

AC 6.6.2012
Item No. 4.53

UNIVERSITY OF MUMBAI



Syllabus for the M.E. (Civil)

Programme : M.E.

Course : Civil Engineering

(Environmental Engineering Subjects)

University of Mumbai
Program Structure for Master of Engineering
ME Civil Engineering
(Environmental Engineering Subjects)
(With Effect from 2012-2013)

Semester I

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
EVC101	Environmental Chemistry	04	--	--	04	--	--	04
ENC102	Advanced Water Treatment	04	--	--	04	--	--	04
EVC103	Hydraulics and Hydrology of water and wastewater	04	--	--	04	--	--	04
EVE101X	Elective-I	04	--	--	04	--	--	04
EVE102X	Elective-II	04	--	--	04	--	--	04
EVL101	Lab Practice- I	--	02	--	--	01	--	01
EVL102	Lab Practice- II	--	02	--	--	01	--	01
Total		20	04	--	20	02	--	22

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
EVC101	Environmental Chemistry	20	20	20	80	03	--	--	100
ENC102	Advanced Water Treatment	20	20	20	80	03	--	--	100
EVC103	Hydraulics and Hydrology of water and wastewater	20	20	20	80	03	--	--	100
EVE101X	Elective-I	20	20	20	80	03	--	--	100
EVE102X	Elective-II	20	20	20	80	03	--	--	100
EVL101	Lab Practice- I	--	--	--	--	--	25	25	50
EVL102	Lab Practice- II	--	--	--	--	--	25	25	50

Total	100	100	100	400	--	50	50	600
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Semester II

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
EVC201	Environmental Microbiology and Ecology	04	--	--	04	--	--	04	
EVC202	Advanced Waste Water Treatment	04	--	--	04	--	--	04	
EVC203	Solid Wastes and Hazardous Waste Management	04	--	--	04	--	--	04	
EVE201X	Elective-III	04	--	--	04	--	--	04	
EVE202X	Elective-IV	04	--	--	04	--	--	04	
EVL201	Lab Practice - III	--	02	--	--	01	--	01	
EVL202	Lab Practice - IV	--	02	--	--	01	--	01	
Total		20	04	--	20	02	--	22	
Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
EVC201	Environmental Microbiology and Ecology	20	20	20	80	03	--	--	100
EVC202	Advanced Waste Water Treatment	20	20	20	80	03	--	--	100
EVC203	Solid Wastes and Hazardous Waste Management	20	20	20	80	03	--	--	100
EVE201X	Elective-III	20	20	20	80	03	--	--	100
EVE202X	Elective-IV	20	20	20	80	03	--	--	100
EVL201	Lab Practice - III	--	--	--	--	--	25	25	50
EVL202	Lab Practice - IV	--	--	--	--	--	25	25	50
Total		100	100	100	400	--	50	50	600

Semester III

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
EVS301	Seminar	--	06	--	--	03	--	03	
EVD301	Dissertation I	--	24	--	--	12	--	12	
Total		--	30	--	--	15	--	15	
Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test 2	Avg.					
EVS301	Seminar	--	--	--	--	50	50	100	
EVD301	Dissertation I	--	--	--	--	100	--	100	
Total		--	--	--	--	150	50	200	

Semester IV

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
EVD401	Dissertation II	--	30	--	--	15	--	15	
Total		--	30	--	--	15	--	15	
Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test 2	Avg.					
EVD401	Dissertation II	--	--	--	--	100	100	200	
Total		--	--	--	--	100	100	200	

SEMISTER I

Elective I (Any One)	Elective II (Any One)
1) Air Pollution and Control	1) Environmental legislation and Management
2) Groundwater Contamination and Pollution Transport	2) Transport of Water and Wastewater
3) Remote Sensing and GIS applications in Environmental Engineering	3) Environmental Geotechnology

SEMISTER II

Elective III (Any One)	Elective IV (Any One)
1) Membrane Technology in Environmental Engineering	1) Industrial Waste Water Treatment
2) Environmental Engineering Structures	2) Modern Trends in Environmental Engineering
3) Disaster Management and Risk Analysis	3) Numerical Methods and Statistics

Note:

- In case of Seminar, 01 Hour / week / student should be considered for the calculation of load of a teacher
- In case of Dissertation I, 02 Hour / week / student should be considered for the calculation of load of a teacher
- In case of Dissertation II, 02 Hour / week / student should be considered for the calculation of load of a teacher

- **End Semester Examination:** In all six questions to be set, each of 20 marks, out of these any four questions to be attempted by students. Each question will comprise of mixed questions from different units of the subjects.

Semester I

Subject Code	Subject Name	Credits
EVC101	ENVIRONMENTAL CHEMISTRY	04

Detailed Syllabus

Sr. No	Content
1	Concept and Scope of Environmental Chemistry: Definition and explanation for various terms, segments of environment. 26 principles and cyclic pathways in the environments.
2	Basic Principles: Chemical equations, types of chemical reactions, stoichiometric calculations, solutions, chemical thermodynamics, fundamentals of process kinetics, Gas laws, ways of shifting chemical equilibria.
3	Physico-Chemical methods for analysis of environmental samples : Physico-chemical parameters; Definition and determination of conductivity, pH, emf, COD, BOD, viscosity, surface tension, estimation of various elements at major, minor trace, ultra trace level concentrations; Choice of a technique; Principle, merits and demerits of the techniques – Neutron Activation Analysis, isotope dilution analysis, calorimetric, colourimetry, Atomic Absorption Spectroscopy, Gas chromatography, HPLC, Ion exchange Chromatography and Polarography.
4	Colloidal chemistry: fundamentals, coagulation, mechanisms of coagulation, effect of turbidity and alkalinity, chemistry of coagulants.
5	Ion exchange, reverse osmosis, fluoride removal iron and manganese removal:- basic concepts of water and wastewater analysis: basic concepts of quantitative analytical chemistry, instrumental methods of analysis, determination of turbidity, colour, pH, acidity, alkalinity, hardness, residual chlorine and chlorine demand, chlorides, dissolved oxygen demand, nitrogen, solids, iron and manganese, fluoride, sulphate, phosphorus and phosphate, grease, volatile acids, gas analysis, preparation of standard solutions.
6	Drinking water standards
7	Trace organics and trace inorganics

Recommended Books, periodicals etc.

- (1) Chemistry for environmental engineering - Sawyer & McCarty. McGraw Hill Publication.
- (2) Process chemistry for water and wastewater treatment-Benefield, Judkins, Weand. Prentice Hall, Inc. N.J.
- (3) Aquatic chemistry-Stumm and Morgan. Wiley-Interscience.
- (4) Physico chemical processes for water quality control- W.J.Weber Jr. WileyInterscience.
- (5) Environmental Pollution Analysis : Khopkar
- (6) Instrumental Methods of Analysis: G. W. Ewing.
- (7) Chemistry for Environmental Engineers by C.D. Sawyar McGraw Hill (latest edition)
- (8) Standard methods for the examination of water and wastewater joint publication of APHA, AWWA and WEF
- (9) Journal of American Water Works Association

Semester I

Subject Code	Subject Name	Credits
EVC102	ADVANCED WATER TREATMENT	04

Detailed Syllabus

Sr. No	Content
1	Standards for raw and treated waters: Surface waters, Effects of storage on water quality. Limnology, Water ecology Thermals stratification. Seasonal Change, lake overturns. Algae, Control measures, quality of underground waters. Nature and source of impurities.
2	Examination of Waters Requirements of water treatment facilities. Process design and hydraulic design. Unit operations, gravity systems, Pumping systems. Design Period Fluctuations in demand. Useful concepts from water chemistry and biology.
3	Intake structures Principles of sedimentation and floatation. General equations for settling of discrete particulates. Hindered settling effect of temperature, viscosity efficiency of an ideal basin. Short circuiting. Sludge moisture content - specific gravity relationships. Upflow and sludge blanket tanks - mathematical model of the unit processes.
4	Theories of chemical coagulation Nature of colloids, Zeta potential, coagulant and their specificity. Design of mechanical flocculators. Mean velocity gradient "G", "Gt" effect of temperature and other variables. Power consumption, Mathematical Modeling.
5	Theory of Filtration System Parameter and mathematical modeling, size and shape characteristics of granular filtering materials/ Preparations of filter sand Hydraulics of filtration through homogeneous and stratified beds. Performance of slow, rapid, high rate multilayer and composite filters. Upflow, two way filter, dual media filter. Pressure filters. Diatomaceous earth filters. Micro-strainers, filterability index.
6	Principles of disinfection. Factors effecting disinfection. Halogens: Chlorine, Iodine and Bromine.
7	Principles of aeration, system parameters and mathematical model ,Methods of aeration, Theories of adsorption, Freundlich equation, removal of taste and odour by adsorption,

	Removal of colour, Effects of fluorides, Fluoridation, removal of fluorides.
8	Industrial water treatment: Boiler feed water. Softening of water, Langlier, Ryzner and other indices. Reuse of water and conservation of water in industry. Methods of Iron and Manganese removal, use of aeration, oxidation, ion-exchange and other methods and their control. Theory of corrosion, and corrosion control.

Recommended Books, Journals etc.

- (1) Unit operations of Sanitary Engineering -Linvil G.Rich John Wiley & Sons, Inc. (Wiley Toppan Co. Ltd. Tokyo)
- (2) Chemical Engineering Vol.II Coulson & Richardson. McGraw Hill Book Co., New York.
- (3) Water and Wastewater Engineering-Vol.11 Fair, Geyer & Okun Wiley Toppan Co.Ltd. Tokyo.
- (4) Unit processes of Sanitary Engineering - Linvil B.Rich John Wiley & Sons, Inc. (Wiley Toppan Co.Ltd. Tokyo)
- (5) Water and its impurities T.R. Camp Reinhold Publ. Corp New York
- (6) Handbook of applied hydraulics -C.V.Davis. International Students' Edition McGraw Hill Book Co., New York.
- (7) Operation and Control of Water Treatment processes C.R.Cox WHO Monograph Series No.49.
- (8) Journal American Water Works Association.
- (9) Journal Water Pollution Control federation (Now Water Environment Federation)
- (10) Transactions - American Society of Civil Engineers- Hydraulics Division and Environmental Engineering Division.
- (11) Manual of Water Supply and Treatment Ministry of Urban Development
- (12) Operation and control of water treatment processes - C. RCox WHO Monograph no.49
- (13) Water supply for rural areas and small communities - Wagner and Lanoix. WHO Monograph no.42.
- (14) Water supply and pollution control-Clark, Viessman Jr. & Hammer International Textbook Co. London.
- (15) Water Treatment Principles and Design-J.M.Montgomery-Wiley Interscience, Publication, NY.

Semester I

Subject Code	Subject Name	Credits
EVC103	HYDRAULICS AND HYDROLOGY OF WATER AND WASTEWATER	04

Detailed Syllabus

Sr. No	Content
1	Objectives of a public water supply: Design periods for water and wastewater Structures. Population estimates. Estimate of water consumption and fluctuation in demand. Brief introduction of Hydrology of water resources - surface and ground water.
2	Transmission of water: Types and materials of conduits. Hydraulic characteristics- size, capacity, number and shapes of conduits and their location. Pumping of water. Types, design and selection of pumps. Economics of pump and pumping main selection. Water hammer. Water hammer controlling devices and their location on rising mains.
3	Distribution of water: Pressure and capacity requirements of systems. Provision for fire fighting. Field and office analysis of distribution networks. Hardy cross method, electrical network analysis. Optimization of network by various methods. Service storage and equalizing storage capacity requirements. Use of available software packages for design of distribution networks. Design of optimum size of rising mains.
4	Hydraulics of sewers: Open channel flow with special reference to sewers. Flow at sewer transitions. Measurement of flow in sewers. Patterns of sewerage systems Estimate of waste water flow. Desired velocities in sewers and effect of flow variation.
5	Rational method estimating storm drainage: Internally-duration-frequency relationship Time of concentration and time of inlet. Lengths of side weirs and street inlets. Investigation, design and layouts of sanitary and combined sewerage systems. Maintenance of sewerage systems.
6	Sewage pumping: Selection of pumps, Capacity of wet wells and dry wells. Design of pumping station.
7	Household plumbing systems: Types and suitability of each system Design and pipe sizes for water and wastewater. Storage tanks and fixtures.

Recommended Books and Journals

- (1) Handbook of applied hydraulics -C.V.Davis. International Students Edition McGraw Hill Book Co., New York.
- (2) Water and Wastewater Engineering-Vol. I &II Fair, Geyer & Okun Wiley Toppan Co. Ltd. Tokyo.
- (3) Manual of sewerage and Sewage Treatment. Ministry of Urban Development.
- (4) Manual of Water Supply and Treatment Ministry of Urban Development
- (5) Open Channel hydraulics, V.T. Chow - McGraw Hill New York

Semester I

Subject Code	Subject Name	Credits
EVE101X	AIR POLLUTION AND CONTROL (ELECTIVE-I)	04

Detailed Syllabus

Sr. No	Content
1	Composition of dry ambient air properties of air Definition of air pollution. Classification of air pollutants. Units for classification of air pollutants. History of air pollution, global and national. Scope of problem-general, urban, rural and specific. Sources of air pollution. Natural and man-made Major pollutants from different sources in Greater Bombay area and other Indian cities. Emission factors. Effect of air and noise pollution on human health, plants, animals, properties and visibility, CoHb.
2	Meteorological aspects of air pollution: Large scale wind circulation: geotropic wind, gradient wind, cyclone, anticyclone, planetary boundary layer, lapse rate, stability conditions, wind velocity profile, maximum mixing depth, topographic effects, plume patterns.
3	Plume dispersion: Gaussian model for predicting concentration downwind from a single source, line source, area source. Diffusion coefficients. Stability categories and graphs for dispersion estimates. Maximum ground level concentration, inversion effects, modification of model to predict particulate dispersion. Other mathematical models. Plume rise. Holland equation. ASME equations. Brigg's equation. Other models for plume rise. Comparative evaluation of various models. Design of tall stacks.
4	Methods and instruments for sampling and analysis of air for stack and ambient air monitoring of gaseous and particulate pollutants. Theory of sampling. Isokinetic sampling, Continuous monitoring particle size analysis and mass analysis. IS methods of sampling analysis
5	Government of India's air pollution Acts and laws. Indian standards - emission and air quality standards. Noise standards. Amendments in Acts. IS for various ambient air standards emission standards for various industries.
6	Control devices: Principles, types, operations of each individual device. Settling chambers: Laminar flow, turbulent flow, economic sizing, dust removal, fractional and overall collection efficiency. Inertial devices: Cyclone flow, collection efficiency in laminar and turbulent flow, pressure drop and power requirement, economic sizing. Electrostatic precipitators: Collection efficiency, electric field, particle charging, electrical operating point, corona

	<p>discharge, corona onset voltage, sparking field strength, effect of temperature and resistivity of dust on collection efficiency. Pressure drop and power requirement. Sizing and costing of ESPs. Practical design considerations. Particulate scrubbers: Interception and impaction collection efficiencies, pressure drop. Design criteria, Cyclone scrubber. Venturi scrubber. Filters Collection efficiency and pressure drop for packed filter bed and single layer filter, Bag filters and baghouses. Fabric filtration theory, design considerations, sizing and costing of fabric filters.</p> <p>Incinerators for gaseous pollutants. Waste gas characterization, theoretical considerations, design considerations of thermal incinerators. Catalytic incinerators. Flammable mixtures and flares, pressure drop considerations, capital and annual operating costs.</p>
7	Noise- Basic concept, measurement and various control methods

Recommended Books and Periodicals

Books:

- (1) "Air pollution" by Henry C Perkins - McGraw Hill Publications
- (2) "Air Pollution" part A - Analysis" and part B - prevention and control" by J.O. Ledbetter Marcel Dekker Inc. New York. Publication
- (3) "Air Pollution" by Wark and Warner
- (4) "Air pollution control Guidebook for Management" Edited by A.T.Rossano Environ-Science Service Dim. ERA Inc.USA
- (5) "Air pollution control Theory" by Martin Crossford - McGraw Hill Publication
- (6) Government of India's publication of laws related to air pollution. Maharashtra Pollution control Board's (MPCB) publication of standards IS relevant to air pollution monitoring definitions, standards etc.
- (7) "Air pollution" by Rao M.N. and Rao H.V.N. Tata McGraw Hill Pub. New Delhi.
- (8) "Air pollution Vol. 1" by Tripathi A.K.(editor) Ashish Publication House New Delhi.
- (9) "Air pollution (biopollutants in air)" by Srivastava A.K. Ashish Publication House New Delhi.
- (10) Process Engineering and Design for Air pollution Control - J.Benitez - PTR Prentice Hall N.J.
- (11) Air Pollution Control Engineering - N DeNevers-McGraw Hill

Handbooks

- (1) "Environmental Engineers" Handbook Vol.11 'Air Pollution' by B.G.Liptak (ed.) chilton Book Co.USA
- (2) Air Pollution Handbook by P.L.Magill and Others. McGraw Hill Publ. New York.
- (3) Industrial Air Pollution Handbook by A.Parker Tata McGraw Hill Publication

Journals

- (1) Journal of Air & Waste Management Association (formerly known as Journal of Air Pollution Control Association) published from USA.

Semester I

Subject Code	Subject Name	Credits
EVE101X	Groundwater Contamination and Pollution Transport (ELECTIVE-I)	04

Detailed Syllabus

Sr. No	Content
1	Introduction: Ground water and the hydrologic cycles-Ground water as a resource-Ground water contamination-Ground water as a Geotechnical problem-Ground water and geologic processes. Physical properties and principles-Darcy's Law-Hydraulic Head and Fluid Potential piezometers and Nests. Hydraulic conductivity and permeability-Homogeneity and Anisotropy porosity and voids Ratio- Unsaturated flow and the water table-Steady state flow and Transient Flow-compressibility and effective stress-Transmissivity and storativity-Equations of Ground water flow-Limitations of Darcian Approach-hydro dynamic dispersion.
2	Hydrologic Cycle and Flownet: Flow nets-Graphical construction-Flow nets by numerical simulation, steady state Regional Ground water Flow-Steady state hydrologic-budgets-Fluctuations in ground water levels.
3	Resource Evaluation: Development of Ground water Resources-Exploration for Aquifers-the response of Ideal aquifers to pumping-Measurement of parameters -Laboratory tests- Piezometer test-pumping tests-Estimation of saturated hydraulic conductivity-Numerical simulation for aquifer yield prediction-Artificial recharge and induced infiltration-Land subsidence-sea water intrusion
4	Chemical Properties And Principles: Constituents-chemical equilibrium- Association and Dissociation of dissolved species-effects of concentration gradients-Mineral dissolution and solubility- Oxidation and Reduction Process-Ion exchange and Adsorption- Environmental isotopes-Field Measurement of Index parameters. Chemical Evolution: Hydro Chemical Facies-Ground water in carbonate terrain-Ground water in crystalline rocks-Ground Water in complex sedimentary systems- Geochemical interpretation of 14C Dates-process rates and molecular diffusion.
5	Solute Transport: Water Quality Standards-Transport Process-Nonreactive Constituents In Homogeneous Media And Heterogenous Media-Transport In Fracture Media-Hydeochemical Behaviour of Contaminants-Trace Metals-Nitrogen-Trace Nonmetals Organic Substances-Measurement of Parameters-Velocity-Dispersivity-Chemical Partitioning-Sources Of Contamination- Land Disposal Of Solid Wastes-Sewage Disposal On Land.

Reference Books:

1. Randall J. Charbeneau, "Ground Water Hydraulics and Pollutant Transport ", 2000.
2. Allen Freeze, R. and John A. Cherry, "Ground Water ". Prentice Hall.Inc.1979

Semester I

Subject Code	Subject Name	Credits
EVE101X	Remote Sensing and GIS applications in Environmental Engineering (ELECTIVE-I)	04

Detailed Syllabus

Sr. No	Content
1	FUNDAMENTALS OF REMOTE SENSING Definition, Physics of Remote Sensing, Electromagnetic Radiation and its interactions with atmosphere, Spectral reflectance of earth materials and vegetation
2	PLATFORMS AND SENSORS Aerial Photographs, Active and passive sensors, Data products, Various satellites in orbit and their sensors.
3	DATA PROCESSING Data analysis - Visual Interpretation and Digital Image Processing - classification
4	GIS Introduction to GIS, concepts and Data base structure, various GIS softwares.
5	REMOTE SENSING AND GIS APPLICATIONS Management and monitoring of land, air, water and pollution studies, conservation of resources, coastal zone management - Limitations.
6	LABORATORY PRACTICES Reflectance measurement, Visual Interpretation, Digital Image Processing, data analysis in ARC/INFO.

Reference Books:

- (1) Lillies and T.M. and Kiefer, R.W., "Remote Sensing and Image Interpretation ", John Wiley and Sons, 1994.
- (2) Burrough, P.A. and McDonnell, R.A., "Principles of Geographical Information Systems ", Oxford University Press, 1998.
- (3) Lintz, J. and Simonet, " Remote Sensing of Environment ", Addison Wesley Publishing Company, 1994.

Semester I

Subject Code	Subject Name	Credits
EVE102X	ENVIRONMENTAL LEGISLATION AND MANAGEMENT (ELECTIVE-II)	04

Detailed Syllabus

Sr. No	Content
1	Environmental acts-their need, historical background, national and international acts; .
2	Genesis of environmental acts - general procedure followed in changing a bill into an act; implementation of an act using judiciary, executive and legislative powers and their limitations.
3	Main national acts - Environmental protection agency, air act, water act, water and sewerage Board's Factory act, Municipal acts, acts dealing with hazardous and infectious wastes.
4	Environmental impact assessment, environmental audit, general procedures followed in preparing reports incorporating EIA ES and EA.
5	Case laws- Principles of case laws, statutory interpretations, site selection, land use planning, town planning act.
6	ISO: 14001 - its need, procedure to be followed to obtain ISO: 14001 certification, implications of ISO.
7	Environmental management plan, environment management cells, rehabilitation and remediation, NGOs and their role.
8	Environmental and occupational health, industrial hygiene, risk assessment, disaster management plan, epidemiology..
9	Assessment of existing effluent treatment plants, trouble shooting, remedial measures.

Recommended books:

- (1) Pollution legislation - A. K. Mhaskar, M/s. Media Enviro, Pune
- (2) Environmental Audit - An overview, A. K. Mhaskar - M/s. Media Enviro, Pune.
- (3) Matter Hazardous? Laws Explained. A.K.Mhaskar M/s. Media Enviro, Pune
- (4) Environmental impact assessment Larry W Canter McGraw Hill International Edition, New York 1996.
- (5) Various publications of Central Pollution Control Board, New Delhi.

Semester I

Subject Code	Subject Name	Credits
EVE102X	Transport of Water and Wastewater (ELECTIVE-II)	04

Detailed Syllabus

Sr. No	Content
1	FUNDAMENTAL HYDRAULICS Fluid properties ; fluid flow - continuity principle, energy principle and momentum principle ; frictional head loss in free and pressure flow, major and minor head loss, formula for estimation of head loss - pumping of fluids - selection of pumps - Flow measurement.
2	WATER TRANSMISSION AND DISTRIBUTION Planning factors - Water transmission main design - pipe material - economics; water distribution pipe networks - methods for analysis and optimization - Laying and maintenance, insitu lining - appurtenances – corrosion prevention.
3	WASTEWATER COLLECTION AND CONVEYANCE Planning factors - 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.
4	STORM WATER DRAINAGE Planning - run-off estimation, rainfall data analysis, storm water drain design -rainwater harvesting.
5	SOFTWARE APPLICATIONS Use of computer software in water transmission, water distribution and sewer design.

References:

- (1) “Manual on water supply and Treatment ”, CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1999.
- (2) “Manual on Sewerage and Sewage Development ”, CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1993.
- (3) B.A. Hauser, “Practical Hydraulics Hand Book ”, Lewis Publishers, New York, 1991.
- (4) M.J. Hammer, “Water and Wastewater Technology ”, Regents/Prentice Hall, New Jersey, 1991

Semester I

Subject Code	Subject Name	Credits
EVE103X	Environmental Geotechnology (ELECTIVE-II)	04

Detailed Syllabus

Sr. No	Content
1	INTRODUCTION Introduction to Environmental Geotechniques-Environmental cycles and their interaction-Soil water environment interaction relating to geotechnical problems-Effect of pollution on soil water behaviour- Sources, production and classification of wastes-Environmental regulations in India-Case studies of foundation failures by ground contamination.
2	SITE SELECTION AND METHOD OF DISPOSALS Criteria for selection of sites for waste disposal facilities-parameters controlling the selection of wastes disposal sites-current practices for waste disposal, subsurface disposal techniques-Passive contaminant systems-Leachate contamination-applications of geomembrane and other techniques in solid and liquid waste disposal-rigid or flexible membrane liners.
3	HYDROLOGY OF CONTAMINANTS Transport phenomena in saturated and partially saturated porous media-contaminant migration and contaminant hydrology-Hydrological design for ground water pollution control-Ground water pollution downstream for landfills. Bearing capacity of compacted fills-foundation for waste fill ground-pollution of aquifers by mining and liquid wastes-protection of aquifers
4	HAZARDOUS WASTE DISPOSAL Hazardous waste control and storage system-Stabilization/Solidification of wastes-Processes and Functions- Monitoring and performance of contaminant facilities-Environmentally safe disposal of solid and liquid waste
5	REMEDIAL MEASURES Ground modification techniques in waste fill, Remedial measures for contaminated grounds- Remediation technology-Bio-remediation

References:

- (1) Wentz, C.A., "Hazardous Waste Management", McGraw Hill, Singapore, 1989.
- (2) Daniel, B.E., "Geotechnical Practice for Waste disposal", Chapman and Hall, London, 1993.
- (3) "Proceedings of the International symposium of Environmental Geotechnology (Vol.I and Vol.II)", Environmental Publishing Co., 1986 and 1989.
- (4) Ott, W.R., "Environmental Indices", Theory and Practice, Ann, Arbor, 1978.
- (5) Fried, J.J., "Ground Water Pollution", Elsevier, 1975.
- (6) ASTM Special Technical Publication 874, "Hydraulic Barrier in Soil and Rock", 1985.
- (7) Westlake, K., (1995), "Landfill Waste Pollution and Control", Albion Publishing Ltd., England, 1995.
- (8) Lagrega, M.D., Buckingham, P.L. and Evans, J.B., "Hazardous Waste Management", McGraw Hill, Inc., Singapore, 1994.

Semester I		
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Subject Code	Subject Name	Credits
EVL101	(Lab Practice - I)	02

Detailed Syllabus

Sr. No	Content
	<p>Course Objectives:</p> <p>To provide students hands-on practice for analyzing the physical and chemical quality of water.</p>
1.	<p>This will be based on the theory subjects [MENV-C101, MENV-C102, MENV-C103].It shall consist of the assignments/ tutorials based on the syllabus of the respective subjects. The assignments/tutorials should be given in such a manner that it will cover the contents of the syllabus evenly.</p>
2.	<p>The students shall be encouraged to deliver the seminar pertaining to any one of the topics in each above subject heads.</p>
3.	<p>Each student should perform the experiments from the list given below :-</p> <p>List of Experiments</p> <ol style="list-style-type: none">1. Physico-Chemical analysis of water:<ol style="list-style-type: none">a. Turbidityb. Solids: Dissolved, suspended, total, volatile, fixedc. pHd. Electrical conductivitye. Alkalinity and acidityf. Dissolved oxygeng. Hardness: Total, calcium and magnesiumh. Residual chlorinei. Fluoridej. Nitratek. Sulphatel. Iron and Manganese2. Optimum coagulant dose by jar test3. Bacteriological quality through most probable number

Semester I		
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Subject Code	Subject Name	Credits
EVL102	(Lab Practice - II)	02

Detailed Syllabus

Sr. No	Content
	<p>Course Objectives:</p> <ul style="list-style-type: none">(1) To train the students for ambient air and stack gas monitoring.(2) To impart students with the skill required for operation of air monitoring equipment.
1	This will be based on the theory subjects [MENV-E101, MENV-E102, MENV-E103].It shall consist of the assignments/ tutorials based on the syllabus of the respective subjects. The assignments/tutorials should be given in such a manner that it will cover the contents of the syllabus evenly.
2	The students shall be encouraged to deliver the seminar pertaining to any one of the topics in each above subject heads.
3.	At least one site visit and preparation of report.
4.	Each student should perform the experiments from the list given below and submit the journal which will form the term work for the subject <ul style="list-style-type: none">(1) Determination of SPM, Sox, Nox by using High Volume Sampler.(2) Ambient air monitoring(3)Study of stack monitoring kit(4)Determination of Ambient noise quality(5)Analysis of soil for pH(6)Analysis of soil for moisture(7) Classification of soil

Semester II

Subject Code	Subject Name	Credits
EVC102	ENVIRONMENTAL MICROBIOLOGY & ECOLOGY	04

Detailed Syllabus

Sr. No	Content
1	Life support system: Role of life science in environmental engineering as useful, nuisance causing and harmful organisms.
2	The microorganism: Cell structure, eucaryotes, procaryotes, viruses. Their detection and quantification.
3	Nutrition and growth conditions: Temperature, pH, oxygen, nutritional requirements as selective agents for microbial population.
4	Chemical composition of cell and nature of organic matter used by microorganisms. Metabolic classification of microorganisms: phototrophs, chemotrophs, application in environmental field.
5	Enzymes function, classification, kinetics, inhibitors, inhibition.
6	ATP formation: energy generation in cell.
7	Metabolism: central pathways, aerobic anaerobic and fermentative metabolism of carbohydrates, proteins, lipids, nucleic acids and hydrocarbons, control of metabolic reactions.
8	Kinetics of biological growth bacterial growth in terms of numbers and mass, growth curve, interpretation of curve, substrate limited growth, Monod's expression, substrate utilization and cell growth, effect of endogenous metabolism, effect of temperature application of growth and substrate removal kinetics to biological treatment.
9	Microbiology and ecology of activated sludge process, trickling filters, oxidation ponds, aerobic and anaerobic digesters, anaerobic filters, UASB reactors, composting, vermiculture and other methods. Reduction of pathogens in treatment processes.
10	Nuisance microorganisms: algae, fungi, bacteria.
11	Water related and excreta related diseases: environmental classification, key concepts used in classification.
12	Indicator microorganisms: bacteria, algae, protozoa

13	Bacteriological tests: plate count, presumptive confirmed and completed tests for coliforms, fecal coliforms test fecal streptococci test, bifidoacterium test, clostridium weichii test, MTD MF techniques, algae counting.
14	Ecology: basic principles, food chain, trophic structure, gross production to total community respiration ratio (P/R), biogeochemical cycles, limiting factors- Liebig's law, extended, ecological regulation, important ecosystems.

Recommended Books and Periodicals

- (1) Microbiology for sanitary engineers - Ross E Mckinney N.York, McGraw Hill Publication
- (2) Microbiology for environmental scientists and engineers -A.F. Gaudy & E.T.Gaudy McGraw Hill Int. Book Co.
- (3) Ecological aspects of used-water treatment Vol.I, Vol.11 and Vol.IV-Hawkes H.A. of Curds C.R. (Editors) Academic Press - London UK
- (4) Microbiology - Pelzar, Reid and Roger D. McGraw Hill
- (5) Fundamentals of Microbiology - M.Frobisher Philadelphia Saunders College Publishing.-
- (6) Basic ecology - E.P.Odum Philadelphia Saunders College Publishing
- (7) Standard Methods for examination of water and wastewater joint publication of APHA, AWWA, and WEF.

Periodicals

- (1) Journal of American Water Works Association
- (2) Journal of Water Pollution Control Federation
- (3) New journal of Water Environment Federation
- (4) Journal of Air and Waste Management Association

Semester II

Subject Code	Subject Name	Credits
EVC202	ADVANCED WASTE WATER TREATMENT	04

Detailed Syllabus

Sr. No	Content
1	Fluctuations in quality and quantity. Sampling, preservation of samples. C.O.D. B.O.D. Aerobic decomposition of organic material. Five day and ultimate values of oxygen demand. Population equivalent. Generalised B.O.D. formulations. Different methods of B.O.D. curve fitting. Various equations mathematical, Nitrogen and phosphorous
2	Object of sewage treatment, unit operations, Process design and hydraulic design. Period of design, Pre-treatment, primary treatment and secondary treatment methods Percentage removal and overall efficiency. Physics, chemical and biological methods of treatment. Measurement of sewage flow. Economics.
3	Screening, Design of fixed and rotary screens. Operation, disposal of screening, comminutors. Separation of grit. Principles of sedimentation applied to design of grit chambers. Primary, intermediate and final clarification. Inter-mittent or continuous removal of sludge. Scum removal Factors affecting performance. Sedimentation aided by chemicals.
4	Principles of biological treatment of sewage, Mechanism of stabilization, zoological films. Design and operation of trickling filters. Natural and artificial media. Mathematical model - optimization. Factors affecting performance, Recirculation. Treatment efficiency of standard and high rate filters. Hydraulic design of rotary and fixed design nozzles,
5	Biological treatment in activated sludge process. Loading parameters, sludge-values Index, Process control, Aeration requirements and methods of Aerations. Activated sludge process modification. Mathematical models and optimization.
6	General considerations in disposal of sludge, Sludge pumping. Quantities, Characteristics and behaviour of sludge. Moisture - weight - volume relationships. Digestibility. Fuel value. Fertilizer value. Flow characteristics.. Unit operations in sludge disposal. Design of sludge digestion tanks. Disposal of digested sludge, and supernatant. Gas utilization. Kinetics of sludge digestion. Design of thickeners. Disinfection of sewage effluents.
7	Design consideration in septic and Imhoff off Tanks. Up flow filters, Effluent disposal in high-water-table areas. Operation and maintenance of sewage farms. Design considerations in oxidation of stabilization pond. Algal bacterial symbiosis. Aerobic and anaerobic ponds. Aerated lagoons. Oxidation ditches Tertiary treatment.

Recommended Books and Journals etc.

- (1) Unit operations of Sanitary Engineering -Linvil G.Rich John Wiley & Sonsjnc. (Wiley Toppan Co.Ltd. Tokyo)
- (2) Biological treatment of sewage and industrial wastes - Vol.11 Anaerobic oxidation. Reinhold Publ.Crop.New York. 3. Chemical Engineering Vol.II Coulson & Richardson. McGraw Hill Book Co., New York.
- (3) Wastewater Engineering-Treatment, disposal, reuse Metcalf & Eddy 3rd ed. McGraw Hill International Editions.
- (4) Water and Wastewater Engineering-Vol.II Fair, Geyer & Okun Wiley Toppan Co.Ltd. Tokyo.
- (5) Unit processes of Sanitary Engineering - Linvil B.Rich John Wiley & Sons, Inc(Wiley Toppan Co.Ltd. Tokyo)
- (6) Journal Water Pollution Control federation (Now Water Environment Federation)
- (7) Transactions - American Society of Civil Engineers- Hydraulics Division and Environmental Engineering Division.
- (8) Manual of sewerage and Sewage Treatment. Ministry of Urban Development.
- (9) Wastewater treatment Plants Planning, Design and Operation. S.R. Qasium CBS International Edition.
- (10) Wastewater Treatment for Pollution Control S.J.Arceivala Tata McGraw hill Publishing Co.Ltd.New Delhi.
- (11) Sewerage and Sewage Treatment. Babbit & Baumann. Asia Publishing House.
- (12) Waste Stabilization ponds - E.F. Gloyne WHO Monograph no.60
- (13) Excreta disposal for rural areas and small communities - Wagner and Lanoix. WHO Monograph no.39
- (14) Biological process design for wastewater treatment - L.D.Beneield and C.W.Randall Prenticehall Inc.Englewood Cliffe, N.J.

Semester II

Subject Code	Subject Name	Credits
EVC203	SOLID WASTES AND HAZARDOUS WASTE MANAGEMENT	04

Detailed Syllabus

Sr. No	Content
1	Solid wastes - sources, types, composition, physical, chemical and biological properties of solid wastes, sources and types of hazardous and infectious wastes in municipal solid wastes.
2	Solid waste generation and collection, Handling, storage, processing, transportation
3	Disposal of solid wastes - materials separation and processing, thermal conversion, biological and chemical conversion, recycling of material in municipal solid wastes, Land filling, Composting, gas generation, closure of landfills.
4	Industrial solid wastes-composition, biodegradable, nonbiodegradable hazardous, toxic solid wastes, methods of detoxification, disposal on land, disposal into water bodies.
5	Legal aspects of municipal solid waste collection, conveyance, treatment and disposal.
6	Hazardous wastes - origin, quantity and quality parameters.
7	Treatment and disposal methods-physico-chemical and biological, stabilization and solidification, thermal methods, land disposal. site remediation.

Recommended Books and Periodicals

- (1) Integrated solid waste management. Tchobanglous, Theissen and Vigil-McGraw Hill Book Co.
- (2) Hazardous waste management LaGrega, Buckingham & Evans. McGraw Hill Book Co.
- (3) Solid wastes - Engineering principles and management issues. Tchobanglous, Theissen and Eliassen. McGraw Hill Book Co.
- (4) Composting - H.B.Gotaas. WHO Monograph No.31.
- (5) Solid waste management - Hagerty, Pavoni, Heer-Van Nostrand Reinhold Co., New York
- (6) Handbooks of solid wastes disposal-Materials and Energy Recovery-Paveni, Heer, Hagerty. Van No strand Remhold Co.NY.
- (7) Infectious & Medical Waste Management by Peter A Reinhardt Judith G Gordon

Semester II

Subject Code	Subject Name	Credits
EVE201X	Membrane Technology in Environmental Engineering (ELECTIVE-III)	04

Detailed Syllabus

Sr. No	Content
1	Introduction to Membrane Processes, Membranes and Modules: Principles of Membrane processes; Types and uses of membranes; Recent development in membranes; Types and uses of modules; Washing procedures.
2	Applications of Membrane Processes in Environmental Engineering: Membrane bioreactors; Pre evaporation and its applications; Reverse Osmosis, Ultrafiltration and Microfiltration and their applications; Dialysis and Electrodialysis and their applications;
3	Preparation of Synthetic Membranes: Introduction, preparation of synthetic membranes, phase inversion membranes, preparation technique for immersion precipitation, preparation technique for composite membranes,
4	Characterization of Membranes: Introduction, membrane characterization, characterization of porous membranes, characterization of ionic membranes, characterization of non porous membranes.
5	Module and process design: Introduction, plate and frame model, spiral wound module, tubular module, capillary module, hollow fiber model, comparison of module configurations. Case studies of Selected Environmental Processes with Membrane Technology

Reference Books:

- (1) M.H.V. Mulder, Membrane Separations. Kluwer Publications
- (2) S.P. Nunes, and K.V. Peinemann, membrane Technology in the chemical industry, Wiley VCH.
- (3) R. Rautanbach and R. Albrecht, Membrane Process, John Wiley & Sons.
- (4) R.Y.M. Huang, Pre evaporation Membrane Separation Processes, Elsevier.
- (5) J.G. Crespo, K.W. Boddekes, Membrane Processes in Separation and Purification, Kluwer Academic Publications.
- (6) Larry Ricci and the staff of chemical engineering separation techniques, Mc Graw Hill publications.

Semester II

Subject Code	Subject Name	Credits
EVE202X	Environmental Engineering Structures (ELECTIVE-III)	04

Detailed Syllabus

Sr. No	Content
1	<p>DESIGN OF PIPES</p> <p>Structural design of a) Concrete b) Prestressed Concrete c) Steel and d) Cast-iron piping mains, sewerage tanks design - anchorage for pipes - massive outfalls - structural design and laying - hydrodynamic considerations. Advances in the manufacture of pipes.</p>
2	<p>ANALYSIS AND DESIGN OF WATER TANKS</p> <p>Design of concrete roofing systems a) Cylindrical b) Spherical and c) Conical shapes using membrane theory and design of various types of folded plates for roofing with concrete. IS Codes for the design of water retaining structures. Design of circular, rectangular and spherical type of tanks using concrete. Design of prestressed concrete cylindrical tanks - Economic analysis - introduction to computer aided design and packages.</p>
3	<p>DESIGN OF SPECIAL PURPOSE STRUCTURES</p> <p>Underground reservoirs and swimming pools, Intake towers, Structural design including foundation of water retaining structures such as settling tanks, clarifloculators, aeration tanks etc. - effect of earth pressure and uplift considerations - selection of materials of construction.</p>
4	<p>REPAIR AND REHABILITATION OF STRUCTURES</p> <p>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.</p>
5	<p>EXPOSURE ON STEEL, LATTICE STRUCTURES USED IN WATER AND SEWERAGE WORKS</p>

Text Books:

- (1) Reinforced Concrete by P.Dayaratnam.
- (2) Prestressed Concrete by Krishna Raju, Tata McGraw Hill Publishing Co. 2nd Edition 1988.
- (3) 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.

Semester II		
Subject Code	Subject Name	Credits
EVE203X	Disaster Management and Risk Analysis (ELECTIVE-III)	04

Detailed Syllabus

Sr. No	Content
1	Disaster: Definition, Classification, Natural and Anthropogenic, Accidents, Disaster Profile of India. Geo-climatic and Social conditions, Past records, Vulnerable areas of the country, national Response approach
2	Risk assessment, Contingency Planning, Major Natural disasters, Earth Quake, Cyclone, Flood, Epidemics, Check list-Agencies, Personnel, Equipment, Materials, Services and Time management
3	Prediction and forecasting, disaster preparedness, data base Assessment of disaster relief and Rehabilitation measures, Mobilization of men and material
4	Legal frame work, Trigger mechanism – Water. Climate and Geologically related Chemical, Industrial, Nuclear, GIS enabled Disk net
5	Maps Special and non special data. Activities, Agencies, Resources and Funds, Implementation and Monitoring Flood Hazard Map
6	Quick response flow chart, Emergency operation center, Emergency support functions, Disaster specific modules

Reference Books:

- (1) “National Disaster Response Plan”, A Document prepared by Department of Agriculture and Cooperation.
- (2) “Concept of Trigger Mechanism”, Govt. of India, Ministry of Home Affairs, February 2001, Publication.
- (3) “Water and Climate related Disasters”, Govt. of India, Ministry of Home affairs, Publication.

Semester II

Subject Code	Subject Name	Credits
EVE202X	INDUSTRIAL WASTEWATER TREATMENT (ELECTIVE-IV)	04

Detailed Syllabus

Sr. No	Content
1	Stream sanitation. Different equations of self-purification, River standards, Effluent standards, Minimal national standards (MINAS). Sources and effects of various pollutants, Disposal of industrial wastes-on land, in creeks and the sea, in inland streams, into impoundments.
2	Importance of planning location of industries and industrial estates, Common effluent treatment plants, their economics and management.
3	Waste volume reduction, Strength reduction, Neutralization, Proportioning, Equalization
4	Detailed considerations of wastes from industries such as textile (Cotton, wool, rayon, synthetics),sugar, pulp and paper, distilleries, oil refineries, petrochemicals, pharmaceuticals, dairy, food processing, soaps and detergents, mining, iron and steel, pickling, plating, galvanizing, tanning, slaughter house, fertilizers, pesticides, dyes and dye intermediates, radioactive wastes.
5	Recovery of byproducts, reuse of wastewaters with or without treatment

Recommended Books & Periodicals.

- (1) Rudolfs, W.Industrial Wastes-Their Disposal and treatment Reinhold Publ.Corp.
- (2) Gurnham, C.F. Industrial waste water control Academic Press
- (3) Gurnham C.F. Principles of industrial waste treatment, Wiley, NY.
- (4) Nemerow, N.D. Theories and practices of industrial waste treatment
- (5) Mahajan S.P.Pollution Control in Process Industries.
- (6) Echenfelder, W.W. Jr.Industrial Water Pollution Control McGraw Hill Book Co. International edition.
- (7) Proceedings of Industrial Waste Conference-Purdue University.
- (8) M.N.Rao & Datta –Waste water Treatment
- (9) Besselièvre, ED. The treatment of industrial wastes - McGraw Hill Book Co. New York

Semester II

Subject Code	Subject Name	Credits
EVE202X	Modern Trends in Environmental Engineering (ELECTIVE-IV)	04

Detailed Syllabus

Sr. No	Content
1	Emerging fields in ESE: Cleaner Production Technologies, Environmental Bio-Technology, Bioremediation, Risk Analysis, Software and Information Systems, Global Issues
2	Environmental pollution monitoring sensors- Basic understanding of the interaction of electromagnetic radiation, sound, laser etc. with matter. Familiarization with a variety of sensors and platforms Anthropogenic Endocrine Disruption. The Scientific Basis of the Endocrine Hypothesis. Scientific Uncertainty, Risk Analysis and Policy Response Unit – IV
3	Land pollution- Definition and scope, necessity and importance, Treatment methods: Various methods of refuse processing, fertilizer, fuel and food values.
4	Sanitary land filling - definition, methodology, trench, area, ramp, pit method, site selection, basic steps involved, cell design, prevention of site pollution, Leachate treatment, gas collection and recirculation.
5	Composting – Aerobic and anaerobic composting, Factors affecting composting Indore and Bangalore processes of composting. Incineration - Processes 3Ts to control high temperature Incinerators, design approach prevention of air pollution.

Reference Books:

- (1) Special issue and reviews articles on the relevant topics in Science, Scientific American, Nature, Current Science and Environmental Science and Engineering.
- (2) C.S. Foster and D.A. Johnwase, Environmental Biotechnology, (Ellis Harwood) (1987).
- (3) B. Vallely, '1001 Ways to Save the Planet', (Ivy Books) Newyork (1990)
- (4) Solid Waste Management, Van Nostrand Reinhold Co. 1975.
- (5) C.L. ell, Solid Waste Management, John Wiley, 1975.
- (6) P.W. Powers. How to dispose of toxic substances and industrial Waste, Noyes Data Corporation, England, 1976.

Semester II

Subject Code	Subject Name	Credits
EVE203X	Numerical Methods and Statistics (ELECTIVE-IV)	04

Detailed Syllabus

Sr. No	Content
1	The meaning of Numerical Methods, Significance of Numerical Methods, Accuracy & Precision, Error, Round-off Error, Truncation Error, Total Error, Relative Error, Percentage Error, Significance of Error Computation in Numerical Methods, Pre specified Error, Error Propagation, and Importance of Modern Computers in Numerical Methods
2	Roots of Nonlinear Equations, Simple One-Point Iteration, Newton-Raphson Method, Secant Method, Multiple Roots, System of Nonlinear, Equations
3	Systems of Linear Algebraic Equations, Review of Graphical Method, Cramer's Rule. Naïve gauss elimination Method, pitfalls of elimination method. Techniques for improving solution, Gauss Jordan method, Gauss Seidel Method
4	Curve fitting, Difference between regression and interpolation Interpolation: Linear interpolation, quadratic interpolation, General form of Newton's Interpolating Polynomial, Newton's divided difference interpolation polynomials, Lagrange's Interpolating Polynomials
5	Necessity of statistical approach, review of basic concepts of statistics, Linear Regression: Least Squares Method, Polynomial Regression, Nonlinear Regression
6	Numerical Differentiation and integration, Trapezoidal Rule, Simpson's Rule, Solutions of Ordinary Differential Equations, Runge-Kutta Method, Classification of Partial Differential Equations, Solution by Liebmann's Method. Introduction to Finite Element Method

Reference Books:

- (1) "Numerical Methods for Engineers", Chapra S.C. And Canale R.P., Tata McGraw Hill Publications, 2002, 4th Edition.
- (2) "Numerical Methods", E. Balguruswamy.
- (3) "Applied Numerical Analysis", Gerald. C.F. And Wheatly. P.O., Addison Wesley, 1994, 5th Edition.

Semester II

Subject Code	Subject Name	Credits
EVL201	(Lab Practice -III)	02

Detailed Syllabus

Sr. No	Content
	<p>Course Objectives:</p> <p>To provide students the necessary knowledge about the characteristics of waste water and solid waste.</p>
1.	<p>This will be based on the theory subjects [MENV-C201, MENV-C202, MENV-C203]. It shall consist of the assignments/ tutorials based on the syllabus of the respective subjects. The assignments/tutorials should be given in such a manner that it will cover the contents of the syllabus evenly.</p>
2.	<p>The students shall be encouraged to deliver the seminar pertaining to any one of the topics in each above subject heads.</p>
3.	<p>Each student should perform at least 8 experiments from the list given below :-</p> <ol style="list-style-type: none">(1) Determination of pH of waste water(2) Determination of chloride concentration(3) Determination of Total solids and volatile solids(4) Determination of sludge volume index(5) Determination of BOD(6) Determination of COD(7) Determination of DO(8) Determination of pH of solid waste(9) Determination of moisture content of solid waste(10) Determination of carbon content of solid waste

Semester II		
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Subject Code	Subject Name	Credits
EVL202	(Laboratory - IV)	02

Detailed Syllabus

Sr. No	Content
1.	This will be based on the theory subjects [MENV-E201, MENV-E202, MENV-E203].It shall consist of the assignments/ tutorials based on the syllabus of the respective subjects. The assignments/tutorials should be given in such a manner that it will cover the contents of the syllabus evenly.
2.	The students shall be encouraged to deliver the seminar pertaining to any one of the topics in each above subject heads.
3.	At least one site visit and preparation of report.

Subject Code	Subject Name	Credits
EVS301	Seminar	03

Guidelines for Seminar

- Seminar should be based on thrust areas in Environmental Engineering and Development with emphasis in the context of Solid Waste Management/ Public Health Engineering/ Water Distribution System/Advanced Water Treatment etc.
- The objective behind seminar is to equip the student for carrying out literature survey, summarize the findings of the literature and formulate the problem or arrive upon the statement of the problem. Along similar lines, the student can work for their dissertation in the subsequent stages.
- The student in consultation with the Guide/ Supervisor shall settle or finalize / identify the topic of the seminar in the context of the specialization or allied theme. The students shall carry out literature survey pertaining to the topic, various sub-topics/ approaches/ methods falling within the purview of the topic. The student shall use multiple literatures and understand the topic, analyze the literature and summarize the findings. The report shall be compiled in a standard format. The student shall have to present the deliver the seminar/presentation in front of the board of examiners (refer NOTE below)
- The supervisor may ask the student to author a technical paper based on the seminar report and present it in a seminar or conference of national repute. Publication of paper in an International Conference shall be preferred. The paper could be a review paper.
- The assessment of the seminar shall be assessed in respect of the following points:
 - Quality of Literature survey and Novelty in the topic
 - Relevance to the specialization
 - Understanding of the topic
 - Quality of Written and Oral Presentation
 - Efforts made by the students to author a technical paper and its subsequent publication and presentation.

IMPORTANT NOTE:

1. Assessment of Seminar will be carried out by a pair of Internal and External examiner. The external examiner should be selected from approved panel of examiners for Seminar by University of Mumbai, OR faculty from Premier Educational Institutions /Research Organizations such as IIT, NIT, BARC, TIFR, DRDO, etc. OR a person having minimum Post-Graduate qualification with at least five years' experience in Industries.
2. Literature survey in case of seminar is based on the broader area of interest in recent developments and for dissertation it should be focused mainly on identified problem.
3. At least 4-5 hours of course on Research Methodology should be conducted which includes Literature Survey, Problems Identification, Analysis and Interpretation of Results and Technical Paper Writing in the beginning of 3rd Semester.

Subject Code	Subject Name	Credits
EVD301 / EVD401	Dissertation (I and II)	12 + 15

Guidelines for Dissertation

- Student should carry out the preliminary literature survey and subsequently, identify the problem in broad terms for Dissertation and finalize/ settle it in consultation with Guide/ Supervisor.
- Pursuant to this, the student shall refer multiple literatures pertaining to the theme of the problem and understand the problem and define the problem in the precise terms.
- Student should attempt solution to the problem by analytical/simulation/experimental methods. The solution shall be validated with proper justification. The students shall compile the report in standard format.
- Student should publish at least one paper based on the work in reputed International / National Conference in which papers are blindly reviewed. (desirably in Refereed Journal)
- The work to be pursued as a part of the dissertation shall be divided broadly in two parts, namely- Dissertation Stage I and Dissertation Stage II.
- The topic of the Dissertation should be such that it is a value addition for the existing knowledge in the field.

Guidelines for Assessment of Dissertation I

- Dissertation I should be assessed based on following points
 - Quality of Literature survey and Novelty in the problem
 - Clarity of Problem definition and Feasibility of problem solution
 - Relevance to the specialization
 - Clarity of objective and scope
 - Methodology for carrying out the work defined as a Problem Statement (Formulation in respect of the analytical studies/ Experimental Work / Combination thereof depending upon the nature of the work involved)/ Data Collection, etc.
- Dissertation I should be assessed through a presentation by a panel of internal examiners appointed by the Head of the Department/Institute of respective Programme.

Guidelines for Assessment of Dissertation II

After completion of about 80% of the work (which shall be decided by the Guide/ Supervisor), proposed to be apart of the Dissertation, the student shall deliver a seminar (which will be called as a pre-submission seminar) on based on the work pursued by him/ her during the second stage. It will be assessed by the panel of internal examiners appointed by the Head of the Department/ Institute of the respective programme.

The student shall take into account the suggestions made by the examiners/s during pre-submission seminar in view of the work pursued by the students and shall try to incorporate it in the work, if the suggestions are worthwhile, consistent with the situation and provided they are such that those can be accommodated/ included in the work being pursued by the candidate at that point of time.

After the pre-submission seminar, the student shall compile the report in a standard format and written in the systematic manner and chapter wise.

The student shall adhere to the following scheme of chapterization while compiling the final report by and large. The Guide/ Supervisor shall ensure the student has written the Dissertation Report in appropriate language (grammatically correct).

1. Introduction: The student shall give the introduction to the theme of the subject chosen as a Dissertation, give further current state of art related to the theme (i.e., brief review of literature), broad problem definition and scope of the work. The student shall also state at the end of this chapter the scheme of chapterization included in his/ her Dissertation.
2. Theoretical Aspects/ Review of Literature: The student is expected to highlight the various theoretical aspects pertaining to the topic chosen, literature (updated) available related to the various aspects of the topic chosen citing the research work carried out by the earlier researchers and summarize the findings of the literature. The student may state the precise the problem definition.
3. Formulation/ Methodology/ Experimental Work: In this chapter, the student is expected to explain the methodology for pursuing his/ her work. In case of analytical work, student may give the Formulation along with validation for assessment of accuracy of the numerical procedure being used/ proposed by him/ her. In respect of experimental work, the student may outline the experimental set up/ procedure. In case of the work in which either approach is involved, the student may appropriately provide the methodology to cover either approach. This chapter may be supported by the Data Collection if the work involves the Collection of the Data and its subsequent processing.
4. Analysis/ Results and Discussion: The student is expected to present the results emerging from the analytical/ theoretical/ experimental study/ studies being pursued by the students. The results shall be discussed properly. The results may be compared with the results published by the earlier researchers if the work being pursued by the student warrants the same. The student may indicate the broad conclusions/ inferences at the end.
5. Summary and Conclusions: Based on the results discussed in the previous chapter, the student shall give in the systematic manner the conclusions/ inferences emerged from the study and summarize it properly. The student shall indicate the scope of the future work which can be extended by any other student/ researcher in the future. The student may point out the limitation/s left out in the work pursued by him/ her while carrying out the work contained in the Dissertation.
6. References: The student shall at the end give the list of the references in the appropriate manner. This part should not be treated as a Chapter. For referencing style, student may refer any standard journal of national and international repute.

7. Publication/s: The student shall give the list of the technical/ research papers published/ accepted for publication in the referred journal/ conference proceedings. This part should not be treated as a Chapter.

Dissertation II should be assessed based on following points

- Quality of Literature survey and Novelty in the problem
 - Clarity of Problem definition and Feasibility of problem solution
 - Relevance to the specialization or current Research / Industrial trends
 - Clarity of objective and scope
 - Methodology for carrying out the work defined as a Problem Statement (Formulation in respect of the analytical studies/ Experimental Work / Combination thereof depending upon the nature of the work involved)
 - Quality of work attempted
 - Presentation of the results along with the validation of results or part thereof.
 - Quality of Written Report and Oral Presentation
 - Publication of the technical/ research paper by the student in a conference of National/ International repute. Publication of paper in a referred/ peer reviewed journal is highly preferred.
- Dissertation II shall be assessed through a presentation jointly by the Internal Examiner (Guide/ Supervisor) and External Examiner appointed by the University of Mumbai.