Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

(Accredited 'A' Grade by NAAC with a score of 3.25)

Hingna Road, Wanadongri, Nagpur - 441 110

Master of Technology
SoE & Syllabus 2019
Environmental Engineering

28 June 2019

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

M. Tech. SCHEME OF EXAMINATION 2019

Environmental Engineering

SN	Sem	Sub Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
					L	T	P	Hrs		MSEs*	TA	ESE	
I SEMESTER													
1	1	CV3961	Environmental Chemistry and Microbiology	T	3	0	0	3	3	30	10	60	3
2	1	CV3962	**Lab** Environmental Chemistry and Microbiology	P	0	0	2	2	1	-	40	60	-
3	1	CV3963	Water Supply and Waste Water Collection System	T	3	0	0	3	3	30	10	60	3
4	1	CV3964	**Lab :-** Water Supply and Waste Water Collection System	P	0	0	2	2	1	-	40	60	-
5	1	CV3965	Municipal Water Treatment	T	3	0	0	3	3	30	10	60	3
6	1	CV3966	Municipal Solid Waste Management	T	3	0	0	3	3	30	10	60	3
7	1	CV3967	Municipal Waste Water Treatment	T	3	0	0	3	3	30	10	60	3
Total					**15**	**0**	**4**	**19**	**17**				
II SEMESTER													
1	2	CV3975	Industrial Waste Water Treatment and Reuse	T	3	0	0	3	3	30	10	60	3
2	2	CV3976	Envrionmental Management	T	3	0	0	3	3	30	10	60	3
3	2	CV3977	Air Quality Management	T	3	0	0	3	3	30	10	60	3
4	2	CV3978	Rural Water Supply and Sanitation	T	3	0	0	3	3	30	10	60	3
5	2		Professional Elective-I	T	3	0	0	3	3	30	10	60	3
6	2		Professional Elective-II	T	3	0	0	3	3	30	10	60	3
7	2	CV3986	Seminar	P	0	0	2	2	1	-	100		-
Total					**18**	**0**	**2**	**20**	**19**				

List of Professional Electives-I

2	CV3979	PE I: Hazardous Waste Management
2	CV3980	PE I: Water Resource Management
2	CV3981	PE I: Environmental Biotechnology
2	CV3982	PE I: Advanced Water Treatment

List of Professional Electives-II

2	CV3983	PE II: Energy Conversion and Environment
2	CV3984	PE II: Applied Structure
2	CV3985	PE II: Water Reuse and Recycling

III SEMESTER													
1	3	CV3989	Project Phase - I	P	0	0	14	14	8	-	100	-	-
Total					**0**	**0**	**14**	**14**	**8**				
IV SEMESTER													
1	4	CV3990	Project Phase-II	P	0	0	20	20	20	-	40	60	-
Total					**0**	**0**	**20**	**20**	**20**				
Total Credits									**64**				

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

		June 2019	1.00	Applicable for Sem 1 & 2 AY 2019-20 & Sem 3 & 4 AY 2020-21 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	

1st SEMESTER

CV3961	Environmental Chemistry and Microbiology		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To bring into focus those aspects of chemistry that are particularly valuable for solving problems of environmental monitoring and pollution control 2. To give a fundamental perspective of the microbial technology for adopting cleaner environmental practices	1. An ability to understand the concepts Environmental chemistry & to learn how the concepts of environmental chemistry can be put to practical applications. 2. An ability to explain microbial technology in environmental engineering practices
PO Mapped: 1, 4	

UNIT-I: **General Chemistry:** -Theory of valency, oxidation, numbers, oxidation-reduction reaction, law of mass action, Stoichiometry, gas laws. Physical Chemistry: - Types of solutions, Buffer solution, electrical conductivity, indicators. Amphoteric hydroxide, chemical equilibrium Osmosis, Dialysis.	**[07 Hrs.]**
UNIT-II: **Organic Chemistry**: -Organic compounds of interest to environmental engineers, general properties of the functional groups of organic compounds.	**[06 Hrs.]**
UNIT-III : Enzymes, classification of enzymes catalyzed reaction, energy considerations, coupling of reaction. Breakdown and synthesis of carbohydrates, fats, proteins under aerobic and anaerobic conditions. CNP cycles under aerobic and anaerobic conditions. Concept of BOD, COD, TOC.	**[07 Hrs.]**
UNIT-IV : Colloidal Chemistry: -Colloids, dispersion of colloids, general and electro-kinetic properties of colloids, colloidal solution and mixtures.	**[06 Hrs.]**
UNIT-V : **Environmental Chemistry: -**Chemistry involved in water treatment procedure like coagulation, softening, defluorination, iron and manganese removal, demineralization, analysis of pesticide and heavy metals.	**[07 Hrs.]**
UNIT-VI : **Environmental Microbiology** Introduction of microbiology, Haeckel's classification and characterization of microorganisms, viruses. Morphology and structure of bacteria, nutrient requirement, growth of bacteria. Basic microbiology of water and sewage. Basic principals involved in the analysis of faecal indicator bacteria – coliforms and streptococci, plankton analysis, analysis of pseudomonas & streptococci. Kinetics of microbial growth.	**[06 Hrs.]**

Text Book :-

1. Sawyer, C.N. and McCarty, P.L., and Parkin, G.F. Chemistry for Environmental Engineers, 4th Edn. McGraw Hill, New Delhi, 1994.
2. Benefield, Judkins and Weand – Process Chemistry for Water and Wastewater Treatment, Prentice Hall
3. Maier R M, Pepper I L and Gerba C P. Environmental Microbiology, Second Edition, Elsevier- AP, 2009.
4. Pelczar, Jr, M.J., Chan, E.C.S., Krieg, R.N., and Pelczar M. F, Microbiology, 5th Edn., Tata McGraw-Hill Publishing Company Limited, New Delhi, 1996.
5. Rittman B, McCarty P L McCarty P, Environmental Biotechnology: Principles and Applications, 2nd edition, McGraw-Hill, 2000

References Book :-

1. Powar & Daginawala, General Microbiology Vol. I &II, Himalaya Publishing House, Latest.

1st SEMESTER

CV3962	Lab: Environmental Chemistry and Microbiology		L=0	T=0	P=2	Credits=1
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**	**ESE Duration**	
	-----	**40**	**60**	**100**	**-----**	

COURSE OBJECTIVE	COURSE OUTCOMES
1. To study the water quality criteria & permissible standards 2. To study the characteristics of water and experimental procedure 3. To study the analysis of various parameters related to water quality	1. An ability to understand importance of water quality standards. 2. An ability to perform various physical and chemical tests on water sample. 3. An ability to understand various biological tests performed on water sample and to perform a few biological tests on water
PO Mapped: 1, 4	

Any TEN experiments of the following will be performed.

1. To determine Alkalinity of a water sample.
2. To determine Available Chlorine in given bleaching powder sample
3. To determine Total, Calcium and Magnesium hardness of given water sample.
4. To determine Dissolved Oxygen concentration in given water sample.
5. To determine Sulphates concentration in given water sample.
6. To determine Biochemical Oxygen Demand (B.O.D.) of a wastewater sample.
7. To determine Chemical Oxygen Demand (C.O.D.) of a wastewater sample.
8. To determine Maximum Probable Number (MPN) of coli form bacteria present in water sample by Multiple Tube Dilution (MTD) technique-presumptive test.
9. To determine Density of bacteria in a water sample pour plate (Standard Plate Count) method.
10. To determine concentration of Chlorides in a given water sample.
11. To determine Hydrogen ion concentration (pH) of a solution
12. To determine Turbidity of a solution using Nepheloturbidimeter.
13. To determine optimum coagulant dose by Jar test.
14. To determine effective size and co-efficient of uniformity of a given sand sample and to separate required sand from given stack of sand for required effective size and coefficient of uniformity.
15. To determine total, dissolved and suspended solids in given water sample.

1st SEMESTER

CV3963	Water Supply and Waste Water Collection System		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To Learn the water transmission and distribution system 2. To provide an understanding of analysis, design, and operation of water distribution system 3. To provide and understanding of sewer Networks and storm water drains.	1. An Ability to understand fundamental of design of the pipe in water distribution system and wastewater collection system 2. An Ability to understand different methods of analysis of pipe network for water distribution. 3. Ability to design of water distribution system and sewerage system
PO Mapped: 1, 4	

UNIT-I : Analysis of Water Supply System Components of water Supply system, Water use and demand estimation Flow through pipes- Continuity principle, and energy principle, Equation for flow through pipes, Moody diagram, Maintenance of distribution System, Water hammer Analysis.	**[07 Hrs.]**
UNIT-II : Analysis of Water Distribution System Analysis of flow through pipe network through various method such as 1. Hardy cross method 2. Newton Raphson's method 3. Linear Theory method	**[06 Hrs.]**
UNIT-III : Types of Reservoirs and design parameter, Importance and design of pumps and different valves in the distribution system, Node flow analysis.	**[07 Hrs.]**
UNIT-IV : Design of Water Distribution System, Design of Rising Main, Critical path method for design of water distribution networks and its cost analysis.	**[07 Hrs.]**
UNIT-V : Waste Water Collection General – Objectives, types of system and sewers, requisites for sewerage system design – survey and investigations. Hydraulics of sewer – flow equations, pipe and open channel flow, self-cleansing and scouring velocities through sewer, flow in partially filled sewers, velocity of equal cleansing, sewer shape vis-a-vis their usefulness, sewer invert drop.	**[06 Hrs.]**
UNIT-VI : Design of wastewater Collection system Separate, Combined, and semi-combined sewers Sewer Pipe hydraulics: size and design of pipes, Manholes, street inlets, catch basins, sewer junctions, inverted siphon, flushing tanks, air ejectors.	**[06 Hrs.]**

Text Book :-

1. Bhave P. R. And Gupta R, Analysis of Water Distribution Networks, Narosa Publishing Co., New Delhi (2006).
2. Fair G. M., Geyer J. C. & Okun D. A., Water & Wastewater Engg. Vol.I & II, John-Willey & Sons, New York.
3. McGhee N. J. & Steel E. W., Water supply and sewerage, McGraw hill publications, 1991.
4. Bhave P.R, Optimal design of water distribution networks, Narosa Publishing Co., New Delhi (2003).

Reference Book :-

1. CPHEEO, Manual on water supply and treatment, Ministry of urban development, GoI.
2. CPHEEO, Manual on Sewerage and Sewage Treatment, Ministry of urban development, GoI.

CV3964	Lab: Water Supply and Waste Water Collection System		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	-----	10	60	100	-----	

COURSE OBJECTIVE	COURSE OUTCOMES
1. To Learn the water transmission and distribution system 2. To provide an understanding of analysis, design, and operation of water distribution system 3. To provide and understanding of sewer Networks and storm water drains.	1. An Ability to understand fundamental of design of the pipe in water distribution system and wastewater collection system 2. An Ability to understand different methods of analysis of pipe network for water distribution. 3. Ability to design of water distribution system and sewerage system
PO Mapped: 1, 2	

Following assignments in the field of

1. Water Distribution system and its design
2. Design of sewerage system
3. Analysis of water distribution
4. Cost Benefit Analysis

1st SEMESTER

CV3965	Municipal Water Treatment		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide a basic description and understanding of the principal unit operations used in the treatment of municipal water including coverage of the scientific basis of each unit process, as well as the conventional approach to their engineering design.	1. An ability to understand the fundamentals related to water treatment 2. An Ability to design different water treatment Units
PO Mapped: 1, 2, 4	

UNIT-I : Water quality criteria and standards, Requirement of water treatment facilities, Unit operation & Unit process, Site selection, Process selection. Aeration: Objective, Principles, Types of aerator, Design of aerators.	**[06 Hrs.]**
UNIT-II : Coagulation: History, need of coagulation, Chemistry of coagulation, Various coagulants used in process, Factors affecting efficiency of coagulation process, Operation of feeders, Types of rapid mixing devices, design of flash mixer. Flocculation: Theory of flocculation, Slow mixing devices.	**[07 Hrs.]**
UNIT-III : Sedimentation: Principle, Stoke' law, working of ideal sedimentation tank, Types of sedimentation tank, Design and working of clariflocculator, Operational problems in sedimentation tank.	**[06 Hrs.]**
UNIT-IV : Filtration: Theory of filtration, Types of filters, working of slow and rapid sand filter, operational difficulties and design of rapid sand filter.	**[07 Hrs.]**
UNIT-V : Disinfection: Methods of disinfection, Kinetics of chemical disinfection, Chlorination, Chemistry of chlorination, Methods of chlorination.	**[06 Hrs.]**
UNIT-VI : Adsorption: Theory, Granular and powder activated carbon, Performance and reactivation. Adsorption of organic compounds. Defluorination, Ion Exchange, Materials and reactions, Kinetics, Applications.	**[07 Hrs.]**

Text books:

1. N.J. McGhee, Steel E.W., Water Supply and Sewerage, McGraw hill 1991.
2. N.J. Weber, Physicochemical Process for Water Quality Control, John Wiley & Sons 1972.
3. Fair Geyer & Okun, Water and Waste Water Engineering, Vol I and II, John Wiley & Sons 1st.

Reference Book: -

1. Nordel, E, Water Treatment for Industrial And Other Uses, Reinhold Publishing Corporation, N.Y.
2. CPHEEO, Manual on Water supply and Treatment, Govt. of India Publication

1st SEMESTER

CV3966	Municipal Solid Waste Management		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To develop insight into the collection, transfer, and transport of municipal solid waste. 2. To examine the engineering and scientific principles of municipal solid waste (MSW) management. 3. To Processing and disposal methods for solid waste.	1. An ability to understand different characteristic of solid waste. 2. An ability to understand different methods of collection, transfer and transport of solid waste. 3. An ability to understand different Processing and disposal methods for solid waste.
PO Mapped: 1, 4	

UNIT-I : Problems and impacts of solid waste in developing countries, Solid waste management and organization. Sources, Types, Quantity and Composition of municipal solid waste.	**[06 Hrs.]**
UNIT-II : Characteristics of solid waste – Sampling – physical, chemical, and biological Analysis. Functional Elements of MSW.	**[07 Hrs.]**
UNIT-III : Storage, Collection, Transportation, Optimization of roots, Tools and equipment, Transfer station, Volume reduction.	**[06 Hrs.]**
UNIT-IV : Composting – Process microbiology, Aerobic and anaerobic composting. Sanitary Landfill – Process, mechanism, Classification, types, site considerations, Maintenance of site. Incineration-Mechanism, types, and Operation, Mechanical Composting.	**[07 Hrs.]**
UNIT-V : Future processing method, Pyrolysis, Refuse derived fuel.	**[07 Hrs.]**
UNIT-VI : Legislation on Management and Handling of Municipal Solid Waste Management, Handling of Bio-Medical Waste.	**[06 Hrs.]**

Text Books :-

1. Solid waste management in developing countries – A.D. Bhide, B.B. Sudresan
2. Solid waste water management – D. Joshep Hangertey, Joseph L. Pavoni.
3. George Techobanoglous, "Integrated Solid Waste Managementll, McGraw-Hill Publication, 1993.

Reference Books :-

1. Municipal Refuse Disposal – Institute of America Public Health Association, Interstate printer and publisher inc – Tanvil Elinoy
2. CPHEEO manual on MSW, GoI, New Delhi

1st SEMESTER

CV3967	Municipal Waste water Treatment		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. Fundamentals of treatment processes 2. Working of different sewage treatment units 3. Design of various units for sewage treatment	1. An ability to understand basics of different wastewater treatment processes 2. An ability to understand working of different sewage treatment units 3. An ability to design different sewage treatment units. 4. An ability to understand different methods of treatment and disposal of biosolids.
PO Mapped: 1, 2, 4	

UNIT-I : General objectives of sewage treatment, sewage characteristics, Reactor types and their hydraulic characteristics, mass balance analysis, reaction order, rates and coefficients.	**[07 Hrs.]**
UNIT-II : Conventional sewage treatment flow sheet, functions of different unit processes. Physical treatment: screening, gravity separation theory, types of settling, grit removal, primary sedimentation tank and its design.	**[06 Hrs.]**
UNIT-III : Chemical Treatment: chemical coagulation and precipitation, removal of phosphorus, heavy metals.	**[07 Hrs.]**
UNIT-IV : Biological treatment: Fundamentals, basic terminologies Activated sludge process: process description, recent developments, process analysis, design of conventional activated sludge process unit.	**[06 Hrs.]**
UNIT-V : Denitrification, Biological phosphorous removal, Membrane Bio-Reactors	**[07 Hrs.]**
UNIT-VI : Treatment of biosolids: process flow diagram, thickening, aerobic and anaerobic digestion, conditioning, dewatering.	**[06 Hrs.]**

Text Books :-

1. S.J. Arceivala, Wastewater Treatment and Disposal, Marcel Dekker,1981.
2. Metcalf and Eddy, Wastewater Engineering, Treatment, Disposal and Reuse, Inc. Third edition McGraw – hill 1991.
3. Qasim S.R. Wastewater Treatment Plant Planning, Design and Operation, Holt, Rinehart and Winston, N.Y.

References Books : -

1. N.F. Grey Activated Sludge Process, Theory and Practices, Oxford University Press

2nd SEMESTER

CV3975	Industrial Wastewater Treatment and Reuse		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To know importance of industrial wastewater treatment 2. Fundamentals of various treatment processes 3. Design various treatment units for treatment of industrial wastewater.	1. An ability to understand importance of industrial wastewater treatment. 2. An ability to understand the fundamentals of various treatment processes. 3. An ability to understand treatment methodologies for various industrial wastewaters. 4. An ability to design various treatment units for Industrial wastewater
PO Mapped: 1, 2, 4	

UNIT-I : Environmental impact due to industrial water pollution, problems associated with industrial wastewater, characterization of industrial wastewater. Sampling and analysis of wastewater, toxicity testing, statistical analysis of data, Indian standards for waste disposal.	**[06 Hrs.]**
UNIT-II : Common effluent treatment plant. Recycle and reuse of industrial waste, volume and strength reduction, concept of zero liquid discharge.	**[07 Hrs.]**
UNIT-III : Equalization and proportioning of wastewater, design of equalization tank. Neutralization of wastewater, Oil and grease removal, Floatation.	**[06 Hrs.]**
UNIT-IV : Stabilization pond, oxidation ponds.	**[07 Hrs.]**
UNIT-V : Anaerobic treatment, UASB, attached growth processes.	**[06 Hrs.]**
UNIT-VI : Treatment of specific industrial wastes: textile, dairy, tanning, sugar, brewery and distillery, iron and steel, food industries.	**[07 Hrs.]**

Text Books :

1. Metcalf and Eddy, Wastewater Engineering, Treatment, Disposal and Reuse, Inc. Third Edition McGraw Hill 1991.
2. W.W. Eckenfelder, Industrial Pollution Control, McGraw Hill Int. Edition 1990.
3. W.J. Weber, Physicochemical Processes for Water Quality Control, John Wiley and Sons, 1972.
4. Nemerow, N.L. Theories and Practices of Industrial Waste Treatment. New York: Addison Wisely.
5. Bess Elivievre, E.B. The Treatment of Industrial Wastes, McGraw Hill Book co.
6. Culp R L et al, Handbook of Advanced Wastewater Treatment Van No Strand Reinhold Publ. N.Y.
7. Arceivala, S.J., (1998) "Wastewater Treatment for Pollution Control ", Tata McGraw Hill.

References Books :

1. Central pollution control board, India, comprehensive industry document series.
2. World Bank Group (1998) "Pollution Prevention and Abatement Handbook – Towards Cleaner Production", World Bank and UNEP, Washington D.C.

2nd SEMESTER

CV3976	Environmental Management		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. Understand environmental policies of Government of India. 2. Understand different methods of environmental impact assessment. 3. Understand different national and international environmental laws	1. An ability to grasp the fundamentals and identify the tools used for Environmental Management 2. An ability to understand environmental impact assessment (EIA) as an environmental management tool 3. An ability to understand the evolution of environmental policies and laws and implications of international policies and laws for India.
PO Mapped: 3, 4	

UNIT-I : Development and Environment, Global and Indian scenario. National Environmental Policy, Environmental organizations for planning and implementation sustainable development. Concept of carrying capacity, assimilative and supportive capacity.	**[06 Hrs.]**
UNIT-II : Preventive and reactive strategies for environmental pollution control, Nature of impact – primary, secondary, tertiary, short –term long-term, local and regional, reversible & irreversible impacts.	**[07 Hrs.]**
UNIT-III : Environmental impact Assessment: Screening scoping, Methodologies: Adhoc, check-lists, network, matrix etc. Environmental Management plan. EIS Typical case studies (various sectors) of environmental impact assessment. MoEF questionnaire for environmental clearance, Disaster management plan	**[06 Hrs.]**
UNIT-IV : Environmental Audit definition, concept of EA, types of environmental audit, audit scope, procedural aspects of conducting environmental audit, water audit, wastewater audit, health and safety audit.	**[07 Hrs.]**
UNIT-V : Eco Labeling, Concept of Cleaner Technology, Life Cycle assessment, waste minimization, I SO 14001.	**[06 Hrs.]**
UNIT-VI : Environmental Legislations and its basic concepts, critical issues, civil liability, various enactment, and their provisions – Water Act (1974, 1988), forest Conservation Act (1980), Air Act (1981, 1988), Water (Cess) Act 1977, Environmental Protection Act 1986, other major environmental acts/rules.	**[07 Hrs.]**

Text Books: -

1. S. Musharraf, Legal Aspects of Environmental Pollution and Its Management, C.B.S. publishers, Delhi
2. R. K. Jain, L.V. Urban G.S. Stacey, H.E. Balbach, Environmental Assessment McGraw – Hill, Inc. N.Y.
3. Rao, J.G. and Wooten, Environmental Impact Analysis, Handbook, 1980.
4. Canter, L.W. Environmental Impact Assessments, -- N.Y. McGraw – hill book Co.1977.

Reference Books: -

1. Rosencrannz, S. Divan, M.L. Noble, Environmental Law and Policy in India, Cases, Materials and Statutes, Tripathi Pvt. Ltd. Bombay.

2nd SEMESTER

CV3977	Air Quality Management		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To make insight into the knowledge of major air pollutants; their sources and their effects (environmental, economic and health), standards and limits 2. To understand the dispersion phenomenon of air pollutants covering diffusion and advection, meteorological components, stability of atmosphere and corresponding plume shapes 3. To understand the techniques and instrumentation of ambient air monitoring, establishment of ambient air monitoring stations; stack monitoring and experimental analysis of air gaseous and particulate air pollutants; 4. To understand the principles of air pollution control and various control equipment's at source 5. To understand the indoor air pollution, sources, causes and effects 6. To understand the elements of urban air pollution, odour and noise pollution	1. An ability to understand air pollution and its control 2. An ability to understand various meteorological factors and its influence on air pollution. 3. An ability to understand the basic principles, equipment, and methods used to control particulate matter, gaseous emission and automobile emission 4. An ability to understand basics of urban air pollution, odour and noise pollution
PO Mapped: 2, 4	

UNIT-I : Introduction to Air Pollution: Sources & classification of air pollutants, Industrial processes causing air pollution, Ambient air quality standards, Air pollution control legislation, Effects of pollutants on health, vegetation, materials & atmosphere.	**[06 Hrs.]**
UNIT-II : Meteorological aspects: Meteorological parameters, Temperature lapse rate, Plume behavior. Gaussion diffusion model for finding ground level concentration. Plume rise. Formulae for stack height and determination of minimum stack height.	**[07 Hrs.]**
UNIT-III : Air sampling and analysis: Air pollution survey, basis and statistical considerations of sampling sites, devices and methods used for sampling gases and particulars. Stack emission monitoring, isokinetic sampling. Analysis of air samples chemical and instrumental methods. Ambient air quality monitoring	**[06 Hrs.]**
UNIT-IV : Control of air pollution: Air pollution control equipment for particulate and gaseous pollutants. Design of control equipment as Settling chamber, Cyclone, Fabric filter, Electro static precipitator and Wet scrubber. Control of air pollution from automobiles.	**[07 Hrs.]**
UNIT-V : Indoor air pollution: Causes of air pollution, sources and effects of indoor air pollutants, changes in indoor air quality, control of indoor air pollutants and air cleaning systems. Air pollution Index.	**[06 Hrs.]**
UNIT-VI : Urban Air Pollution- Air Pollution from vehicles; Air Pollution from Biomass burning; Air Pollution from landfills Noise pollution: Theory, sources, measurement, and methods of control of noise pollution. Odour pollution: Theory, sources, measurement and methods of control of odour pollution.	**[07 Hrs.]**

2nd SEMESTER

CV3977	Air Quality Management		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Text Book :-

1. Air Pollution, M.N. Rao., Tata McGraw Hill, 2006.
2. Fundamentals of Air Pollution, Stern, Wohlers, Bouble and Lower, Academic Press, 1984.
3. Air Pollution and Control, P. P. Mowli and N. Venkata Subbayya., Divyajyoti Prakashan, Jodhpur, 1989.
4. Environmental Pollution Control Engineering, C.S. Rao, New Age International, 2007
5. Environmental Noise Pollution, PE Cunniff, McGraw Hill, New York, 1987

References Book :-

1. Air Quality Monitoring- A Course Manual, NEERI, 1981.
2. Air Pollution, Vol. I to IX, A. C. Stern, Academic, New York, 1968

2nd SEMESTER

CV3978	Rural Water Supply and Sanitation		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To understand scheme of rural water supply and sanitation. 2. To understand improvised method of treatment of wastewater 3. To understand compact systems of treatment and disposal.	1. An Ability to understand the knowledge regarding rural water supply and sanitation scheme. 2. An Ability to understand different compact units of rural water treatment and supply. 3. An Ability to tell simple wastewater treatment for rural water supply.
PO Mapped: 2, 4	

UNIT-I : Concept of environmental and scope of sanitation in rural areas. Magnitude of problem of water supply and sanitation, National policy.	**[06 Hrs.]**
UNIT-II : Various approaches for planning of water supply systems in rural areas. Selection and development of preferred sources of water, springs, wells, Infiltration wells, radial wells, and infiltration galleries.	**[07 Hrs.]**
UNIT-III : Collection of raw water from surface source. Specific problems in rural water supply and treatment e.g. iron, manganese, fluorides, Low cost treatment.	**[06 Hrs.]**
UNIT-IV : Improvised methods and compact system of treatment of surface and ground waters such as MB settlers, slow sand filter, chlorine diffusion cartridges.	**[07 Hrs.]**
UNIT-V : Water supply through spot sources, hand pumps, open dug wells Planning of distribution system in rural areas Water supply during fairs, festivals and emergencies, Treatment and disposal of wastewater/sewage various methods of collection and Disposal of night soil Onsite sanitation system and community latrines.	**[06 Hrs.]**
UNIT-VI : Simple wastewater treatment system for rural areas and small communities such as stabilization ponds, septic tank and soakage pits, Disposal of solids waste: Composting and Biogas plants.	**[07 Hrs.]**

Text Books :-

1. Wagner, E.G. and Lanoik, J.N., Water supply for Rural areas and small communities, Geneva:

Reference Books :-

1. Manual of water supply and treatment, 3rd Edition, CPHEEO, GOI, New Delhi
2. Low cost on site sanitation option, Hoffman and Heijno Occasional Nov.1981 Paper No.21 P.O. Box 5500 2280 HM Rijswijk, the Netherlands offices,J.C.Monkeniaan,5Rijswijk(The Haque)

2nd SEMESTER

CV3979	PE-I : Hazardous Waste Management		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide insight into sources of hazardous waste & the treatment given thereafter. 2. To Provide knowledge of generation, characteristic and composition of hazardous Waste 3. To enumerate and describe different disposal and treatment methods	1. An ability to understand principle of methods given to hazardous waste. 2. An ability to understand the common functional elements of waste management system 3. An ability to suggest suitable waste processing technologies and disposal methods.
PO Mapped: 1, 4	

UNIT-I : Definition of hazardous waste, U.S.E.P.A. classification, global scenario, episodes. Hazardous waste (management and handling) rules, 1989 and Indian Scenario.	**[06 Hrs.]**
UNIT-II : Source of hazardous waste, effect of Hazardous waste on human health, Sampling and analytical procedures, Overview of treatment and disposal method – waste minimization.	**[07 Hrs.]**
UNIT-III : Physicochemical method and biological method, Thermal Processes. Solidification /stabilization and innovation techniques, In-situ methods for Decontamination of hazardous waste sites	**[06 Hrs.]**
UNIT-IV : Solidification/stabilization and innovation techniques. waste Inventorization procedures.	**[07 Hrs.]**
UNIT-V : Secure landfill**.** Site selection methodology for establishing treatment and disposal methods and EIRA methodology.	**[06 Hrs.]**
UNIT-VI : Legislation on Management &Handling rules based on Hazardous Waste Management .Common hazardous waste treatment Storage and disposal facility (CHWTSDF)	**[07 Hrs.]**

Text Books:-

1. Charles A. Wentz; " Hazardous Waste Management ", McGraw-Hill Publication, 1995

Reference Books:-

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,
2. The World Bank Freeman H.M. standard Handbook of Hazardous Waste Treatment and Disposal, 1989.

2nd SEMESTER

CV3980	PE-I : Water Resources Management		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To understand water resources planning 2. To understand water policies and application of remote- sensing. 3. To understand different methods of conservation and recharging of water resources 4. To understand inter-basin transfer and EIA of water Resource development projects	1. An ability to understand water resources planning 2. An ability to understand water policies and application of remote-sensing. 3. An ability to understand different methods of conservation and recharging of water resources 4. An ability to Understand inter-basin transfer and EIA of water Resource development projects
PO Mapped: 2, 4	

UNIT-I : Introduction: water resources planning, multi–objective planning role in national development.	**[06 Hrs.]**
UNIT-II : Basic concepts of hydrology and hydrogeology, River monitoring, gauging silting, silt load.	**[07 Hrs.]**
UNIT-III : National water policy. Water resources planning and processes. Management of water bodies. Application of remote sensing Techniques. Integrated approach – carrying capacity based planning.	**[06 Hrs.]**
UNIT-IV : Water resources conservation: quantity aspects, surface and ground water development, Rain water harvesting, ground water recharge, conjunctive use of ground and surface water.	**[07 Hrs.]**
UNIT-V : Water resources development in coastal areas. Basic concepts of economics, welfare economics. Inter basin transfer of water.	**[06 Hrs.]**
UNIT-VI : EIA of water Resource development projects. Case study related to water conservation and resources Development.	**[07 Hrs.]**

Text Books :-

1. Linsey, R. K. &Franzini, J.B. water resources Engineering. New Delhi : McGraw Hill
2. Grigg N.S. Water Resources planning McGraw Hill Book company.

Reference Books :-

1. Neil S. Grigg, Water resource management – principles, regulations, and cases New Delhi: McGraw Hill

2nd SEMESTER

CV3981	PE-I : Environmental Biotechnology		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To learn basic concepts of microbial biochemistry and microbial interaction. 2. To learn basic concepts of genetic engineering and mutation of DNA.	1. An Ability to understand the fundamental concept of microbial biochemistry and biotechnology 2. An Ability to understand the Relationship between cell signaling and gene transcription.
PO Mapped: 1, 4	

UNIT-I : Basic concept of microbial biochemistry-carbohydrates, proteins, fats, and nucleic acids.	**[07 Hrs.]**
UNIT-II : Basic concept of biodegradation, biotransformation, biobenification, bio restoration / bioreclammation, microbial interaction, Environmental monitoring-signification of monitory bacterial viral and protozoan pathogens.	**[06 Hrs.]**
UNIT-III : Technique of monitoring-standard methods of monitoring viral bacterial and protozoan pathogens, Advance techniques-gene probes biosensor, immunoassay.	**[07 Hrs.]**
UNIT-IV : Basic concept of genetic engineering-chromosomal DNA, plasmid DNA transformation, mutation recombinant DNA techniques	**[06 Hrs.]**
UNIT-V : Transudation conjugation, protoplast fusion, Biotransformation of biomass/organic waste into value added chemicals, energy, fertilizers, and single cell protein	**[07 Hrs.]**
UNIT-VI : Aerobic and anaerobic waste treatment processes-microorganisms involved, and biochemical changes of different pollutants present in liquid and solid waste, reactor technology.	**[06 Hrs.]**

Text Books :-

1. C.S. Forster and D.A. John Wase, Environmental Biotechnology, Ellis Harwood, 1987
2. Trehan K. Biotechnology, New Delhi, Willey Eastern Ltd.1990

Reference Books :-

1. Forster C.F.N Biotechnology and Wastewater Treatment, Cambridge 1992
2. N.F. Grey, Biology of Wastewater Treatment Oxford University Press ,1989

2nd SEMESTER

CV3982	PE-I : Advanced Water Treatment		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide insight into various advanced methods used for the treatment of municipal and industrial water including coverage of the scientific basis of each operation/process, as well as their engineering design	1. An ability to understand the fundamental, scientific basis governing the design and performance of the treatment technologies. 2. An ability to understand the role of each unit operation 3. Process within typical treatment process trains and their interaction
PO Mapped: 1, 2, 4	

UNIT-I : Significance of Advanced water treatment, water quality requirement and specific treatment for industries.	**[06 Hrs.]**
UNIT-II : Softening of water, Boiler feed water, lime soda process, ion exchange process.	**[06 Hrs.]**
UNIT-III : Desalination: Theory of desalination, various methods of Desalination- Distillation, Electro dialysis, Freezing, Demineralization, Solar evaporation. Membrane filtration process.	**[07 Hrs.]**
UNIT-IV : Adsorption: Theory, Granular and powder activated carbon, Performance, and Reactivation. Materials and Reactions, Kinetics, Applications.	**[06 Hrs.]**
UNIT-V : Fluoride Removal, Arsenic Removal, Fe and Mn removal, Taste, odor and colour removal.	**[07 Hrs.]**
UNIT-VI : Alge control, Corrosion control, Water treatment for Swimming Pool.	**[07 Hrs.]**

Text Book :-

1. N.J. McGhee, Steel E.W., Water Supply and Sewerage, McGraw hill 1991.
2. N.J. Weber, Physicochemical Process for Water Quality Control, John Wiley & Sons 1972.
3. Fair Geyer & Okun, Water and Waste Water Engineering, Vol I and II, John Wiley & Sons 1st.

Reference Book : -

1. Nordel, E, Water Treatment for Industrial and Other Uses, Reinhold Publishing Corporation, N.Y.
2. CPHEEO, Manual on Water supply and Treatment, Govt. of India Publication.

2nd SEMESTER

CV3983	PE-II : Energy Conversion and Environment		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To know the concept of efficient energy forming technologies for sustainable use of resources. 2. To know the Resources Conversion Strategies and Policies.	1. An Ability to Understand and apply basic concept of waste to energy technology and environmental protection. 2. An Ability to understand the concept of environmental appraisal, energy audit and assessment of energy potential of energy sources.
PO Mapped: 2, 4	

UNIT-I : Significance of Energy Conversion and Environment, Overview of Global and Indian Energy Scenario; Environmental Impacts of Energy Conversion, Principles of Waste Minimization, and Energy Recovery.	**[06 Hrs.]**
UNIT-II : Renewable and Non-Renewable Energy Sources; Estimation of Potential of Energy Recovery from various Sources, Energy economics.	**[07 Hrs.]**
UNIT-III : Energy Conversion Methods: Thermal, hydro, nuclear, solar, wind, tidal etc. their principles and application	**[07 Hrs.]**
UNIT-IV : Waste to Energy options: physical, thermochemical and bio chemical processes: palletization, briquetting, Combustion, Gasification, pyrolysis; Fuels Derived anaerobic digestion, Biogas Technology, Future Technologies for Waste to Energy Systems	**[06 Hrs.]**
UNIT-V : Introduction to Microbial Fuel cell, Gas generations and collection in landfills, Measurements, and Control.	**[07 Hrs.]**
UNIT-VI : Energy and Resources Conservation Strategies and Policies, concept of energy management, Intelligent Green Building, Green Rating Systems Alternative Construction Materials & methods Testing and Verification.	**[06 Hrs.]**

Text Book :-

1. D. O. Hall, G. W. Barnard and P. A. Moss, Biomass for Energy in the Developing Countries, Current Roles, Potentials, Problems, Prospects, Pergamos Press Ltd, 1st edition.
2. W. C. Turner, Energy Management Handbook Wiley Newyork 1st edition.
3. P. Meier, Energy System Analysis for Developing countries, Sringer Verlag 1st edition.
4. Dorthy J De Renzo, Energy from Bioconversion of Waste materials, Noyes data Corporation USA 1st edition.

Reference Book :-

1. G.D. Rai, Non-Conventional Energy Source, Standard Publishers Distributors.
2. Fowler J. M. Energy and the Environment McGraw Hill New York 2nd edition.
3. B.H. Khan, Non-Conventional Energy Resources, 2nd Edition, McGraw Hill Companies.

2nd SEMESTER

CV3984	PE-II : Applied Structure		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide detailed concept of structural design of various environmental structures	1. An Ability to design various pipes and associated structures. 2. An ability to analysis different loads conditions applicable for different environmental structures 3. An ability to design water tanks 4. An ability to understand importance of durability of water supply structures
PO Mapped: 1, 4	

UNIT-I : Basic Concept of Structural design of water supply and water collection system.	**[07 Hrs.]**
UNIT-II : Design of pipes such an R.C.C. prestressed mild steel asbestos cement, cast iron etc.	**[06 Hrs.]**
UNIT-III : Estimation of loads such as gravity earth forces, super imposed loads, moving loads etc. On rigid and flexible conduits under various types of field conditions.	**[06 Hrs.]**
UNIT-IV : Design of pipe supports, beddings, shallow and deep manholes, inverted siphons and other appurtenances etc.	**[07 Hrs.]**
UNIT-V : Design of tanks and prestressed structures for water such as circular and intze tank.	**[06 Hrs.]**
UNIT-VI : Study of Durability criteria for environmental structures.	**[07 Hrs.]**

Text Book :-

1. Jai Krishna & Jain O.P. plain & reinforced concrete, Vol. II, Roorkee: New Chand & Bros, 1980.

Reference Book :-

1. N. Krishna Raju, advanced concrete structures, Tata McGraw Hill 1995

2nd SEMESTER

CV3985	PE-II : Water Reuse and Recycling		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	30	10	60	100	3 Hours	

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To learn the principles, applications, and facilities involved in the field of water reclamation and reuse 2. To brief the various methodologies involved in water reuse planning. 3. To Introduce important considerations influencing water reuse planning and implementation	1. An Ability to understand the concept of sustainable water resources management as a foundation for water reclamation and reuse 2. An Ability to understand the various technologies and systems available for reclaimed water 3. An Ability to understand the Water reuse applications including agricultural uses, landscape irrigation, industrial uses, environmental and recreational uses, groundwater recharge.
PO Mapped: 2, 4	

UNIT-I : Hydrological cycle, Water Reuse Past and Current Practices, water Reuse Application.	**[06 Hrs.]**
UNIT-II : Environmental Issues in water Reuse, Water Reclamation criteria in national and international scenario.	**[07 Hrs.]**
UNIT-III : Water reuses treatment methods and technologies.	**[06 Hrs.]**
UNIT-IV : Storage of reclaimed water, water quality discharge requirements, Problems involved in storage system and its Management.	**[07 Hrs.]**
UNIT-V : Water reuse regulation and guidelines, Health and risk management assessment in water reuse application.	**[06 Hrs.]**
UNIT-VI : Water reuses application in agriculture, industrial, urban, groundwater recharge.	**[07 Hrs.]**

Text Books :-

1. Cohn, P. D., M. Cox, and P. S. Berger (1999) —Health and Aesthetic Aspects of Water Quality,‖ in Water Quality & Treatment, A Handbook of Community Water Supplies, American Water Works Association, McGraw-Hill, Inc., New York
2. T. Asano, Water Reclamation and Reuse, Water Quality Management Library 10, CRC Press, Boca Raton, FL

2nd SEMESTER

CV3986	Seminar		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**	**ESE Duration**	
	-----	**100**	-----	**100**	-----	

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the students various aspects of presentation skills 2. To provide the students the academic environment to carry out literature survey 3. To teach the students the various aspects of effective technical paper writing like compilation of literature data.	1. An Ability to understand various aspects of presentation skills 2. An ability to carry out literature survey, compilation of literature data 3. An ability to understand effective technical paper writing
PO Mapped: 3	

Seminar on any related topic to environmental engineering will be presented by the student. The topic of seminar will be approved by the teacher in charge. Evaluation will be based on the subject contents and skill of presentation. Evaluation will be done by a panel of teachers from the department.

3rd SEMESTER

CV3989	Project Phase - I		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**	**ESE Duration**	
	-----	100	-----	100	-----	

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the students with the academic environment to carry out literature survey of advanced topics in Environmental engineering 2. To motivate the students to use the modern tools and software's 3. To provide the students the understanding of various aspects like effective communication skills, working independently and in a team and the importance of lifelong learning etc. to carry out project.	1. An ability to understand the advances in Environmental engineering. 2. An ability to understand the use of modern tools. 3. An ability to work independently and in a team for effective communication 4. An ability to understand the importance of lifelong learning.
PO Mapped: 1, 2, 3, 4	

The Project Phase – I shall start in semester III, and should preferably be literature survey.

The work shall be continuously evaluated as per the norms/ guidelines set up by the B.O.S. for its assessment of 100 marks.

Evaluation of Project Phase – I shall consist of submission of report in a prescribed format based on review of literature related to the topic selected for dissertation. Report should cover introduction, literature review, objective and scope of investigation and pilot studies carried out during the semester. The student will deliver the seminar thereon which will be assessed by panel of examiners.

4th SEMESTER

CV3990	Project Phase - II		L=0	T=0	P=24	Credits=12
Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration	
	-----	40	60	100	-----	

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the students the academic environment to carry out literature survey of advanced topics in Environmental engineering 2. To provide the students the understanding of real-world Environmental engineering problems and their solution. 3. To motivate the students to use the modern tools and software's 4. To provide the students the understanding of various aspects like effective communication skills, working independently and in a team and the importance of lifelong learning etc. to carry out project.	1. An ability to understand the advances in Environmental engineering. 2. An ability to solve real world Environmental engineering problems 3. An ability to understand the importance of lifelong learning and the use of modern tools. 4. An ability to work independently and in a team for effective communication.
PO Mapped: 1, 2, 3, 4	

Project Phase – II shall consist of detailed study of a work that the student has executed in continuation with report submitted by the student in the Project Phase – I and should involve scientific research, design, collection and analysis of data, determining solutions and must preferably bring out the individuals contribution.

The work shall be continuously evaluated as per the norms/ guidelines set up by the B.O.S. for its assessment of 40 marks.

End Semester Evaluation of Project Phase –II shall consist of submission of dissertation in a prescribed format. The student shall present the entire work on Dissertation, followed by viva-voce which will be assessed by panel of examiners.