, GOI, New Delhi, 2000.
3.	Management of Solid waste in developing countries by FrankFlintoff , WHO regional publications 1976

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Department	CIVIL ENGINEERING					R 2019	Semester III	EEC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV302	INDUSTRIAL TRAINING	-	-	-	1	-	100	

Course Objective (s): The purpose of learning this course is to

- Train the students in the field work so as to have a firsthand knowledge of practical problems related to Environmental Engineering in carrying out engineering tasks.

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

- Trained in tackling a practical field/industry orientated problem related to Environmental Engineering

SYLLABUS

The students individually undertake training in reputed Industries during the summer vacation for a specified period of two weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

Department	CIVIL ENGINEERING					R 2019	Semester III	EEC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV303	PROJECT PHASE I	0	0	12	6	180	100	

Course Objective (s): The purpose of learning this course is to

- Identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- Develop the methodology to solve the identified problem.
- Train the students in preparing project reports and to face reviews and viva-voce examination.

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

- Have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

SYLLABUS

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

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Department	CIVIL ENGINEERING					R 2019	Semester IV	EEC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EV401	PROJECT PHASE II	0	0	24	12	360	100	

Course Objective (s): The purpose of learning this course is to

- Solve the identified problem based on the formulated methodology.
- Develop skills to analyze and discuss the test results, and make conclusions

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

- Completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.

SYLLABUS

The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX01	INSTRUMENTATION, SELECTION AND MANAGEMENT OF ENVIRONMENTAL ENGINEERING EQUIPMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate about Machineries and maintenance and analytical instruments I
- Impart knowledge about water and waste water machineries and equipments
- Provide knowledge about equipments in air pollution control

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

- Get knowledge about Machineries and maintenance and analytical instruments
- Learn about water and waste water machineries and equipments
- Learn about equipments in air pollution control

Unit I	GENERAL	9

Study of machinery, electric motors types and characteristics, other prime covers, pumps, capacity, operation and maintenance of pumping machinery, air compressors preventive maintenance, break-down maintenance, schedules – Factors to be considered in the selection of the equipments.

Unit II	INSTRUMENTATION	13

pH meter - Flame Emission Spectrometry. Absorption spectrometry - Nephelometry - Atomic Absorption Spectrometry - Gas chromatography – working principle and components. Total carbon analyser – Mercury Analyser polar graph for metal estimation and organic compounds - Ion selective Electrode -SO2 and CO analyser – Instrument components and its working principle.

Unit III	WATER SUPPLY MACHINERY AND WASTEWATER MACHINERY	8

Drilling equipment, pumping equipment for wells.
Machinery required for primary and secondary treatment, sewage pumps , sludge pumps, vaccum filtration equipment.

Unit IV	EQUIPMENTS FOR TREATMENT UNITS	8

Equipment for treatment unit - electrically and mechanically operated agitators, mixers, aerators, chlorinators, Surface aerators. Meters for measurement of flow, head, electricity.

Unit V	AIR POLLUTION CONTROL EQUIPMENTS	7

Working principles of electrostatic precipitator – cyclone separators – settling chamber – operation and Maintenance. Machinery for solid waste collection and disposal incineration – compactors – magnetic separators-incinerators.

TEXT BOOK(S):

1. Operation and Control of Water Treatment Processes COX CR WHO 1964.
2. Course Manual on Preventive Maintenance of Water Distribution System, NEERI, 1973.

REFERENCES:

1. Trivedy R. K. & Goel P.K., Chemical and Biological methods for water pollution studies, Environmental publication, Karat, 1986.
2. Standards Methods for the Examination of Water and Waste Water, 17th Edition, WPCF, APHA and AWWA, USA, 1989.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX02	REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL ENGINEERING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate about fundamentals of remote sensing, aerial photography and satellite remote sensing
- Impart knowledge on data analysis and application of GIS
- Train the students in the laboratory

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

- Learn fundamentals of remote sensing, aerial photography and satellite remote sensing
- Get knowledge on data analysis and application of GIS
- Use GIS in the laboratory

Unit I	FUNDAMENTALS OF REMOTE SENSING	9

Introduction to remote sensing – Principles of Electro – Magnetic Radiation – Energy /Matter interaction with Atmosphere and land surface – spectral reflectance of earth materials and vegetation – Data products.

Unit II	AERIAL PHOTOGRAPHY AND SATELLITE REMOTE SENSING	9

Aerial Photography – Photogrammetry And Visual Image Interpretation.
Various satellites in orbit and their sensors – Resolutions – Multispectral Remote Sensing system (MSS) and design – VISIBLE - NIR remote sensing - Thermal IR Radiation properties, systems and application – Microwave and LIDAR remote sensing – Principles and applications.

Unit III	DATA ANALYSIS AND GIS	9

Data Analysis – Visual interpretation and digital image processing – Classification.
Introduction to GIS, concepts and data base structure, various GIS software.

Unit IV	REMOTE SENSING AND GIS APPLICATIONS	10

Applications of Remote sensing and GIS – Management and Monitoring of Land, air, water and pollution studies – conservation of resources – coastal zone management – Limitations.

Unit V	LABORATORY PRACTICES	8

Data sources – Visual interpretation - digital image processing – Introduction to ENVI image processing software – GIS / Data Analysis in ARC GIS.

TEXT BOOK(S):

1. Anji Reddy, "Remote Sensing and Geographical Information system", B S publications 2001.
2. M.G. Srinivas (Edited by) "Remote sensing applications", Narosa publishing house, 2001.

REFERENCES:

1. A M. Chandra and S.K .Ghosh, "Remote Sensing and Geographical Information System", Narosa Publishing House, 2006.
2. Lintz, J. and Simonet, Remote Sensing of Environment, Addison Wesley Publishing Company, 1994.
3. Burroughs P.A, Principles of Geographical Information System, Oxford University Press, 1998.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX03	ECOLOGY AND ENVIRONMENTAL QUALITY MANAGEMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate the students on the principles of ecology as applied to environmental engineering.

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

- Acquire knowledge in interior and exterior structure of earth.
- Understand the crystal structure, mineral types and properties
- Understand the formation of rocks and its properties.
- Analyse the rocks for the construction of tunnels, dams and road cuttings.

Unit I	ECOLOGY & ENVIRONMENT	9

Aim, scope and applications of ecology - Development and evolution of ecosystems - Principles and concepts pertaining to communities in ecosystem - Energy flow and material cycling in ecosystems - productivity in ecosystems - Rationale of ecological engineering and ecotechnology - Classification of ecotechnology

Unit II	PRINCIPLES OF ECOLOGICAL ENGINEERING	8

Principles, components and characteristics of Systems - Classification of systems - Structural and functional interactions of environmental systems - Environmental systems as energy systems - Mechanisms of steady-state maintenance in open and closed systems - Modelling and ecotechnology - Elements of modelling - Modelling procedure - Classification of ecological models - Applications of models in ecotechnology - Ecological economics.

Unit III	CONCEPT OF ECOSYSTEM	10

Self-organizing design and processes - Multiple seeded microcosms - Interface coupling in ecological systems - Concept of energy - Determination of sustainable loading of ecosystems.

Unit IV	APPLICATION OF ECOLOGICAL ENGINEERING	9

Ecosanitation - Principles and operation of soil infiltration systems - Wetlands and ponds - Source separation systems - Aquacultural systems - Detritus based treatment for solid wastes - Applications of ecological engineering for marine systems.

Unit V	CASE STUDIES IN ECOLOGICAL ENGINEERING	9

Case studies of Integrated Ecological Engineering Systems and their commercial prospects. classification.

TEXT BOOK(S):

1. Kangas, P.C. and Kangas, P., "Ecological Engineering: Principles and Practice", Lewis Publishers, New York. 2003

REFERENCES:

1. Etnier, C. and Guterstam, B., "Ecological Engineering for Wastewater Treatment", Lewis Publishers, New York. 2007.
2. White, I.D., Mottershed, D.N. and Harrison, S.J., "Environmental Systems - An Introductory Text", Chapman Hall, London. 2004.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX04	URBAN AND RURAL SANITATION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate about healthful housing, Operation and maintenance of Swimming pool
- Educate about refuse and food sanitation
- Educate Rural and Urban water supply and sanitation

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

- Understand healthful housing and swimming pool operation and maintenance
- Understand Refuse and food sanitation
- Understand Rural and Urban water supply and sanitation

Unit I	GENERAL AND BASIC PRINCIPLES OF HEALTHFUL HOUSING	9

Control of environment – Engineering methods - Modes of transmission of diseases – Mosquitoes and Flies - Life cycle, important characteristics and control measures of carriers. Basic principles of healthful housing - heating - ventilation - lighting - air conditioning – noise control in residential buildings.

Unit II	PLUMBING AND SWIMMING POOL SANITATION, OPERATION AND MAINTANENCE	9

Scope of plumbing - definition of plumbing terms - general principles of good plumbing system – water seal - types of traps, siphonage – design of plumbing system for multistory buildings - plumbing codes and standards. Transmission of diseases in swimming pools - quality standards of pool water - design features of pools and their appurtenances. Measures of Urban drainage and flood control benefits-Effective urban water user organizations. General approaches to operations and maintenance-Complexity of operations and need for diagnostic analysis

Unit III	REFUSE AND FOOD SANITATION	9

Refuse characteristics in urban and rural areas - conditions and factors affecting collection, quantity and conveyance of solid waste - disposal methods - incineration - design of incinerators sanitary landfill - composting - waste recycling - biogas and gobar gas plants.

Food borne and food caused diseases – food poisoning - food preservation – precautions in the design of kitchen - bactericidal treatment of kitchen utensils - Bacteriological contents of milk borne diseases - essential of milk sanitation - dairy barn sanitation - pasteurization methods - milk tests.

Unit IV	URBAN AND RURAL WATER SUPPLY SYSTEM	9

Water supply arrangements in urban buildings - design of water supply systems for multistoried buildings - consideration in the development of water supply programmes for rural areas - health and economical aspects in the design and installation of rural water supply systems - methods of construction and development of different types of wells - sanitation of rural wells - pumps for rural wells - treatment methods for rural water supply.

Unit V	RURAL SANITATION	9

Layout of drainage systems in urban domestic areas - methods of disposal of night soil in rural areas - different privies - Twin pit pourflush toilets, VIP latrines - water carriage method of sewage disposal - cesspools and seepage pits - septic tank systems - oxidation ponds - aerated lagoons.

TEXT BOOK(S):

1. Salvato, Environmental Sanitation, John Wiley & Sons, New York,1982.
2. Ehler and Steel, Municipal Rural Sanitation, Mc - Graw Hill Book Co., New York, 1964.

REFERENCES:

1. E.G. Wagner and J.N. Lanoix, Excreta Disposal for Rural areas and small communities, W.H.O. Publication, Geneva, 1958.
2. Babbit H.E and Donald J.J., Water supply Engineering, Mc - Graw Hill Book Co., New York, 1962

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX05	COMPUTING TECHNIQUES IN ENVIRONMENTAL ENGINEERING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate the students to know about computing techniques
- Develop the different numerical technique and logic like ANN, Fuzzy
- Educate the students on aspects data management
- Develop the model Applications for monitoring and management of Environment

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

- Understand the computing techniques.
- Apply the principle of soft computing for solving Environmental problems
- Assess the Environmental Impacts using ANN and Fuzzy logic.
- Employ modern advanced computing tools in environmental studies

Unit I	COMPUTING PRINCIPLES	10

Introduction to Computing techniques – Algorithms and Flowcharts, Numerical methods - Solution to ordinary and partial differential equation using Finite difference and Finite element method , Numerical integration and differentiation, Design of digital models for Environmental applications.

Unit II	ARTIFICIAL INTELLIGENCE	9

Knowledge based Expert system concepts - Principle of Artificial Neural Network (ANN) – Neural Network Structure – Neural Network Operations – ANN Algorithm - Application of ANN Model to Environmental field – Genetic Algorithms

Unit III	FUZZY LOGIC	9

Fuzzy sets, fuzzy numbers, fuzzy relations, fuzzy measures, fuzzy logic and the theory of uncertainty and information; applications of the theory to inference and control, clustering, and image processing - Network analysis models.

Unit IV	DATA MANAGEMENT	9

Data base structure - Data acquisition - Data warehouse - Data retrieval-Data format Attribute - RDBMS - Data analysis - Network data sharing - Statistical Analysis (SYSTAT) - Regression - factor analysis - histogram - scatter diagram - Goodness of fit.

Unit V	ENVIRONMENTAL MODELING USING MATLAB	8

Introduction to MATLAB Software – Environmental modeling principles and MATLAB Applications – Pollutants transport, decay and degradation modeling using MATLAB. Case studies.

TEXT BOOK(S):

1. Aliev R. A, and Aliev Rashad, "Soft Computing and its Applications", World Scientific Publications Co. Pvt. Ltd. Singapore, 2014.
2. Chepra S. C. and Canele R. P., "Numerical Methods for Engineers", McGraw-Hill, a business unit of The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020. 6th Edition 2014.

REFERENCES:

1. . Data-Driven Modeling: Using MATLAB in Water Resources and Environmental Engineering, Springer; 2014 edition.
2. Kotteguda, N.T., and Renzo Resso, Statistics, "Probability and Reliability for Civil and Environmental Engineers", McGraw Hill Companies Inc., New York, 2008.
3. Mathews J. H. and Fink K.D. , "Numerical methods using MATLAB", Pearson Education 2010.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX06	ENVIRONMENTAL IMPACT ASSESSMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.
- Provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

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

- Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
- Know about the legal requirements of Environmental and Risk Assessment for projects.

Unit I	INTRODUCTION	8

Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA –.EIA process- screening – scoping - setting – analysis – mitigation. Cross sectoral issues and terms of reference in EIA – Public Participation in EIA-EIA Consultant Accreditation.

Unit II	IMPACT INDENTIFICATION AND PREDICTION	10

Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment 20

Unit III	SOCIAL IMPACT ASSESSMENT AND EIA DOCUMENTATION	8

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials.

Unit IV	ENVIRONMENTAL MANAGEMENT PLAN	7

EIA Report preparation. Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies

Unit V	ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT	12

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipath way exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs

TEXT BOOK(S):

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996
2. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003

REFERENCES:

1. Raghavan K. V. and Khan A A. , Methodologies in Hazard Identification and Risk Assessment, Manual by CLRI, 1990
2. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
3. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York,1996.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX07	ENVIRONMENTAL POLICIES AND LEGISLATIONS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Make the students conversant with the legislations in India.
- Understand the basic principles in pollution control.
- Expose the students to the pollution control policies in India.

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

- Make the students conversant with the legislations related to pollution control.
- The Students will get idea about the implementation of rules.
- The student shall be able to enforce the rules.

Unit I	WATER (PREVENTION & CONTROL OF POLLUTION)ACT, 1974	9

Definitions-Salient features-Powers &functions of Regulatory agencies–Responsibilities of occupier, provisions relating to prevention& control-procedures to obtain consent-Monitoring and compliance mechanisms-legal provision for violation of Water(P&CP)Act-Case studies on water polluting industries-Textile dyeing, Paper mills-Electroplating, Starch industries-inventorisation of new water polluting industry and its management-field visits.

Unit II	THE AIR (PREVENTION & CONTROL OF POLLUTION)ACT, 1981	9

Definition-Salient features- Powers &functions of Regulatory agencies -National ambient Air quality standards-Emission standards for industries specific- Responsibilities of occupier, provisions relating to prevention& control-procedures to obtain consent Monitoring and compliance mechanisms- legal provision for violation of Air(P&CP)Act- Case studies on Air polluting industries-Foundries, Cement, Thermal power plants- inventorisation of new Air polluting industry and its management-field visits.

Unit III	THE ENVIRONMENT (PROTECTION) ACT, 1986	9

Genesis of the Act-Salient features-Role of Central Government-various notifications and rules –prohibition on import of genetically modified organisms-chemicals-hazardous wastes- Batteries management-Restriction on Ozone depleting substances-EIA notification-Siting of industries-State level EIA Authorities-eco-mark-Control on noise pollution-coastal regulations- Monitoring and compliance mechanisms-Role of National Green Tribunals(NGT),Environmental courts & Public interest litigation -Case studies

Unit IV	REGULATIONS ON INDUSTRIAL SOLID WASTE MANAGEMENT	9

Restriction on Hazardous waste-Bio-medical wastes-Recycled plastic wastes-Municipal solid wastes-e-waste-Salient features-Responsibilities of occupier/generator/local bodies/PCBs- Monitoring and compliance mechanisms-consent clearance, Authorization, Registration procedures for industry specific-Issues &Challenges-Best practices-Case studies on lead refining, engineering units ,hospitals, plastic units, Municipal landfills,-field visits.

Unit V	ELECTRONIC WASTE (MANAGEMENT &HANDLING)RULES2011	9

Definition-Environmental & Occupational Health hazards of e-waste-Salient features of E-waste Rules-Extended producers responsibility-issues and challenges –Compliance and Consent Clearance mechanisms-Best practices of E-waste management-Case studies on E-waste recycling units, Bulk consumers, Collection Centres-field visits.

TEXT BOOK(S):

1. Rosencrannz, S. Divan, M.L.Noble, Environmental law and policy in India, cases, materials and statutes, Tripathi pvt.Ltd. Bombay.
2. Stem A.C. Air pollution, Vol. I to VIII, Academic press.

REFERENCES:

1. Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New

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	Delhi, 2001.
2.	The safe disposal of hazardous waste. Vol. I, II, & III Bat stone, Smith, Wilson, Joint study Sponsored by the world bank, the WHO, & UN Environmental Program UNEP, The world bank Freeman, H.M. standard Handbook of Hazardous Waste Treatment and Disposal, 1989
3.	E WASTE MANAGEMENT IN INDIA (2009), Electronics for you, www. efymag.com.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX08	ENVIRONMENTAL BIO-TECHNOLOGY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate the students about the principles and biological intervention
- Impart knowledge about application biotechnology in industry and genetic modifications
- Provide knowledge about biotechnology applications in waste management

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

- Learn about the principles and biological intervention
- Attain knowledge about application biotechnology in industry and genetic modifications.
- Learn about biotechnology applications in waste management

Unit I	INTRODUCTION: BASICS& PRINCIPLES	9

Basic information on DNA and RNA Microbes- prokaryotes and eukaryotes, metabolism- carbohydrate, protein, lipids. Analysis of metabolism for environmental application and its mechanism, effective microorganism, Mechanism of detoxification, Photorespiration, immobilization, biodegradation, biogeochemical cycle

Unit II	FUNDAMENTALS OF BIOLOGICAL INTERVENTION	9

Extremophiles and thermophiles and its potential applications in environmental issues, diverse degradative abilities of microbes, inhibitors of degradation-xenobiotics, endocrine disrupters

Unit III	INDUSTRIAL APPLICATION	9

Decontamination of ground water, biofertilizers, physical, chemical and microbiological factors of composting, health risk, odor management, biological removal of nutrients- biotrickling filters, biomembrane technology

Unit IV	GENETIC MANIPULATION	9

Basic principles of genetic engineering, concept of recombinant technology-expression vectors- cloning of DNA – mutation, protoplast fusion technology, genetically modified organisms, risk assessment

Unit V	INTEGRATED ENVIRONMENTAL BIOTECHNOLOGY	9

Bioenergy, biogas production, biodiesel, Bioremediation, factors affecting bioremediation , Biosorption, mechanism of biosorption, waste minimization, ,pollution prevention, Biosensors and its application in environmental issues, integrated agricultural application, plant disease suppression, biomonitoring, phytoremediation, microbes external to the plants, plant/microbe interaction, Biotransformation

TEXT BOOK(S):

1. Rehm H J and Reed G, Biotechnology, a comprehensive treatise, VCH Verleg, Germany, 1999.
2. A K Chaterjee, Introduction to Environmental Biotechnology, PHI, India, 2000

REFERENCES:

1. Andrew D Eaton, Lenore S Clesceri, Eugene W Rice and Arnold E Greenberg, Standard Methods – For the Examination of Water and Wastewater, American Public Health Association, 2005.
2. Raina M Maier, Ian L Pepper and Charles P Gerba, Environmental Microbiology, Academic Press, 2009.
3. Bimal C. Bhattacharyya and Rintu Banerjee, Environmental Biotechnology, Oxford Higher Education, 2007.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX09	ENVIRONMENTAL STRUCTURES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate the students about design of pipes and concrete roofing
- Impart knowledge about the design of water tank and special structures
- Provide knowledge about repair and rehabilitation of structure.

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

- Acquire knowledge about design of pipes and concrete roofing
- Do design of water tank and special structures
- Learn about repair and rehabilitation of structure.

Unit I	DESIGN OF PIPES	9

Structural design of Concrete, Prestressed Concrete, Steel and Cast iron pipes - piping mains – joints – Leak detection - sewerage tank design – anchorage for pipes – massive outfalls – structural design - laying – Testing - hydrodynamic considerations - Advances in the manufacture of pipes.

Unit II	DESIGN OF CONCRETE ROOFING SYSTEMS	9

Design of concrete roofing systems – Cylindrical, Spherical and Conical shapes using membrane theory and design of various types of folded plates for roofing with concrete – Design of pumping stations – Drainage plan of a building.

Unit III	ANALYSIS AND DESIGN OF WATER TANKS	9

IS Codes for the design of water retaining structures. Design of circular, rectangular, spherical and Intze type of tanks using concrete. Design of prestressed concrete cylindrical tanks – Economic analysis – introduction to computer aided design and packages.

Unit IV	DESIGN OF SPECIAL PURPOSE STRUCTURES	10

Underground reservoirs and swimming pools, Intake towers, Structural design including foundation of water retaining structures such as settling tanks, clari-flocculators, aeration tanks, etc.,- effect of earth pressure and uplift considerations – selection of materials of construction.

Unit V	REPAIR AND REHABILITATION OF STRUCTURES	8

Diagnosing the cause and damage, identification of different types of structural and non-structural cracks – repair and rehabilitation methods for Masonry, Concrete and Steel Structures. Exposure on Steel, Lattice Structures used in water and sewerage works.

TEXT BOOK(S):

1. Prestressed Concrete by Krishna Raju, Tata McGraw Hill Publishing Co. 2nd edition, 1988.
2. Reinforced Concrete by N. C. Sinha & S .K. Roy -S. Chand and Co.,1985.

REFERENCES:

1. Hulse R. and Mosley W. H., Reinforced Concrete Design by Computer, Macmillan Education Ltd., 1986.
2. Ramaswamy G. S., Design and Construction of Concrete shell roofs, CBS Publishers, India, 1986
3. Green J. K. and Perkins P. H., Concrete liquid retaining structures, Applied Science Publishers, 1981.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX10	ENVIRONMENTAL REACTION ENGINEERING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Identify and address current and future societal problems related to environment within a broader framework of sustainable development.
- Apply a multi-disciplinary approach to conceive, plan, design, and implement solutions to problems in the field of environmental reaction engineering.
- Understanding the impact of solutions to environmental engineering problems in a global, scientific, and societal systems context.

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

- Successfully apply advanced concepts of fundamental sciences and engineering to identify, formulate, and solve complex environmental engineering problems, also to design, analyze, and develop technologies to meet desired needs of society, both, professionally and ethically.
- Be knowledgeable of contemporary issues and research challenges/opportunities related to chemical and environmental engineering, and engage in life-long learning to keep abreast of such issues.
- Use advanced techniques, skills, and modern scientific and engineering tools for problems related to professional practice in the field of environmental reaction engineering.

Unit I	INTRODUCTION	9

Reaction engineering principles with applications to environmental systems, general reaction mechanisms: Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization– Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends. Rate relationships: Concepts and applications to homogenous systems and heterogeneous systems with respective chemical and biological reactions.

Unit II	POLLUTANTS AND REACTIONS IN ENVIRONMENT	9

Reaction leading to generation of pollutants, impact of pollutants and theirs reactions on environment, ozone depletion, smog formation, acid rain, chemical reactions in major treatment technologies- gas – solid catalytic reactions, catalytic oxidation of VOCs, incineration, selective catalytic reduction. Gas – liquid reaction FCC (fluid catalytic cracking) off gas cleaning, wet- gas scrubbing, H2S removal and spent caustic oxidation.

Unit III	REACTORS MODELLING AND DESIGN	9

Ideal systems modeling and design, reactor concepts, ideal reactors, reaction rate measurements, hybrid system modeling and design, sequencing batch reactor, reactors in series and reactors in recycle. Non-ideal system modeling and design, non-ideal reactor behavior, RTD analysis, PFDR model.

Unit IV	MASS TRANSFER AND ITS APPLICATIONS IN ENVIRONMENTAL ENGINEERING	9

Principles of diffusion and mass transfer between phases, Gas absorption, humidification operations, leaching and extraction, drying of solids, fixed-bed separation, membrane separation process, fluid solid surface reactions, Gas-liquid bulk phase reaction, adsorption.

Unit V	BIOLOGICAL REACTION ENGINEERING	9

Biological kinetics, enzyme kinetics, Michaelis – Menden equation, bioreactors, Batch and continuous operation in bioreactors, Aerobic processes: Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. b) Anaerobic processes : Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactor. bio concentration, bioaccumulation, biomagnification, bioassay, bio monitoring. Biotechnology in reduction of CO2 emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications. Vermi technology, Methane production, Root zone treatment, Membrane technology, Biodegradable plastics.

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TEXT BOOK(S):	
1.	A Weber, W.J and Di Giano, F.A., "Process Dynamics in Environmental systems", John Wiley sons Inc, 1996.
2.	Metcalf and Eddy, "wastewater engineering, treatment, disposal and Reuse", Inc. Third edition McGraw – hill 1991.
REFERENCES:	
1.	M Dunn I.J, Elmar Heinzle, John Ingham, Prenosil J.E, „Biological reaction engineering", Wiley inter science, 2005.
2.	A. The Engineering of Chemical reactions by Lanny.D.Schmidt,Oxford University Press , 1997.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX11	ENVIRONMENTAL SYSTEM ANALYSIS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Introduce about ecological modeling, single and multi species modeling on a brief.
- Educate about the modeling of CSTR and the kinetics of reaction taking place in it.
- Introduce the concepts of river and stream water modeling, water quality parameters modeling.
- Educate about the microbial energetic in various reactors systems.
- Elaborate the computational techniques for modeling

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

- Developed conceptual schematics required for system analysis and an ability to translate pertinent criteria into system requirements

Unit I	ECOLOGICAL SYSTEM	9

Basic concepts in ecology and ecological modeling, Population Dynamics: Birth and death processes. Single species growth, Prey-predator models: Lotka-Volterra, Rosenzweig-MacArther, Kolmogorov models. Multi-species modeling - Structural analysis and stability of complex ecosystems.

Unit II	CONTINUOUS-FLOW REACTOR MODELING	9

CSTR, Plug-Flow, Dispersion. A case study of a tubular reactor with axial dispersion, Parameter Calibration: Search algorithms for nonlinear dynamical models, Variance of estimated parameters. Application to Monod and Haldane kinetics.

Unit III	WATER QUALITY MODELING	9

Rivers and streams water quality modeling -dispersion and mixing- water quality modeling process- model sensitivity-assessing model performance; Models for dissolved oxygen and pathogens- Pollutant and nutrient dynamics -Dissolved Oxygen dynamics -Groundwater quality modeling

Unit IV	MICROBIAL DYNAMICS AND ENERGETICS	9

Requirements for carbon and nutrient removal. Activated sludge: Process schemes: completely mixed, plug-flow, SBR, nutrient removal. Anaerobic digestion: process dynamics, Operational control of wastewater treatment processes.

Unit V	COMPUTER BASED SOLUTIONS	9

Formulation of linear optimization models. Linear programming. Sensitivity testing and duality. Solution techniques and computer programming; Formulation of linear optimization models. Application of models- simulation, parameter estimation and experimental design.

TEXT BOOK(S):

1. Deaton, M.L and Winebrake, J.J., "Dynamic Modeling of Environmental Systems", Springer-Verlag, 2000

REFERENCES:

1. Orhon, D and Artan, N., "Modeling of Activated Sludge Systems, Technomic" Publ. Co., 1994.
2. Chapra, S.C. "Surface Water-Quality Modeling", McGraw-Hill, 1997.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX12	ROLE OF ENVIRONMENTAL LEGISLATIONS IN INDUSTRIES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Make the students conversant with the legislations in India.
- Understand the basic principles in pollution control.
- Expose the students to the pollution control policies in India.

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

- Make the students conversant with the legislations related to pollution control.
- Get idea about the implementation of rules.
- Enforce the rules.

Unit I	THE WATER (PREVENTION & CONTROL OF POLLUTION)ACT, 1974	9

Definitions-Salient features-Powers &functions of Regulatory agencies–Responsibilities of occupier, provisions relating to prevention& control-procedures to obtain consent-Monitoring and compliance mechanisms-legal provision for violation of Water(P&CP)Act-Case studies on water polluting industries-Textile dyeing, Paper mills-Electroplating, Starch industries-inventorisation of new water polluting industry and its management-field visits.

Unit II	THE AIR (PREVENTION & CONTROL OF POLLUTION)ACT, 1981	9

Definition-Salient features- Powers &functions of Regulatory agencies -National ambient Air quality standards-Emission standards for industries specific- Responsibilities of occupier, provisions relating to prevention& control-procedures to obtain consent Monitoring and compliance mechanisms- legal provision for violation of Air(P&CP)Act- Case studies on Air polluting industries-Foundries, Cement, Thermal power plants- inventorisation of new Air polluting industry and its management-field visits.

Unit III	THE ENVIRONMENT (PROTECTION) ACT, 1986	9

Genesis of the Act-Salient features-Role of Central Government-various notifications and rules –prohibition on import of genetically modified organisms-chemicals-hazardous wastes- Batteries management-Restriction on Ozone depleting substances-EIA notification-Siting of industries-State level EIA Authorities-eco-mark-Control on noise pollution-coastal regulations- Monitoring and compliance mechanisms-Role of National Green Tribunals(NGT),Environmental courts & Public interest litigation -Case studies

Unit IV	REGULATIONS ON INDUSTRIAL SOLID WASTE MANAGEMENT	9

Restriction on Hazardous waste-Bio-medical wastes-Recycled plastic wastes-Municipal solid wastes-e-waste-Salient features-Responsibilities of occupier/generator/local bodies/PCBs- Monitoring and compliance mechanisms-consent clearance, Authorization, Registration procedures for industry specific-Issues &Challenges-Best practices-Case studies on lead refining, engineering units, hospitals, plastic units, Municipal landfills, field visits.

Unit V	ELECTRONIC WASTE (MANAGEMENT &HANDLING)RULES2011	9

Definition-Environmental & Occupational Health hazards of e-waste-Salient features of E-waste Rules-Extended producers responsibility-issues and challenges –Compliance and Consent Clearance mechanisms-Best practices of E-waste management-Case studies on E-waste recycling units, Bulk consumers, Collection Centres-field visits.

TEXT BOOK(S):

1. Rosencrannz, S. Divan, M.L.Noble, Environmental law and policy in India, cases, materials and statutes, Tripathi pvt.Ltd. Bombay.
2. Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi, 2001.

REFERENCES:

1. The safe disposal of hazardous waste. Vol. I, II, & III Bat stone, Smith, Wilson, Joint study Sponsored by the world bank, the WHO, & UN Environmental Program UNEP, The world bank
   Freeman, H.M. standard Handbook of Hazardous Waste Treatment and Disposal, 1989.
2. Stem A.C. Air pollution, Vol. I to VIII, Academic press.

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Department	CIVIL ENGINEERING					R 2019	Semester III	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX13	CLEANER PRODUCTION AND SUSTAINABLE DEVELOPMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate the students on complete management principles related to Cleaner Production and Control of Industrial Pollution.

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

- Perform rate analysis of materials of construction
- Estimate the quantities of materials of construction
- Estimate the cost of buildings

Unit I	SUSTAINABLE DEVELOPMENT	9

Sustainable Development-Indicators of Sustainability-Sustainability Strategies Barriers to Sustainability-Industrial activity and Environment-Industrialization and sustainable development-Industrial Ecology-Cleaner Production (CP) in Achieving Sustainability-Prevention versus Control of Industrial Pollution-Environmental Policies and Legislations-Regulations to Encourage Pollution Prevention and Cleaner Production-Regulatory versus Market Based Approaches.

Unit II	POLLUTION PREVENTION	9

Definition-Importance-Historical evolution-Benefits-Promotion-Barriers-Role of Industry, Government and Institutions - Environmental Management Hierarchy Source Reduction Techniques-Process and equipment optimization, reuse, recovery, recycle, raw material substitution-Internet Information and Other CP Resources.

Unit III	CONCEPT OF CLEANER PRODUCTION	9

Overview of CP Assessment Steps and skills, Preparing for the site visit, Information Gathering, and process flow diagram, material balance, CP Option Generation Technical and Environmental feasibility analysis-Economic valuation of alternatives total cost analysis-CP Financing-Establishing a program-Organizing a program preparing a program plan-Measuring progress-pollution prevention and cleaner production Awareness plan -Waste audit-Environmental Statement.

Unit IV	LIFE CYCLE ASSESSMENT	9

Elements of LCA-Life Cycle Costing -Eco Labeling-Design for the Environment International Environmental Standards-ISO 14001-Enironmental audit.

Unit V	CASE STUDIES	9

Industrial application of CP, LCA, EMS and Environmental Audits.

TEXT BOOK(S):

1. Paul L Bishop, "Pollution Prevention Fundamental and Practice", McGraw-Hill International, 2000.
2. B World Bank Group, "Pollution Prevention and Abatement Handbook-Towards Cleaner Production", World Bank and UNEP, Washington D.C, 2005.

REFERENCES:

1. Prasad modak, C.Visvanathan and Mandarparasnis "Cleaner Production Audit", Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok, 2005.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX14	SOLAR ENERGY TECHNOLOGIES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Make students understand the fundamental theory governing solar thermal and photovoltaic devices and make them carry out preliminary system designs.

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

- Estimate solar radiation received on a surface
- Predict the performance of solar thermal devices and analyze its performance
- Carryout sizing of solar photovoltaic systems

Unit I	INTRODUCTION	6

Solar radiation relations – Radiation on horizontal and tilted surfaces – Extraterrestrial radiation - Estimation of clear sky radiation – Total radiation on fixed sloped surfaces

Unit II	HEAT TRANSFER & PERFORMANCE ANALYSIS	12

Heat transfer aspects in solar thermal – Radiation absorbed by a solar collector -Theory of Flat Plate Collectors Flat Plate Collectors - Mean fluid and plate temperature calculation – Collector performance - numerical simulation

Unit III	SOLAR AIR HEATERS & PV CELLS	10

Theory of solar air heaters – Basics of concentrating collectors. Characteristics of PV cells and modules – Performance parameters – PV system configurations

Unit IV	MODELLING	9

Battery Modelling a PV system – Sizing of a stand-alone system

Unit V	IMPLEMENTATION & CONTEMPORARY ISSUES	8

Mini sizing projects – Based on each collector Technology. Seminar, work shop and Guest lectures

TEXT BOOK(S):

1. S.P. Sukhatme and J.K.Nayak (2010), Solar Energy - Principles of Thermal Collection and Storage, 4nd Edition, Tata McGraw Hill.
2. D. Yogi Goswami, Frank Krieth and Jan F. Kreider, Principles of Solar Engineering, 2nd Edition, (2000) CRC Press

REFERENCES:

1. John A. Duffie and William A. Beckman, Solar Engineering of Thermal Process,3rd Edition, (2013), John Wiley & Sons.
2. Tomas Markvart , Solar Electricity, 2nd Edition,(2000) John Wiley & Sons.
3. Simon Roberts, Solar Electricity: Practical Guide to Designing and Installing Small Photovoltaic Systems, Prentice-Hall. (1992), Prentice Hall Inc

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Department	CIVIL ENGINEERING					R 2019	Semester III	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX15	ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate about occupational health hazard and safety measures at work place
- Impart knowledge about accident prevention and safety management
- Provide knowledge about general safety measures in industries

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

- Get knowledge about occupational health hazard and safety measures at work place
- Learn about accident prevention and safety management
- Learn about general safety measures in industries

Unit I **OCCUPATIONAL HEALTH AND HAZARDS** **9**

Occupation, Health and Hazards - Safety Health and Management: Occupational Health Hazards - Ergonomics - Importance of Industrial Safety. Radiation and Industrial Hazards : Types and effects - Vibration - Industrial Hygiene - Different air pollutants in industries and their effects. Electrical, fire and Other Hazards - General causes, Machine Guards and its types, Automation.

Unit II **SAFETY A WORKPLACE** **9**

Safety at Workplace - Safe use of Machines and Tools: Safety in use of different types of unit operations - Ergonomics of Machine guarding - working in different workplaces - Operation, Inspection and maintenance Plant Design and Housekeeping, Industrial lighting, Vibration and Noise

Unit III **ACCIDENT PREVENTION** **9**

Accident Prevention Techniques - Principles of accident prevention - Definitions, Theories, Principles - Hazard identification and analysis, Event tree analysis, Hazop studies, Job safety analysis - Theories and Principles of Accident causation - First Aid : Body structure and functions - Fracture and Dislocation, Injuries to various body parts

Unit IV **SAFETY MANAGEMENT** **9**

Safety Management System and Law - Legislative measures in Industrial Safety: Various acts involved in Detail-Occupational safety, Health and Environment Management : Bureau of Indian Standards on Health and Safety, 14489, 15001 - OSHA, Process safety management (PSM) and its principles - EPA standards- Safety Management : Organizational & Safety Committee - its structure and functions

Unit V **GENERAL SAFETY MEASURES** **9**

Plant Layout for Safety -design and location, distance between hazardous units, lighting, colour coding, pilot plant studies, Housekeeping - Accidents Related with Maintenance of Machines - Work Permit System : Significance of Documentation Directing Safety : Definition, Process, Principles and Techniques Leadership : Role, function and attribution of a leader Case studies - involving implementation of health and safety measures in Industries

TEXT BOOK(S):

1. R.K. Jain and Sunil S. Rao, Industrial safety, Health and Environment Management, Khanna publishers, New Delhi (2006).
2. Frank P. Lees - Loss of Prevention in Process Industries, Vol 1 and 2, Butterworth - Heinamann Ltd., London (1991)

REFERENCES

1. Industrial Safety - National Council of India
2. Factories Act with Amendments 1987, Govt. of India Publications DGFASLI, Mumbai

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Department	CIVIL ENGINEERING					R 2019	Semester III	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX16	CLIMATE CHANGE AND ADAPTATION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate about Climate system and its changes and causes
- Impart knowledge about impacts, adaptation and mitigation of climate change
- Provide knowledge about clean technology and clean energy

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

- Get knowledge about Climate system and its changes and causes
- Learn about impacts, adaptation and mitigation of climate change
- Learn about clean technology and clean energy

Unit I	EARTH'S CLIMATE SYSTEM	9

Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes - The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

Unit II	OBSERVED CHANGES AND ITS CAUSES	9

Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.

Unit III	IMPACTS OF CLIMATE CHANGE	9

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

Unit IV	CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES	9

Adaptation Strategy/Options in various sectors – Water – Agriculture — Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

Unit V	CLEAN TECHNOLOGY AND ENERGY	9

Clean Development Mechanism – Carbon Trading - examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.

TEXT BOOK(S):

1. Jan C. van Dam, Impacts of Climate Change and Climate Variability on Hydrological Regimes, Cambridge University Press, 2003.
2. IPCC fourth assessment report - The AR4 synthesis report, 2007
3. IPCC fourth assessment report –Working Group I Report, " The physical Science Basis", 2007
4. IPCC fourth assessment report - Working Group II Report, " Impacts, Adaptation and Vulnerability", 2007
5. IPCC fourth assessment report – Working Group III Report" Mitigation of Climate change", 2007

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REFERENCES	
1.	Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., 'Climate Change and Water'. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 2008.
2.	Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007

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Department	CIVIL ENGINEERING					R 2019	Semester III	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX17	AIR AND NOISE QUALITY MODELLING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Introduce the fundamentals of air pollution with a background on historical perspective on air pollution.
- Introduce the theory of dispersion of air pollution in the atmosphere. To discuss the major approaches for air pollution modeling
- Demonstrate the features and the use of most widely used commercial and freely available air quality models

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

- Develop conceptual schematics required for air quality modeling
- Translate pertinent criteria into air pollution control.

Unit I	MODELING CONCEPT	9

Overview of different types of models-deterministic and stochastic approach- Steps in model development-numerical and simulations models- calibration and validation of models- Limitations- Transport phenomena- Mass balance analysis-Model development and decision making.

Unit II	AIR POLLUTION MODELING	9

Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution –Transport of air Pollutants - Meteorological settling for dispersal of air pollutants – Vertical structure of temperature and stability, atmospheric motions, Wind and shear, self cleaning of atmosphere; transport and diffusion of stack emissions – atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics.

Unit III	AIR QUALITY MODELS	9

Types modeling technique, modeling for nonreactive pollutants, single source, short term impact, multiple sources and area sources, Fixed box models- diffusion models – Gaussian plume derivation- modifications of Gaussian plume equation- long term average-multiple cell model- receptor oriented and source oriented air pollution models- model performance, accuracy and utilization-air Quality Index -air quality mapping

Unit IV	INDOOR AIR QUALITY MODELS	9

Indoor Air Pollutants - Volatile Organic Compounds , Inorganic Gaseous Pollutants Respirable Particulates , Bioaerosols, Radon and its decay products-Infectious disease transmission- A/C units in indoor- Odors and sick building syndrome-Indoor Air quality Models.

Unit V	SOFTWARE PACKAGE APPLICATIONS	9

Commercial air quality models -ADMS, Airviro and USEPA models.

TEXT BOOK(S):

1. Zanneti, P. "Air Pollution Modeling Theories", Computational Methods and Available Software. Van Nostrand Reinhold, New York. 1990
2. Boubel R.W., Fox D.L., Turner D.B & Stern A.C., "Fundamentals of Air Pollution" Academic Press, New York, 1994

REFERENCES

1. Schnoor J.L., "Environmental Modeling Fate and Transport of Pollutants in Water, Air and Soil", John Wiley & Sons Inc., New York, 1996.
2. Arthur C.Stern Air Pollution (3rd Ed.) Volume I – Air Pollutants, their transformation and Transport, (Ed.), Academic Press, 2006.
3. Deaton and Wine Brake, "Dynamic Modeling of Environmental Systems", Wiley & Sons, 2002.

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Department	CIVIL ENGINEERING					R 2019	Semester III	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX18	WATER QUALITY MODELLING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate the students about surface water hydrology and run off
- Impart knowledge about ground water hydrology and flow
- Provide knowledge about ground water modeling

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

- Learn about surface water hydrology and run off.
- Acquire knowledge about ground water hydrology and flow.
- Attain knowledge about ground water modeling

Unit I	SURFACE WATER HYDROLOGY	9

Land Processes – Subsurface and Channel Processes- Precipitation – Rain gauge network, Abstractions, Infiltration, Evaporation, Transpiration, Process and models.

Unit II	SURFACE RUNOFF MODEL	9

Unit Hydrograph & S curve Hydrograph, Dimensionless Unit hydrograph, GUIH, Watershed Model and Conceptual Models.

Unit III	GROUNDWATER HYDROLOGY	9

Occurrence and Movement of Ground water, Properties of aquifer, Groundwater flow equations, Dupuit Forchheimer assumptions, Well hydraulics, Partial penetration of wells, Interference of wells, Collector wells and Infiltration galleries

Unit IV	GROUNDWATER FLOW	9

Pumping tests, Analysis for unconfined and non leaky and leaky confined aquifer and water table aquifer, Locating hydro geologic boundaries, Well design criteria.

Unit V	GROUNDWATER MODEL	9

Natural and Artificial Recharge of Ground water- Salt water intrusion, Application of Finite Difference in ground water

TEXT BOOK(S):

1. Ven Te Chow, "Applied Hydrology", Mc GrawHill Science Publishers, 1988
2. Singh, Vijay ., "Elementary Hydrology", Prentice Hall,1994

REFERENCES:

1. Raghunath. "Ground Water", Mc Graw Hill, 2007
2. Bear, J., Hydraulics of Ground water, Mc Graw Hill, 2007

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Department	CIVIL ENGINEERING					R 2019	Semester III	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX19	ADVANCED WASTEWATER TREATMENT AND REUSE	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Provide knowledge about stripping, nitrogen removal and oxidation
- Impart knowledge about Membrane separation, elecrodialysis
- Educate about phosphorous removal , reclamation and reuse

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

- Get knowledge about air sripping
- Learn about various nutrient processes
- Learn about reclamation and reuse of wastewater

Unit I	GENERAL AND STRIPPING	9

Need for advanced wastewater treatment – technologies used for advanced treatment –conventional reactor modifications in advanced treatment-oxidation processes – regulations in removal of NBOD and other nutrients-Selection of unit operation in advanced treatment. Gas stripping – Analysis of gas stripping – Design of stripping towers – applications. – Air stripping of ammonia – Breakpoint chlorination – Ion exchange.

Unit II	NITROGEN REMOVAL AND OXIDATION PROCESSES	9

Nutrient removal – Nitrogen removal – forms and sources of nitrogen – Biological nitrogen removal – Nitrification kinetics – Denitrification kinetics – Design parameters – Nitrogen removal by – physical and chemical processes. Oxidation processes-advanced oxidation process in removal of nitrogen and phosphorus derivatives-use of peroxy, Cl- and oxy radicals in reducing COD.

Unit III	MEMBRANE SEPARTION PROCESSES AND ELECTRO DIALYSIS	8

Membrane separation processes – process classification – membrane materials-Symmetric and asymmetric membranes – membrane configuration – membrane fouling- Molecular weight cutoff – Reverse osmosis – theory – membrane structure and rejection mechanism – osmotic pressure – Transport models and flux equations – ultra filtration – Electro dialysis – theory – power requirement.

Unit IV	PHOSPHOROUS REMOVAL	9

Phosphorous removal – By biological methods – Phosphorous removal by chemical addition – chemistry of precipitation with Aluminium, calcium and Iron – Comparison of processes – Estimation of sludge produced from chemical precipitation of phosphorous with lime in PST.

Unit V	WASTEWATER RECLAMATION AND REUSE	9

Merits and demerits of advanced treatment-applications of treated wastewater- Wastewater reclamation and reuse – The role of water recycling in the hydrologic cycle – wastewater reuse applications – public health and environmental issues in water reuse – Level of treatment – Risk Assessment – Ground water recharge with reclaimed water.

TEXT BOOK(S):

1. METCALF & EDDY, "Wastewater Engineering Treatment Disposal Reuse", Tata McGraw-Hill, New York,2003
2. Arceivala S. J.' "Wastewater treatment and Disposal" Marcelderdekker Publishers,1981.

REFERENCES:

1. HOWARD S. PEAVY, DONALD R. ROWE & GEORGE TCHOBANOGLOUS, "Environmental Engineering", McGraw-Hill, 1988.
2. QASIM S. R., "Wastewater Treatment Plant – Planning, Design and operation, Holt Rinchart and Winston, New York, 2002.
3. Larry D. Benefield and Clifford W. Randall, "Biological Process Design for Wastewater Treatment" , Prentice - Hall Series in Environmental sciences, 1980.

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Department	CIVIL ENGINEERING					R 2019	Semester II	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX20	OPERATION AND MAINTENANCE OF WATER AND WASTE WATER TREATMENT PLANTS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Educate the student on the various Operation & Maintenance aspects of Water treatment systems, sewer systems, sewage treatment plants and Effluent Treatment Plants

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

- Acquired the knowledge required to operate and maintain water treatment plants and wastewater treatment plants including trouble shooting.

Unit I	ELEMENTS OF OPERATION AND MAINTENANCE	9

Strategy for Good Operation and Maintenance- Knowledge of process and equipment- Preventive and Corrective maintenance scheduling- - Operation and Maintenance Plan - Proper and adequate tools, Spare units and parts - Training Requirements- Laboratory control- Records and Reports- Housekeeping - Corrosion prevention and control –Sampling procedure-Analytical techniques- Code of practice for analytical laboratories- Measurement of Flows, Pressures and Levels -Safety in O&M Operations - Management Information System - Measures for Conservation of Energy- management of residues from plant maintenance

Unit II	OPERATION AND MAINTENANCE OF WATER INTAKES AND SUPPLY SYSTEMS	9

Operational problems, O&M practices and Records of Operation of Reservoir and Intakes - Causes of Failure of Wells- Rehabilitation of Tube wells & Bore Wells- Prevention of Incrustation and Corrosion- Maintenance of Lined and Unlined Canals- Problems in Transmission Mains- Maintenance of Pipelines and Leakage Control- Repair Method for Different types of Pipes- Preventive and corrective maintenance of water pumps – Algal Control - O&M of Service Reservoirs - Problems in the water Distribution System and remedies- Water Quality Monitoring and Surveillance- Water Meters, Instrumentation, Telemetry & Scada- Computerized Water Billing System

Unit III	OPERATION AND MAINTENANCE OF SEWER SYSTEMS	9

Components and functions of sewer system – Conduits or pipes – Manholes – Ventilating shaft – Maintenance of collection system – Operational Problems– Clogging of pipes – Hazards –Precautions against gas hazards – Precautions against infections – Devices for cleaning the conduits – Preventive and corrective maintenance of sewage pumps –operation and maintenance of sewage pumping stations- Maintenance Hazards and Operator Protection -Case Studies

Unit IV	OPERATION AND MAINTENANCE OF PHYSICO-CHEMICAL TREATMENT UNITS	9

Operation and maintenance in screen chamber, Grit Chamber and clarifiers- - Operation issues, trouble shooting guidelines and record keeping requirements for clarifier, Equalization basins, Neutralization unit - Chemical storage and mixing equipment - Chemical metering equipment - Flash mixer –Filters, thickeners and centrifuges- Filter Press - Start-up and maintenance inspection - Motors and Pumps - Hazards in Chemical Handling – Jar Test - Chlorination Equipment - Membrane process systems- SDI and LSI determination- Process Chemistry and Chemical dosage calculations- Case Studies

Unit V	OPERATION AND MAINTENANCE OF BIOLOGICAL TREATMENT	9

Construction, Operation and Maintenance aspects of activated sludge process, trickling filters, anaerobic digester, SBR, UASBR, MBRs- Startup and Shutdown Procedures-DO, MLSS and SVI monitoring- Trouble shooting guidelines – Interaction with other Treatment Processes - Planning, Organizing and Controlling of plant operations – capacity building, case studies of Retrofitting- Case studies

TEXT BOOK(S):

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1.	CPHEEO , Manual on operation and maintenance of water supply systems, Central Public Health and Environmental Engineering Organization, Ministry of Urban Development, Government of India 2005
2.	Ministry of Drinking Water and Sanitation, operation and maintenance manual for rural water supplies, Government of India, 2013
REFERENCES:	
1.	Metcalf & Eddy, Inc., G. Tchobanoglous, H. D. Stensel, R. Tsuchihashi, and F. L.Burton. "Wastewater Engineering: Treatment and Resource Recovery"5th edition). McGraw Hill Company.,2014
2.	Ananth S Kodavasal, The STP Guide-Design, Operation and maintenance, Karnataka State Pollution Control Board, Bangalore,2011
3.	B Frik Schutte, handbook for the operation of water Treatment Works, The Water Research Commission, The Water Institute of Southern Africa, TT265/06, 2006.

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Department	CIVIL ENGINEERING					R 2019	Semester III	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX21	SOIL STRUCTURE INTERACTION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Get an idea on soil structure interaction, soil foundation models, finite difference and finite element analysis and elastic analysis of piles and piled raft.

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

- Understand various soil response models applicable to soil-foundation interaction analysis.
- Come up with elastic solutions for problems of pile, pile-raft system.
- Use software packages to analyze soil-foundation system including laterally loaded piles

Unit I	SOIL - FOUNDATION INTERACTION	9

Introduction to soil – Foundation interaction problems – Soil behaviour – Foundation behaviour – Interface behaviour – Scope of soil-foundation interaction analysis – Soil response models – Winkler, Elastic continuum, Two parameter elastic models, Elastic – Plastic behaviour – Time dependent behaviour

Unit II	BEAMS ON ELASTIC FOUNDATION - SOIL MODELS	9

Infinite beam – Two parameters – Isotropic elastic half space – Analysis of beams of finite length – Classification of finite beams in relation to their stiffness – Analysis through application packages.

Unit III	PLATE ON ELASTIC MEDIUM	9

Infinite plate – Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates – Analysis of finite plates – Rectangular and circular plates – Numerical analysis of finite plates – Simple solutions – Analysis of braced cuts – Application packages.

Unit IV	ELASTIC ANALYSIS OF PILE	9

Elastic analysis of sihgle pile – Theoretical solutions for settlement and load distribution – Analysis of pile group – Interaction analysis – Load distribution in groups with rigid cap – Pile raft – Application packages.

Unit V	LATERALLY LOADED PILE	9

Load deflection prediction for laterally loaded piles – Subgrade reaction and elastic analysis – Interaction analysis – Pile raft system – Solutions through influence charts –Application packages.

TEXT BOOK(S):

1. Saran, S., Analysis and design of substructures, Taylor & Francis Publishers, 2006.
2. Hemsley, J.A., Elastic Analysis of Raft Foundations, Thomas Telford, 1998.
3. Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley, 2008.
4. Murthy, V.N.S., Advanced Foundation Engineering, CBS Publishers, New Delhi, 2007
5. McCarthy, R.N., Essentials of Soil Mechanics and Foundations: Basic Geotechnics, Sixth Edition, Prentice Hall, 2002.

REFERENCES:

1. Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979.
2. Scott, R.F., Foundation Analysis, Prentice Hall, 1981.
3. Structure Soil Interaction – State of Art Report, Institution of structural Engineers, 1978
4. ACI 336, Suggested Analysis and Design Procedures for Combined Footings and Mats, American Concrete Institute, Delhi, 1988

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Department	CIVIL ENGINEERING					R 2019	Semester III	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EVX22	GEOTECHNICAL EARTHQUAKE ENGINEERING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the mechanism of earthquake, wave propagation analysis, ground motion, earthquake hazards, their mitigation and design of earthquake resistant foundations.

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

- Acquire knowledge about the earthquake ground motion, making familiar with code and software packages to study the ground motion.
- Analyze the liquefaction susceptibility of the site using laboratory and field tests.
- Design earthquake resistant geotechnical structures and the methods to improve the ground for hazard resistance.

Unit I	EARTHQUAKE SEISMOLOGY	9

Causes of earthquake – Plate tectonics –Earthquake Fault sources – Elastic Rebound theory – Seismic waves– Elastic Rebound theory – Locating an earthquake – Quantification of earthquakes – Intensity and magnitudes – Locating an earthquake –Case studies.

Unit II	GROUND MOTION AND GROUND RESPONSE ANALYSIS	9

Characteristics of ground motion – Factors influencing ground motion – Evaluation of shear wave velocity – Lab tests – Need for Ground Response Analysis – Methods of Ground Response analysis.

Unit III	LIQUEFACTION AND LATERAL SPREADING	9

Liquefaction related phenomena – Liquefaction susceptibility – Evaluation of liquefaction by Cyclic Stress and Cyclic Strain approaches – Lateral deformation and spreading – Criteria for mapping liquefaction hazard zones – Liquefaction computation from Lab and Field tests.

Unit IV	SEISMIC DESIGN OF FOUNDATIONS, RETAINING WALLS AND SLOPES	9

Seismic design requirements of foundation – Seismic design of pile foundations – Seismic design of retaining walls – Behaviour of reinforced slope under seismic condition – Recommendations of seismic codes related to geotechnical engineering.

Unit V	SEISMIC HAZARD ANALYSIS	9

Seismic hazard analysis – DSHA – PSHA – Seismic microzonation – Soil Improvement for remediation of seismic hazards.

TEXT BOOK(S):

1. Kameswara Rao, N.S.V., Dynamics soil tests and applications, Wheller Publishing – New Delhi, 2000.
2. Krammer S.L., Geotechnical Earthquake Engineering, Prentice hall, International series Pearson Education (Singapore) Pvt. Ltd., 2004.
3. Kameswara Rao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi, 1998.
4. McGuire, R.K., Seismic Hazard and Risk Analysis, Earthquake Engineering Research Institute. MNo – 10, ISBN 0-943198-01-1, 2004.

REFERENCES:

1. Mahanti, N.C., Samal, S.K., Datta, P., Nag N.K., Disaster Management, Narosa Publishing House, New Delhi, India ISBN : 81-7319-727X-2006.
2. Bharat Bhushan Prasad, Fundamentals of Soil Dynamics and Earthquake Engineering, PHI Learning Pvt. Ltd., NewDelhi, 2009.
3. Bharat Bhushan Prasad, Advanced Soil Dynamics and Earthquake Engineering, PHI Learning Pvt. Ltd., NewDelhi, 2011.

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