Course Structure

For Degree Program

M. Tech. in Civil Engineering

with Specialization in

Environmental Engineering

In line with National Education Policy 2020
(Effective from AY 2024-25)

Dr. Babasaheb Ambedkar Technological University

Lonere 402 103, Dist- Raigad, Maharashtra, INDIA

Established vide Maharashtra Act No. XXII of 1989 and Act. No. XXIX of 2014
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Course Structure, Guidelines, Rules and Regulations

Preamble

Economic advancement of a country is closely tied to the quality of technical education it offers. Engineering education is reaching new heights and plays a significant role in the overall education system. The preparation of engineering graduates should focus on enhancing their employability and sustainability in response to evolving industry and societal needs. As technology advances and expectations change rapidly, updating the curriculum to be contemporary and relevant is imperative.

In order to align our technical education system with global standards and practices, based on performance and assessment system was implemented earlier for all Undergraduate Programs (UG). Now as per National Education Policy-2020 framework we are incorporating project-based learning. The realm of engineering and technology, characterized by its interdisciplinary nature, demands the synthesis of knowledge from a wide array of domains including humanities, arts, and advanced technologies. However, what distinguishes technologists is their proficiency in design and their ability to adeptly apply this knowledge across diverse disciplines to achieve effective problem-solving.

In response to these needs, aspiring engineers need thorough preparation and a deep understanding of the latest technological trends and industrial requirements. This calls for studying under a modern and adaptable curriculum that mirrors the global environment. As part of this initiative, there is a push to integrate recent advancements and enrich course content with pertinent and up-to-date subjects. Consequently, a revised structure and curriculum will debut from the academic year 2023-24 for First Year Civil Engineering, with intentions to progressively implement these updates across second, third- and fourth-year engineering programs.

Project-based learning has been introduced alongside traditional classroom teaching and laboratory-based learning to enhance the overall learning experience. The objective is to encourage students to learn collaboratively in groups of 3 to 4, focusing on solving meaningful problems. These problems can be theoretical, practical, social, technical, symbolic, cultural, or scientific, arising from students' curiosity across various disciplines and professional contexts. The selected problems should be exemplary and may require an interdisciplinary approach for both analysis and resolution. This approach aims to develop students' capacity for learning through shared cognition.

- Laboratory Course:

  This is focused on completing experiments and assignments related to the courses of the Semester.

- Seminar: This aspect will revolve around state-of-the-art topics selected by students and approved by the authority. Students are required to submit a certified seminar report in a standard format, evaluated

by their assigned guide and the department/institute head for satisfactory completion of the work.

- Project Work in Final Year: Project work in the seventh Semester is integral to the curriculum. It involves applying knowledge gained throughout the graduation program, ideally addressing societal needs. The project provides an opportunity for students to design and construct complete systems or subsystems, specializing in areas of their interest. Students must prepare a certified final project report in standard format, evaluated by their guide and the department/institute head for satisfactory completion of the work.
- Internship: Internships are crucial for educational and career development, offering practical experience in field of discipline. It plays a significant role as employers seek well-trained employees. The primary objective is to expose technical students to real-world industrial environments, providing insights into the social, economic, and administrative factors influencing organizational operations. Students may choose internships in industries, government agencies, NGOs, MSMEs, rural settings, innovation hubs, intellectual property rights (IPR), or entrepreneurship initiatives. They can opt to focus on innovation, leading to start-up's, or gain experience in industry/NGO/government/MSME settings to prepare for professional roles. The conduction, monitoring, assessment, and evaluation of internships follow guidelines provided by AICTE.

Definition of Credit **

1 Hour Lecture (L) per week	1 credit for 1 Hour
Tutorial (T) per week	1 credit for 1 Hour
Practical(P) per week 2 Hours Practical (Lab)/week	1 credit for 2 Hours

** The head of Tutorial and Practical (as a special case) may be merged for common credit with the permission of authority.

Rule No. 1: Eligibility for Admission

Eligibility Criteria

Students seeking admission to the first year of the Bachelor's degree course in Engineering and Technology must fulfil the eligibility criteria as laid down from time to time by the following authorities:

- **Dr. Babasaheb Ambedkar Technological University (DBATU)**
- **Government of Maharashtra**
- **All India Council for Technical Education (AICTE)**

Rule No. 2: Scheme of Assessment

Eligibility for the Degree of Bachelor of Engineering and Technology

To be eligible for the degree of Bachelor of Engineering and Technology, a candidate must:

1. **Appearing for Examinations**:
    - A candidate is required to appear for all prescribed examinations during the course of study. This includes theory exams, practical exams, term-work assessments, project evaluations, and any other form of examination as specified in the syllabus.
2. **Passing of Examinations**:
    - A candidate must pass all the prescribed examinations. The passing criteria, including minimum marks required in theory, practical, term-work, and other components, will be as per the rules laid down by the university.

Components of Assessment

The scheme of assessment typically includes the following components:

1. **Theory Examinations**:
    - Conducted at the end of each Semester.
    - Assess the theoretical understanding of the subjects.
2. **Practical Examinations**:
    - Conducted to assess the practical skills and application of knowledge.
    - Includes laboratory work, experiments, and practical assignments.
3. **Term-Work Assessments**:
    - Continuous assessment of assignments, tutorials, and project work throughout the Semester.
    - Includes the evaluation of written assignments, presentations, and project reports.
4. **Project Work**:
    - Assessment of project-based learning and final year projects.
    - Includes continuous assessment by the faculty and final evaluation through project reports, presentations, and viva-voce.
5. **Internal Continuous Assessment**:
    - Regular assessments conducted throughout the Semester.
    - Includes quizzes, class tests, mid-term exams, and participation in class activities.

Program Objectives

Goal of the Civil engineering with a specialization in Environmental Engineering (ENE) at Dr. Babasaheb Ambedkar technological University, Lonere (BATU) is to provide students with preparation to become worthy of professional careers in the field and to be motivated for lifelong learning. All prescribed courses have definite objectives and outcomes. Program objectives are expected qualities of engineers as under:

a) Preparation: To prepare students to excel in various educational program or to succeed in industry / technical profession through further education/training;

b) Core Competence: To provide students with a solid foundation in mathematical, scientific fundamentals required to solve E&T related problems;

c) Breadth: To train students with a breadth of scientific knowledge to comprehend, analyze, design & create novel products and solutions for real life problems;

d) Professionalism: To inculcate in students professional/ethical attitude, effective team work skills, multidisciplinary approach and to relate engineering issues to a broader context;

e) Learning Environment: To provide students with academic environment of excellence, leadership, ethical guidelines and life-long learning needed for a long / productive career.

In addition to above DBATU graduate is expected to be

1. Taking pride in their profession and have commitment to highest standards of ethical practices,
2. Able to design structural system that is safe, economical and efficient.
3. Capable of using modern tools efficiently in all aspects of professional practices.
4. Dealing successfully with real life civil engineering problems and achieve practical solutions based on a sound science and engineering knowledge.
5. Shall represent the highest standards of Structural engineering and related technical disciplines.
6. Shall be engage in continuous research, development and exchange of knowledge for professional development.
7. Be honest in their control and performing their duties and promote effective use of resources through open, honest and impartial services to the public.
8. Act in such a manner, which will uphold the honour, integrity, or dignity of the engineering profession, and avoid knowingly engaging in business or professional practices of a fraudulent, dishonest or unethical nature.
9. Recognize that the lives, safety, health and welfare of the general public are dependent upon engineering, decision and practices.
10. Continue their professional development throughout their careers and provide opportunities for the professional development.

Table A: Credit Structure for PG program in Engineering

Course Category	Provided
Program Core Course (PCC)	15
Program Elective Course (PEC)	12
Experiential Learning Courses (ELC)	42
Humanities Social Science and Management (HSSM-IKS/VEC/AEC)	5
Open Elective (OE) Other than a particular program	3
Multidisciplinary Minor (MDM)	6
TOTAL	**83**

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for M. Tech. in Civil Engineering with Specialization in Environmental Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	ISE	MSE	ESE	Total	
Semester- I										
1	MCVENEPCT 101	Environmental Chemistry and Microbiology	3	--	--	20	20	60	100	3
2	MCVENEPCT 102	Physico- chemical process for water and waste water	3	--	--	20	20	60	100	3
3	MCVENEPCT 103	Environmental Legislation and Management	3	--	--	20	20	60	100	3
4	MCVENEPET 104	Program Elective-I	3	--	--	20	20	60	100	3
5	MCVENEPET 105	Program Elective-II	3	--	--	20	20	60	100	3
6	MCVENEELL 106	PG Lab-I	--	--	4	25	--	25	50	2
7	MCVENEHMP 107	Communication Skills	2	--	--	25	--	25	50	2
8	MCVENEAUP 108	YOGA for Stress Management	--	--	2	AU	--	--	--	AU
		Total	**17**	**0**	**06**	**150**	**100**	**350**	**600**	**19**
Semester- II										
1	MCVENEPCT 201	Industrial waste water and Treatment Management	3	--	--	20	20	60	100	3
2	MCVENEPCT 202	Solid and Hazardous waste Management	3	--	--	20	20	60	100	3
3	MCVENEPET 203	Program Elective-III	3	--	--	20	20	60	100	3
4	MCVENEPET 204	Program Elective-IV	3	--	--	20	20	60	100	3
5	MCVENEOET 205	Open Elective-V	3	--	--	20	20	60	100	3
6	MCVENEELP 206	PG Lab-II	--	--	4	25	--	25	50	2
7	MCVENEELP 207	Mini -Project	--	--	8	25	--	25	50	4
8	MCVENEHMP 208	Indian Knowledge System	3	--	--	20	20	60	100	3
		Total	**18**	**0**	**12**	**170**	**120**	**410**	**700**	**24**

Type of course:

Program Core: **PC**	Program Elective: **PE**
Open Elective: **OE** (Other than particular program)	Ability Enhancement Course: **AE**
Modern Indian Language: **MIL**	Humanities, Management, language and Commerce: **HM**
Experiential Learning Courses: **EL**	Multidisciplinary Minor Courses: **MD**
ABBRIVATIONS: **ISE**-INSEMESTER EVALUATION, **MSE**-MID SEMESTER EVLUATION, **ESE** -END SEMESTER EVALUATION	

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Teaching & Evaluation Scheme for M. Tech. in Civil Engineering with Specialization in Environmental Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	ISE	MSE	ESE	Total	
Semester-III										
1	MCVENEMDT 301	MOOC/SWAYAM/ NPTEL PLATFORM COURSES/Self Study.(It is desirable to choose one course from each of PE,OE &AE.)	3	--	--	20	20	60	100	03
2	MCVENEMDT 302		3	--	--	20	20	60	100	03
3	MCVENEHMT 303		3	--	--	20	20	60	100	03
4	MCVENEELP 304	Seminar-I	--	--	4	25	--	25	50	02
5	MCVENEELP 305	Dissertation Stage -I	--	--	20	50	--	50	100	10
		TOTAL	**9**	**--**	**24**	**135**	**60**	**255**	**450**	**21**
Semester-IV										
1	MCVENEELP 401	Dissertation Stage-II	--	--	40	100	--	100	200	20
		TOTAL	--	--	--	**100**	--	**100**	**200**	**20**

Internship
Students can take Industry Internship along with Dissertation Stage –I. Students must maintain regular reporting with Dissertation supervisor regarding status of Dissertation **Dissertation Stage I and Synopsis Approval Presentation:** It is a course requirement under the guidance of faculty Supervisor. PG student from second year is required to do innovative and research oriented applied work related to various theory and laboratory courses. Dissertation work may cover analytical formulation, experimentation or survey based project or combination of these. Student are encouraged to undertake an interdisciplinary type project.

Sr.No.	**Multidisciplinary Minor Courses**
A	MOOC/SWAYAM/ NPTEL -Project Management and Intellectual Property Rights (Self Study) Student may select this course either from MOOC/SWAYAM/ NPTEL pool or any other approved reputed source. The submission of course completion certificate is mandatory. **MCVENEMDT301/302,MCVENEHMT 303 -** Institute has to take care of registration of subjects with detailed syllabus in first two weeks of beginning of the semester with exam department of DABATU.

Sr.No.	Program Elective-I	Program Elective-II
A	Environmental Engineering Structures	Environmental Biotechnology
B	Air Quality Modeling	Climate Change
C	Ground Water Contamination and Pollution Transport	Marin Pollution

Sr.No.	Program Elective-III	Program Elective-IV	Open Elective
A	Agricultural Pollution Control	Environmental Sanitation	Elements of Research Methodology
B	Environmental Auditing	Air Pollution Control	Disaster Management and Risk Analysis
C	Nano Technology for Water and Wastewater Treatment	Geo-environmental Engineering	Remote Sensing and GIS Application

Sr.No.	Multidisciplinary Minor	Indian Knowledge System
A	MOOC/SWAYAM/ NPTEL	History of Environmental Engineering In India
B	Project Management and Intellectual Property Rights (Self Study)	

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Teaching & Evaluation Scheme for M. Tech. in Civil Engineering with Specialization in Environmental Engineering

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			L	T	P	ISE	MSE	ESE	Total	
Semester- I										
1	MCVENEPCT 101	Environmental Chemistry and Microbiology	3	--	--	20	20	60	100	3
2	MCVENEPCT 102	Physico- chemical process for water and waste water	3	--	--	20	20	60	100	3
3	MCVENEPCT 103	Environmental Legislation and Management	3	--	--	20	20	60	100	3
4	MCVENEPET 104	Program Elective-I	3	--	--	20	20	60	100	3
5	MCVENEPET 105	Program Elective-II	3	--	--	20	20	60	100	3
6	MCVENEELL 106	PG Lab-I	--	--	4	25	--	25	50	2
7	MCVENEHMP 107	Communication Skills	2	--	--	25	--	25	50	2
8	MCVENEAUP 108	YOGA for Stress Management	--	--	2	AU	--	--	--	AU
		Total	**17**	**0**	**06**	**150**	**100**	**350**	**600**	**19**

Type of course:

Program Core: **PC**	Program Elective: **PE**
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Modern Indian Language: **MIL**	Humanities, Management, language and Commerce: **HM**
Experiential Learning Courses: **EL**	Multidisciplinary Minor Courses: **MD**
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SUBJECT CODE	Environmental Chemistry and Microbiology	CREDITS
MCVENEPCT 101		3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To have adequate knowledge on environmental interactions and measurement of water and wastewater quality parameters
CO2	To have adequate knowledge on various principles and applications of colloidal chemistry and colorimetry
CO3	To familiarize the students with Microbiological Parameter Analysis, measurement techniques and applications in environmental engineering.
CO4	To have adequate knowledge on various unit processes e.g, titrimetric, gravimetry, Solvent extraction, gas chromatography, spectroscopic techniques like AAS, NAA, GCMS, HPLC.
CO5	To make the students conversant with fundamentals of Environmental chemistry

Course Outcomes: Students will be able to	
CO1	Students will be able to analyse the reactions of Environmental chemistry.
CO2	Students will be able to design colloidal system purifier, colorimeter and spectrophotometer
CO3	Students will be able to analyse titrimetric, gravimetry, Solvent extraction, gas chromatography.
CO4	Students will be able to analyse water and wastewater quality parameters cost-effective.
CO5	Students will be able to analyse spectroscopic techniques like AAS, NAA, GCMS, HPLC.

Course Contents

Module 1	**Fundamentals of Chemistry for Environmental Engineering**	**Hrs. 8**

Introduction, Basic Concepts from General Chemistry, Physical Chemistry, Equilibrium Chemistry, Organic, Biochemistry, Colloid Chemistry and Nuclear Chemistry.

Chemistry of pollutants: Chemistry of pollutants in the Atmosphere, Solid, liquid, gaseous and radioactive pollutants in the atmosphere, formation of physical processes of pollutants in the atmosphere, Effects of temperature, solar radiation and wind current on the various pollutants, Effect of gravitational force and rain scrubbing on air pollutants, Chemical properties of air pollutants chemisorptions, effect of solar radiation on acidic basic characteristics.

Module 2	**Chemistry of Various Organic and Inorganic Compounds**	**Hrs. 8**

Carcinogenic compounds and their effects. **Hydrocarbons:** Chemistry of hydrocarbon decay, environmental effects, effects on macro and micro organisms. **Surfactants:** Cationic, anionic and nonionic detergents, modified detergents. **Pesticides:** Classification, degradation, analysis, pollution due to pesticides and DDT problems.

Module 3	**Synthetic Polymers**	**Hrs. 6**

Microbial decomposition, polymer decay, ecological and consideration, Photosensitize additives. Lead and its

compounds: Physical and chemical properties, behavior, human exposure, absorption, influence. Aflatoxin occurrence, chemical composition and properties metabolism, acute toxicity, carcinogenicity.		
Module 4	**Optical Methods and Microbiology**	**Hrs. 8**
Principles of Optical Methods such as Absorption, Spectrophotometer, Flame photometry, Fluorometry. Principles of Chromatographic Methods such as Gas chromatography, High Performance Liquid Chromatography and Ion Chromatography. Spectroscopic techniques, AAS, NAA, GCMS, HPLC, Electro analytical techniques, EEM-608 **Environmental Microbiology:** Scope and Areas of Environmental Microbiology, Cell and its Structure, Introduction to Enzyme and Metabolic Reactions, Aerobic and anaerobic respiration, Classification.		
Module 5	**Microscopy and Micrometry**	**Hrs. 6**
Observations, Measurements and Isolation of Microorganism, Different Cultures, Media and Techniques of Staining and Enumeration of microorganism. **Applied Microbiology:** of Soil, Air, Water and Biological Processes of Wastewater Treatments, Industrial Microbiology.		

Text Books:	
1	C.N. Sawyer, P.L. McCarty and G. F. Parkin, Chemistry for Environmental Engineering and Science, Tata McGraw-Hill, Fifth edition, New Delhi, 2003.
2	G.W. Vanloon and S.J. Duffy 'Environmental chemistry – a global perspective, Oxford University press, New York., 2000.
3	Tortora. G.J, B.R. Furke, and C.L. Case, "Microbiology-An Introduction" (4th Ed.), Benjamin/Cummings Publ. Co., Inc., California, 1992.
4	Pelczar, M. J.Chan E.C.S. and Krieg, N. R. Microbiology, Tata McGraw Hill, New Delhi,1993
5	Bhatia S.C. "Hand Book of Environmental Microbiology", Part 1 and 2, Atlantic Publisher, 2008

Reference Books:	
1	Benefield L. D., Judkins J.F. and Weaned R.L., Process Chemistry for Water and Wastewater Treatment, Prentice Hall, Inc. London, 1987.
2	R.E. McKinney, "Microbiology for Sanitary Engineers", McGraw Hill Book Company, 1962.
3	W.G. Walter and R.H. McBee, "General Microbiology", East West Edition, 1969.
4	Botkin, "Environmental Science" 8th ed.—Wiley, India
5	A. Holmes, 1944, "Principles of Physical Geology", ELBS Chapman & Hall, London.

SUBJECT CODE	Physico- chemical Process for Water and Waste Water			CREDITS			
MCVENEPCT 102				3			
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To provide in-depth knowledge of unit operations and processes for the treatment of water and wastewater.
CO2	To impart technical competency for analysis, evaluation and design of physical and chemical treatment systems for water and wastewater
CO3	To explain the limitations, advantages and disadvantages of each unit operations and processes
CO4	To learn the physical, chemical and biological characteristics of water and wastewater
CO5	To study the principle and design of the physical and chemical treatment units used for the removal of undesirable constituents (contaminants) from water and wastewater

Course Outcomes: Students will be able to	
CO1	To evaluate various physical and chemical treatment options for treatment of water and wastewater
CO2	To explain the mechanism behind the treatment processes and their advantages and disadvantages
CO3	To design various physico- chemical units for the treatment of water and wastewater
CO4	To use the modeling concepts in the real field application
CO5	Design the treatment scheme for municipal and industrial water, wastewater.

Course Contents

Module 1	Reactors and Preliminary Treatment	Hrs. 8

Process Dynamics, Reactions and Reactors: Reactors Used for the Treatment of Wastewater, Mass transport processes, The Mass-Balance Principle, Reactions kinetics and reaction rates, Configurations of ideal and non-ideal reactors, Principle of ideal reactor design, Completely mixed batch reactors, Completely mixed flow reactors, Determination of rate parameters in CMF reactors, Plug Flow Reactors.

Coagulation and Flocculation: Coagulation Process, Stability of colloids, Repulsive and Attractive Potentials, destabilization of Colloids, Transport of colloidal particles, Orthokinetic and Perikinetic flocculation, Destabilization in Water and Wastewater Treatment by Al(III) and Fe(III).

Module 2	Coagulation & Sedimentation	Hrs. 8

Selection of a coagulant, Sedimentation Processes, Zone Settling, Compression, Sedimentation tank design for water and wastewater, Design of tube settlers, Concept and design aeration and gas transfer.

Water and wastewater purification systems: biological and chemical processes for water and wastewater purification. Secondary and Tertiary treatment systems with their design. Aeration and gas transfer.

Module 3	Filtration and Disinfection	Hrs. 6

Filtration: Principle Mechanisms of filtration, Filter Hydraulics backwash hydraulics, Rate control Patterns and Methods, Head loss patterns at Constant Rate, Slow sand and Rapid sand Filtration and their performances, Design of Gravity filters, Design and Operating variables for deep Granular Filters: Filter media, Fluidization and bed expansion in backwashing, Under drainage systems with design, operational problems.

Disinfection: Modes of disinfection, rates of disinfection, disinfection concentration Factors affecting disinfection

such as temperature, pH and organic matter, Chemical Disinfectants – chlorine and Chlorine derivatives; Non Chemical Methods for Disinfection : Ozonation; UV radiation.		
Module 4	**Membrane & Oxidation Processes**	**Hrs. 8**
Reverse Osmosis: Osmosis and Osmotic Pressure, Water and Solute Diffusion, Properties of Cellulose Acetate Membranes, Feed temperature and pH, Solute rejection, System Design, Pretreatment and Flux Maintenance, Application. Chemical Oxidation: Limitation of Oxidative Processes and Oxidizing agents in Water and Wastewater Treatment, Principle and Theories of Chemical Oxidation, Redox reaction		
Module 5	**Adsorption & Ion Exchange**	**Hrs. 6**
Adsorption processes: types of adsorption, factors influencing, adsorption equilibrium and development of adsorption isotherms, activated carbon adsorption kinetics, analysis and design of Granular Activated carbon and PAC contactors. Miscellaneous methods: Ion Exchange: Exchange processes, Exchange Materials, Synthetic Exchange resins, Exchange reaction, Equilibria, Exchange Isotherm.		

Text Books:	
1	Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw- Hill Publication, New Delhi, 2003.
2	Lee, C.C. and Shun dar Lin, "Handbook of Environmental Engineering Calculations", McGraw Hill, New York, 1999.
3	Qasim.S.R., Guang Zhu., "Wastewater Treatment and Reuse" – Volume 1& 2 2018
4	CPHEEO manual – "Manual for water supply and treatment" –Ministry of Urban development, New Delhi, 1999.
5	Weber, W.J., Physicochemical processes for water quality control, John Wiley and sons, Newyork, 1983.

Reference Books:	
1	Peavy, H.S., Rowe, D.R. and Tchobanoglous, G. Environmental Engineering, McGraw Hills, New York 1985.
2	CPHEEO manual – "Manual for sewerage and sewage treatment systems" – Part A,B,C, Ministry of Urban development, New Delhi,2013.
3	Water & Waste Water Engineering by Fair and Gayer. C.A. Sastry, Water Treatment Plants, Narosa Publishing House, Bombay, 1996.
4	Davis, M, L, and Cornwell, D, A, "Introduction to Environmental Engineering", Tata McGraw Hill Publishing Company, Special Indian Edition, 2010
5	Droste, Ronald L "Theory and Practice of Water and Wastewater Treatment", Wiley student Edition, 2009.

SUBJECT CODE	Environmental Legislation and Management					CREDITS
MCVENEPCT 103						3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To provide knowledge of Environmental Ethics and Environmental Legislation
CO2	To provide necessary knowledge of managerial tools required for assessing, analyzing and solving problems in the field of environmental management
CO3	To deliberate the role of judiciary in sustainable development
CO4	To impart knowledge on the policies, legislations, institutional frame work and enforcement mechanisms for environmental management in India
CO5	To learn the legal aspects of environmental problems

Course Outcomes: Students will be able to	
CO1	To elucidate the application of Environmental Management
CO2	To demonstrate concepts of sustainability for environmental management
CO3	To analyze the need of environmental legislation.
CO4	To illustrate the application of National Environmental Protection Acts
CO5	To choose appropriate methodology for EIA and auditing and assess the impacts.

Course Contents

Module 1	**Environmental Management**	**Hrs. 8**
Definition of Environmental Management, Principles of Environmental Management, Nature, Scope and Components of Environmental Management, Policies and Legal Aspect of Environmental Management, Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration,		
Module 2	**Environmental Impact Assessment (EIA)**	**Hrs. 6**
Overview of Environmental Impact Assessment (EIA), Need and Importance, Steps involved, Methods of EIA, Public Participation and Communication, Preparation and Review of Environmental Impact Assessment Report, Life Cycle Assessment as Environmental Management Tool, Environmental Audit, Components of Audit, Preparation of Audit Reports.		
Module 3	**Policy & Legal Framework**	**Hrs. 6**
Environmental Policy Analysis- Macro level and Micro level, Methods of Policy Analysis, steps involved, Environmental Management Plan (EMP), Components of EMP, Preparation of EMP, Case Study Acts related to environmental protection – Water (P&CP) Act 1974, Air (P&CP) Act 1981, Environment (Protection)		

Act 1986 - Relevant provisions of Forest (Conservation) Act 1982, Wild Life (Protection) Act 1972		
Module 4	**Environmental Organizations & ISO 14000**	**Hrs. 8**
Organization for Environmental Management, Organizational Design, Institutionalization of Environmental management in India, Ministry of Environment and Forest, Central Pollution Control Boards, State Pollution Control Boards, Local Bodies, their scopes, Organizational and Functional issues, Related Issues in Environmental Management ISO: 14000 – Background and development of ISO 14000 series, its need, procedure to be followed to obtain ISO: 14000 certification, implications of ISO.		
Module 5	**Environmental Legislation & Enforcement**	**Hrs. 8**
Environmental Legislation -their need, historical background, national and international acts; 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. Environmental protection agency, Municipal acts, acts dealing with hazardous and infections wastes. Preventive and reactive strategies for environmental pollution control, sustainable development, International and national efforts at environmental protection, Relevant Provisions of Indian Forest Act, Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.		

Text Books:	
1	Divan S. and Roseneranz A.: Environmental law and policy in India – Cases, Material & Statements, Oxford University Press, New Delhi, 2001. 2. 3. 4.
2	CPCB: Pollution Control Acts, Rules and Notifications issued there under Pollution Control Series, Central Pollution Control Board, N. Delhi.
3	Diwan P.: Environmental administration –law and judicial attitude Vols. I & II, Vedams eBooks (P) Ltd, N. Delhi, 1992.
4	Jaswal P.S. and Nistha: Introduction to Environmental Law, Allahabad Law Agency, Allahabad, 2017
5	Environmental Policies in India by Surendra Kumar, Northan Book Centre, New Delhi

Reference Books:	
1	The Limits of Growth by D. H. Meadows, D. L. Meadow, J. Randers and W. W. Behren, Earth Island Ltd., London.
2	World Commission on Environment and Development, Our Common Future. Oxford University Press, Oxford
3	Environmental Audit – An overview, A. K. Mhaskar – M/s. Media Enviro, Pune
4	Environmental Impact Assessment, Lauren David P., Willy Interscience, New Jersey editions.
5	Primes on 'Environmental Management', Prof. P. Khanna, Multitech publications Co. New Delhi 2001.

SUBJECT CODE	(Program Elective-I)	CREDITS
MCVENEPET 104A	Environmental Engineering Structures	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To learn about materials used in environmental structures and their durability factors.
CO2	To design water and wastewater treatment structures using industry standards.
CO3	To evaluate structural stability, maintenance needs, and safety of environmental structures.
CO4	To apply learned principles to real-world environmental engineering case studies.
CO5	Develop skills for designing structural components in water and sewage treatment facilities.

Course Outcomes: Students will be able to	
CO1	Identify the principles and loads applicable to environmental engineering structures.
CO2	Select and evaluate suitable materials for specific environmental engineering applications.
CO3	Design structural elements for water and wastewater treatment facilities.
CO4	Assess the stability, safety, and maintenance requirements of environmental structures.
CO5	Assess contamination due to waste of environmental structures.

Course Contents

Module 1	**Elevated Reservoir Design**	**Hrs. 8**
Structural Design of Elevated Service Reservoirs: Rectangular, Circular type. Design of staging for wind and earthquake forces, container with flat base and domed bottom. Membrane analysis, Effect of Joint reactions due to continuity.		
Module 2	**Water Retaining Structures**	**Hrs. 6**
Structural design of water retaining structures like Primary Clarifier (Circular & Rectangular) for WTP & STP; Biological Reactors (Circular & Rectangular) for STP for worst load conditions;		
Module 3	**WTP & STP Component Design**	**Hrs. 6**
Structural design of various components of WTP & STP (Underground / partially below & above ground).		
Module 4	**Appurtenances & Load Considerations**	**Hrs. 8**
Design considerations including loads such as traffic load, backfill load, live load etc. for Appurtenances like man-holes, concrete bedding and thrust blocks for sewers, rising mains etc, Case studies of successful and failed environmental engineering structures		
Module 5	**Waste Containment Structures**	**Hrs. 8**
Waste Containment and Landfill Structures, design of landfill liners, leachate collection systems, and landfill caps, structural stability considerations in landfill engineering, geosynthetics and their applications in waste		

containment, environmental impacts and mitigation strategies for waste containment structures,

Text Books:	
1	T.Y. Lin & Ned H. Burns – Design of Prestressed Concrete Structures, John Wiley Publication
2	N. Krishna Raju – Prestressed Concrete, Tata McGraw Hill Publication Co
3	Edward Nawy – Prestressed Concrete – A Fundamental Approach, Prectice Hall 16 International
4	B.C. Punmia, Ashok K. Jain, Arun K. Jain – Reinforced Concrete Structures Vol. II, Laxmi Publications, New Delhi
5	Amalendu Bagchi, Design of Landfills and Integrated Solid Waste Management, Wiley

SUBJECT CODE	(Program Elective-I)						CREDITS
MCVENEPET 104B	Air Quality Modeling						3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To understand the importance of mathematical models for air quality management.
CO2	To study air pollution metrology.
CO3	To learn about basic diffusion equation and various modeling approaches.
CO4	To understand the ambient air quality standards.
CO5	To learn theory and application of various types of models.

Course Outcomes: Students will be able to	
CO1	Understand the fundamentals of air quality modelling
CO2	Identifies emission source and applies suitable modeling tools to estimate the impact of the
CO3	Understand the application of models to predicts the air quality scenarios for different conditions
CO4	Concepts and types of models, model development, their applicability and limitations.
CO5	Estimate the concentration of pollutant in ambient air using dispersion models.

Course Contents

Module 1	**Air Pollution Modeling**	**Hrs. 8**
Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution –Transport of air Pollutants – Meteorological settling for dispersal of air pollutantsvertical structure of temperature and stability, atmosphere, transport and diffusion of stack emission –atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics.		
Module 2	**Air Quality Models**	**Hrs. 6**

Types modeling technique, modeling for non reactive pollutants, single source, short term impact, multiple sources and area sources, fixed box models- diffusion models.		
Module 3	**Air pollution Models**	**Hrs. 6**
Gaussian plume derivative- modification of Gaussian plume equation- long term average multiple cell model – receptor oriented and source oriented air pollution models- model performance, accuracy and utilization.		
Module 4	**Air quality index**	**Hrs. 8**
Categories of air quality index, determination of air quality index (AQI): National AQI, Extreme value indices, Regional indices.		
Module 5	**Software package applications**	**Hrs. 8**
Commercial air quality models - ADMS, AERMOD, CALINE, CALPUFF, DEGADIS, HYROAD, INDUSTRIAL SOURCE COMPLEX, SCREEN, HYSPLIT, INDEX		

Text Books:	
1	R.W. Boubel, D.L. Fox, D.B. Turner & A.C. Stern, (2008), "Fundamentals of Air pollution", 4th Edition, Academic Press, New York.
2	Peavy, Rowe and Tchobanoglous (1987) Environmental Engineering, McGraw Hill Book Company, Singapore.
3	Air Pollution by Rao M N, Tata McGraw Hill, New Delhi.
4	Arthur C. Stern, Air Pollution, Air Pollutants, their transformation and Transport, (Ed.), (Third Ed.) Volume I, Academic Press, 2006.
5	Principles of Air Quality Management by Griffin R D, CRC Press, Boca Raton, USA.

Reference Books:	
1	Barratt, R., Atmospheric Dispersion Modeling, Earthscan Publication Ltd, 2003
2	Seinfeld, J.H. (1986) Atmospheric Chemistry and Physics of Air Pollution, John Wiley and Sons Inc., USA
3	J. L. Schnoor, Environmental Modeling Fate and Transport of Pollutants in Water, Air and Soil, John Wiley & Sons Inc., New York, 1996.
4	Tokyo, 2004 4. John H. Seinfeld and Spyros N. Pandis Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, 2 nd Edition, , 2006,
5	Air Pollution Its Origin and Control by Wark K, Warner C F and Davis W., Harper and Row, New York.

SUBJECT CODE	(Program Elective-I)				CREDITS		
MCVENEPET 104C	Ground Water Contamination and Pollution				3		
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To understand the sources and types of groundwater contamination.
CO2	To study the physical, chemical, and biological processes governing contaminant transport.
CO3	To gain knowledge of various remediation techniques and strategies for contaminated groundwater.
CO4	To explore analytical and numerical modeling techniques for predicting contaminant transport.
CO5	To discuss case studies and current challenges in groundwater contamination management.

Course Outcomes: Students will be able to	
CO1	To develop flow and transport model for contaminant in subsurface water.
CO2	To differentiate various numerical techniques for solving flow and transport equations.
CO3	To develop reactive transport model for reactive species.
CO4	To apply the software packages to develop contaminant transport model for field condition.
CO5	Learn about Remediation Techniques

Course Contents

Module 1	Fundamentals of Groundwater Hydrology and Contamination Sources	Hrs. 8
Introduction to Groundwater Hydrology: Aquifers, porosity, permeability, hydraulic conductivity, Darcy's law, and flow systems. Sources of Groundwater Contamination: Point and non-point sources, natural and anthropogenic sources, including industrial discharge, agricultural runoff, mining, waste disposal sites, and leachate from landfills. Types of Contaminants: Inorganic and organic contaminants, heavy metals, nutrients, pathogens, and emerging contaminants like pharmaceuticals		
Module 2	**Physico-Chemical and Biological Processes in Contaminant Transport**	**Hrs. 8**
Physical Processes: Advection, dispersion, and diffusion in porous media; retardation and sorption; colloidal transport. Chemical Processes: Chemical reactions including precipitation, dissolution, sorption, ion exchange, complexation, and redox reactions affecting contaminant mobility. Biological Processes: Role of microbial activity in contaminant degradation, biotransformation, biodegradation, and bioaccumulation.		
Module 3	**Groundwater Quality Modelling**	**Hrs. 6**
Groundwater flow and mass transport of solutes – groundwater quality modelling using numerical methods - degradation of organic compounds in sub surface - prediction of contaminant transport and particle tracking -seawater intrusion – basic concepts and modelling. Coupling of Contaminant - Soil Interactions with Transport - Reaction and Transport of Trace Metals, Ligands and Non-polar Organic Solutes - Model Input Parameters - Initial and Boundary Conditions - Calibration - Sensitivity Analysis - Groundwater Transport Modelling Using VISUAL MODFLOW.		
Module 4	**Field Investigation, Sampling, and Monitoring Techniques**	**Hrs. 8**

Site Characterization: Hydrogeological mapping, geophysical methods, and borehole logging for subsurface assessment, Sampling Techniques: Methods for collecting groundwater and soil samples, sampling protocol, and analysis of contaminants, Monitoring Network Design: Designing effective groundwater monitoring networks, sampling frequency, and data interpretation, Data Interpretation and Management: Analyzing trends and data quality management using GIS and remote sensing for groundwater contamination studies.		
Module 5	**Remediation Techniques and Case Studies**	**Hrs. 8**
In-situ Remediation Techniques: Bioremediation, phytoremediation, monitored natural attenuation, chemical oxidation, and permeable reactive barriers, Ex-situ Remediation Techniques: Pump-and-treat, air stripping, activated carbon adsorption, and soil vapor extraction. Emerging Remediation Technologies: Electrokinetic remediation, nanotechnology-based methods, and advanced		

Text Books:	
1	Remson, I., Hornberger, G.M., and Molz. F.J., Numerical methods in sub-surface hydrology, Wiley Inter Science.
2	Rushton, K.R. and Redshaw, S.C., Numerical analysis by analog & digital methods, John Wiley.
3	Todd, D.K., Groundwater Hydrology, John Wiley, 1980.
4	Groundwater Modeling by Anderson.
5	Numerical ground water modeling by A K Rastogi, Penram International Publishing (India) Pvt Ltd. 2007

Reference Books:	
1	Sun, N. Z., Mathematical modelling of groundwater Pollution, Springer –Verlac Newyork Inc., and Geological publishing house, 1996.
2	Ralph A. Wurbs, (1995), "Water Management Models - A Guide to Software", Prentice Hall PTR, Facsimile edition, New Jersey,
3	Todd, D.K., (2011), Ground Water Hydrology, Third Edition, Wiley India Pvt Ltd
4	Philip B. Bedient, H. S. Rifai, and Charles J. Newell, "Groundwater Contamination: Transport and Remediation"
5	Charles R. Fitts, "Groundwater Science".

SUBJECT CODE	(Program Elective-I)						CREDITS
MCVENEPET 105A	Environmental Biotechnology						3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To study the principles and concepts of environmental biotechnology.
CO2	To learn the applications of various biotechnological tools for the treatment and betterment of environment
CO3	To enumerate the various biotechnological remedies for environmental pollution
CO4	To brief the environmental effects and ethics of microbial technology
CO5	To have sufficient knowledge on fundamentals of Environment and Microbiology.

Course Outcomes: Students will be able to	
CO1	to list out the different methods for bioremediation of environment
CO2	to design biological system for the removal of nutrients
CO3	to evaluate the benefit of microorganisms in degrading organic contaminants
CO4	to choose suitable microorganism for biodegradation of selected compounds.
CO5	to select suitable assessment methods for bioremediation

Course Contents

Module 1	Environmental Biotechnology and Bioremediation	Hrs. 8
Environmental Biotechnology -Principles and concepts - scope and importance, usefulness to mankind. Biotechnological remedies for environmental pollution - decontamination of groundwater – Bioremediation - Production of proteins – biofertilizers - Physical, chemical and microbiological factors of composting – health risk – pathogens – odor management		
Module 2	**Genetic Engineering**	**Hrs. 8**
Genetic engineering structure of DNA, RNA, Replication of DNA, genetic code, Transcription, Protein synthesis, Biotechnological remedies for environmental pollution, decontamination of groundwater – bioremediation. Microbial cell/enzyme technology – adapted microorganisms – biological removal of nutrients – algal biotechnology– extra cellular polymers - Biogas technology.		
Module 3	**DNA Technology**	**Hrs. 6**
Concept of DNA technology – expression vectors – cloning of DNA – mutation – construction of microbial strains - radioactive probes - protoplast fusion technology – applications.		
Module 4	**Environmental Ethics and Impact of Microbial Technology**	**Hrs. 6**
Environmental effects and ethics of microbial technology – genetically engineered organisms- Microbial containment-Risk assessment.		
Module 5	**Microbiology of Wastewater Treatment**	**Hrs. 8**
Microbiology of waste water treatment. a) Aerobic processes: Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. b) Anaerobic processes : Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactor. biofertilizers , Physical, chemical and microbiological factors of composting		

Text Books:	
1	Microbial Biotechnology: A. N. Glazer and H. Nikaids .
2	Biotechnology: A Text Book of Industrial Microbilogy, T. D. Brock,
3	Biological degradation and Bioremediation of toxic chemicals: Chaudhury, G.R., Dioscorides Press,Oregon, 1994.
4	R.L. Smith, (2000), "Ecology and field biology", 6th Edition, Benjamin Cummings.
5	Manahan S.E., (2009), "Principals of Environmental chemistry", 9th Edition, CRC press.

Reference Books:	
1	Rittmann, B.E., and McCarty, P.L., Environmental Biotechnology: Principles and Applications, McGraw Hill, 2001.
2	Trends in Biotechnology by Hamer, G., Elsevier
3	Bhattacharya, B. C. and Banerjee R., Environmental Biotechnology, Oxford University Press, India, 2007.
4	Martin.A.M, Biological degradation of wastes, Elsevier Applied Science, London, 1991.
5	1. Chaudhury, G.R., Biological degradation and Bioremediation of toxic chemicals, Dioscorides Press, Oregon, 1994.

SUBJECT CODE	(Program Elective-I)						CREDITS
MCVENEPET 105B	Climate Change						3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To have adequate knowledge on effects of greenhouse gases.
CO2	To have adequate knowledge on impacts of climate change.
CO3	To acquire knowledge on modeling on climate change.
CO4	To understand rules and protocols on global trading related to global warming.
CO5	To understand the basic of clean environmental mechanism and alternatives techniques.

Course Outcomes: Students will be able to	
CO1	Understand the basics of climate change and variability
CO2	Students will be able to gather knowledge on effects of greenhouse gases.
CO3	Students will be able to knowledge on impacts of climate change.
CO4	Students will be able to understand rules and protocols on global trading related to global warming
CO5	Students will be able to know about the basic of clean environmental mechanism and alternatives

Course Contents

Module 1	Introduction	Hrs. 8
Atmosphere and its constituents, Synoptic observations- surface and upper air, Tropical meteorology: Easterly Waves, ET-ITCZ, Inversion. Monsoon – Onset, Activity, Withdrawal, Breaks, Depressions, Easterly Jet Stream. Post Monsoon - Cyclones in the Indian Seas, N. E. Monsoon		
Module 2	**Global Climatology**	**Hrs. 6**
Global distribution of pressure and temperature at m.s.l. in winter and summer, distribution of annual rainfall and its variability, distribution of moisture and clouds. Vertical distribution of temperature. General circulation of atmosphere, Development of monsoons, Major categories of world climates		
Module 3	**Indian Climatology**	**Hrs. 8**
Different seasons, Distribution of Means Sea level pressure/temperature in different seasons, Wind circulation and temperature distribution over India in lower, middle and upper troposphere in different seasons, Indian rainfall in different seasons, Indian summer monsoon, onset, withdrawal, rainfall distribution, inter annual variability of monsoon. Main synoptic pressure systems causing weather over India in different seasons		
Module 4	**Climate Change & Variability**	**Hrs. 8**
Overview of the climatic history of the earth. Long term changes (Climate of Past century, past millennium, past glacial period), Methods of determining past climate. Possible causes of climate change- External (Milankovitch variation and Solar activity) and Internal (natural and anthropogenic), General idea of internal dynamical processes of the atmosphere, oceanic processes, Cryospheric processes, land processes.		
Module 5	**Climate Change and Global Warming**	**Hrs. 6**
Man's impact on climate, Greenhouse gases and global warming, basic radiation processes, Climate feedback mechanism, Climate predictability, future climate, potential consequences, International efforts to minimize climate change and their effects. Indian scenario		

Text Books:	
1	Atmosphere, Weather and Climate R.J. Barry and R.G. Chorley (Methuen Publication)
2	An Introduction to Meteorology by S. Pettersen
3	Elements of meteorology by Miller, Thompson and Paterson
4	Linden E., (2007), "The Winds of Change: Climate, Weather and the Destruction of Civilizations", Simon and Schuster Publications.
5	Srivatsava A.K., (2009), "Global Warming", First Edition, APH Publications.

Reference Books:	
1	Yadav, Chander and Bhan, (2005), "Global Warming India's Response and Strategy", RPH Publications.
2	Mintzer I.M., (Ed.), (1992), "Confronting Climate Change, Risks, Implications and Responses",

	Cambridge University Press.
3	Wyman R.L., (Ed.), (1991), "Global Climate Change and Life on Earth", First Edition, Springer, Chapman and Hall Publications.

SUBJECT CODE	(Program Elective-II)	CREDITS
MCVENEPET 105C	Marin Pollution	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To impart the knowledge about marine and coastal environment.
CO2	To impart the knowledge about oceanography
CO3	To understand various sources of marine pollution.
CO4	To study various effects of marine pollution on aquatic life.
CO5	To have adequate knowledge about monitoring of marine pollutants.

Course Outcomes: Students will be able to	
CO1	Know about the different components of marine environment.
CO2	Understand physical concepts lying behind the tides, waves, and oceanic currents
CO3	Understand natural processes of various activities happening over the marine environment
CO4	Identify and measure the marine pollution levels and effects
CO5	Develop marine pollution control measures

Course Contents

Module 1	**MARINE AND COASTAL ENVIRONMENT**	**Hrs. 6**
Seas and oceans, continental area, coastal zone, properties of sea water, principles of marine geology, coastal features – beaches, estuaries, lagoons, salt marshes, mangroves and sand dunes– the oceans and climate, coastal zone regulation in India- national and international treaties.		
Module 2	**OCEAN HYDRODYNAMICS**	**Hrs. 8**
Wave theory, waves in shallow waters – refraction, diffraction and shoaling, approximations for deep and shallow water conditions – tidal classification - general circulation of ocean waters - ocean currents - coastal sediment transport - onshore offshore sediment transport - beach formation and coastal processes - Tsunamis, storm surge, El Nino effect.		
Module 3	**MARINE POLLUTION**	**Hrs. 6**
Sources of marine pollution – point and non-point sources, pollution caused by effluent discharge, oil exploration, dredging, offshore mining, port and harbour activities, power plants, agriculture runoff, plastic waste, marine debris, oil spills, industrial pollution, radioactive pollution, red tides and marine litter - effects of marine pollution on marine water quality and coastal ecosystems.		

Module 4	MARINE POLLUTION MONITORING	Hrs. 8
Basic measurements - sounding boat, echo sounders – current meters - tide gauge - use of GPS – measurement of coastal water characteristics – sea bed sampling – modelling of pollutant transport and dispersion - oil spill models - ocean monitoring satellites – applications of remote sensing and GIS in monitoring marine pollution – online marine pollution monitoring,		
Module 5	**MARINE POLLUTION CONTROL MEASURES**	**Hrs. 8**
Marine discharges and effluent standards, pollution control strategies – marine outfall design, selection of optimal marine outfall locations - Total Maximum Daily Load (TMDL) applications – protocols in marine pollution control– Integrated Coastal Zone Management (ICZM) and sustainable development. Different case studies.		

Text Books:	
1	Chemical Oceanography (Vol: 3) 1975- Riley J.P and Skirrow, G.
2	Marine Pollution. 1986 Clark, R.B.
3	Marine and offshore corrosion. 1985. Chandler, K. A.
4	Laws, E.A., "Aquatic pollution", an introductory text. John Wiley and Sons, Inc., New York, 2000
5	Practical Handbook of Estuarine and Marine Pollution, Michael J. Kennish, Volume 10 of CRC Marine Science, CRC Press, 1996.

Reference Books:	
1	Quantitative aquatic biological indicators. 1980 Phillips J.D.H.
2	Marine Pollution: New Research - Tobias N. Hofer, Nova Publishers, 2018,
3	Thermal and radioactive pollution. 1994. Sharma, B.K and Kaur, H.
4	The health of the oceans. 1976 Goldberg, E.D
5	Water Pollution. 1994. Sharma, B. K and Kaur, H.

SUBJECT CODE	PG Lab-I (Environmental Chemistry and Microbiology Lab)			CREDITS			
MCVENEELL 106				2			
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	4	4	25	-	25	50

Course Objectives	
CO1	Understand various physico-chemical and bacteriological analytical techniques
CO2	To familiarize the methods to estimate the organic strength of wastewater
CO3	To analyse the physical, chemical and bacteriological characteristics of water and wastewater
CO4	To determine dose of disinfectant and coagulant

CO5	Use advanced techniques to measure metals, nutrients, and ions in water and wastewater.

Course Outcomes: Students will be able to	
CO1	Relate the theoretical knowledge of sampling and analysis into lab practice
CO2	Decide appropriate water and wastewater quality parameters for analysis of water and wastewater
CO3	Apply different analysis techniques for the measurement of physical, chemical and bacteriological
CO4	Determine dose of coagulant, chlorine
CO5	Understand and practice on basic methods of environmental analysis.

Course Contents

Physicochemical and bacteriological analysis of raw water and treated water to determined its quality status, suitability for various uses of water and suggest dose of alum and chlorine for water treatment. Physicochemical and bacteriological analysis of raw wastewater, treated wastewater and polluted water to determined strength of wastewater, degree of treatment required, suitability of treated effluent for disposal in surface water or land disposal, suitability for reuse of treated wastewater for various applications

1. To determine pH, acidity, alkalinity and hardness
2. To determine colour, turbidity and conductivity
3. To determine total solids, total dissolved solids, total suspended solids, volatile solids, fixed solids and settleable solids
4. To determine oil and grease
5. To determine chloride, sulfate, fluoride
6. To determine DO, BOD, COD and TOC
7. To determine the optimum coagulant dose
8. To determine residual chlorine and chlorine dose
9. To determine MPN and total plate count
10. To determine nitrogen and phosphorous
11. To determine metals using AAS
12. To determine major ions in water using ion chromatograph

Text Books:	
1	Standard Methods for the Examination of Water and Wastewater, 22nd Edition, 2012.
2	Sawyer, C.N., McCarty, P.L., Parkin, G.F., Chemistry for Environmental Engineering, Tata McGraw-Hill, 2000.
3	Pelczar, M. J. (Jr), Chan, E C S and Krief, N. R., Microbiology, 5th Ed., McGraw-Hill, 1996
4	Metcalf and Eddy Inc, Wastewater Engineering: Treatment and Reuse, TMH publication, 4th Edition, 2003.
5	S. K. Garg , Water Supply and Sanitary Engineering.

SUBJECT CODE	Communication Skill						CREDITS
MCVENEHMP 107							2
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
2	0	0	2	25	--	25	50

Course Outcomes: Students will be able to	
CO1	Understand the preliminary information of various masonry structures including materials of construction, basic properties and parameters.
CO2	Understand the compressive strength of masonry structures under various conditions and situation.
CO3	Determine strength of masonry structure in flexure, shear, bond and factors affecting.
CO4	Design the load bearing masonry buildings.
CO5	Design the earthquake resistant masonry structures.

Course Contents

Module 1	**Language for Technical Purpose and Presentation Tools**	**Hrs. 6**
Technical vocabulary, Sentence structures, Microsoft office, Graphical presentations, Preparation, Understanding audience, Use of presentation tools, Presentation, nonverbal techniques, handling questions, Demo presentations		
Module 2	**Formal Written Communication**	**Hrs. 3**
Drafting Letters, e-Mails, Memos, Notices, Circulars, Schedules.		
Module 3	**Project Research Proposals and Reports**	**Hrs. 6**
Research Proposal: Essentials, Abstract, Aims, Background & significance, Design & methods, Writing a sample proposal.Project Report: Types of reports, Planning a report, Collection & organization of information, Structure & style, Proofreading etc. Writing a sample report.		
Module 4	**Project Research Proposals and Reports**	**Hrs. 6**
Research Proposal: Essentials, Abstract, Aims, Background & significance, Design & methods, Writing a sample proposal.Project Report: Types of reports, Planning a report, Collection & organization of information, Structure & style, Proofreading etc. Writing a sample report.		
Module 5	**Business Meetings**	**Hrs. 6**
Understanding role of meetings, planning meetings, developing meeting agendas, scheduling meetings, conducting meetings effectively, Taking notes and publishing minutes and concluding meetings, action plans, Demo meetings.		

Text Books:	
1	S. Hariharan, et.al. Soft Skills; MJP Publishers, 2010.
2	John Seely, Oxford Guide to Effective Writing and Speaking; Oxford University Press, 2009.
3	Thomas N. Huckin and Leslie A. Olsen, Technical Writing and Professional Communication
4	for Nonnative Speakers of English; Tata McGraw Hills, International Edition, 1991.
5	Jeff Butterfield,Soft Skills for Everyone,cengage Learning India Private Limited,2010

Reference Books:	
1	L. Ann Masters & Harold R. Wallace, Personal Development for Life & Work,10e,Cengage
2	Learning India Private Limited,2011.

SUBJECT CODE	YOGA for Stress Management			CREDITS			
MCVENEAUP 108				AUDIT			
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	AU	AU	AU	AU

Course Objectives	
CO1	Understand the physiological and psychological aspects of stress and its impact on overall well-being.
CO2	Learn and practice specific yoga postures, breathing exercises, and relaxation techniques to alleviate stress.
CO3	Explore the connection between mindfulness, meditation, and stress reduction, fostering mental clarity.
CO4	Discover holistic practices that promote better sleep, nutrition, and overall lifestyle habits for stress management.
CO5	Develop practical skills to manage stress in daily life, enhancing resilience and promoting emotional balance.

Course Outcomes: Students will be able to	
CO1	Recognize the signs and sources of stress, understanding its effects on mental and physical well-being.
CO2	Master a variety of yoga techniques, including postures, breathing, and meditation, to effectively manage stress.
CO3	Acquire relaxation strategies that promote calmness, reduce anxiety, and enhance overall mental clarity.
CO4	Incorporate healthy habits inspired by yoga principles to foster better sleep, nutrition, and self-care routines.
CO5	Develop practical skills to navigate and cope with stress, enhancing emotional balance and promoting a more harmonious life.

Course Contents

Module 1	Introduction to Yoga for Stress Management	Hrs. 6
Stress according to Western perspective Stress Eastern Perspective Developmental process: Western and Eastern Perspective Stress Hazards and Yoga		
Module 2	**Meeting the challenges of Stress**	**Hrs. 6**
Introduction to Stress Physiology Stress, Appetite and Dietary management- Modern and Yogic perspective Sleep and Stress: understanding the relationship for effective management of stress		
Module 3	**Stress Assessment methods**	**Hrs. 6**
A valuable tool toward stress management Role of Yoga in prevention and management of stress related disorders – a summary of research evidence Concept of stress and its management - perspectives from Patanjali Yoga Sutra - Part 1/Part 2/ Part 3		
Module 4	**Stress Management**	**Hrs.6**
Concept of stress and its management - perspectives from Bhagavad Gita - Part 1 / Part 2 / Part 3		
Module 5	**Yoga practices for Stress Management**	**Hrs. 8**
Bio-Psycho-Socio-Spiritual model of stress management Yoga practices for Stress Management Breathing practices , Asana practices- Tadasana, Ardhakati Chakrasana, Ardha Chakrasana, Trikonasana, Vrikshasana, Vakarasana, Janu Sirshasana, Ushtrasana, Sashankasana, Ardhamatseyndrasana, Paschimottanasana, Poorvottanasana, Gomukhasana, Makarasana, Bhujangasana, Salambha Shalabahasana, Dhanurasana, Setubandhasana, Sarvangasana, Mastyasana, Deep Relaxation Technique (DRT),etc.		

Text Books:	
1	H R Nagendra and R Nagarathna. Yoga for Promotion of Positive Health. Swami Vivekananda Yoga Prakashana. 2011.
2	Contrada, R., & Baum, A. (Eds.). The handbook of stress science: Biology, psychology, and health. Springer Publishing Company. 2010
3	Al'Absi, M. (Ed.). Stress and addiction: Biological and psychological mechanisms. Elsevier. 2011.
4	Van den Bergh, O. Principles, and practice of stress management. Guilford Publications. 2021.
5	Swami Muktibodhananda, Hatha Yoga Pradipika, Bihar Scool of Yoga, 1998

Reference Books:	
1	Swami Satyananda Saraswati, Four Chapters on Freedom, Bihar Scool of Yoga, 1975
2	Swami Tapasyananda, Srimad Bhagavat Gita, Sri Ramakrishna Math, 2012
3	**NPTEL Course-**Yoga for Stress Management-Dr H R Nagendra, Dr Mithila M V, Dr Rajesh Nair,Swami Vivekananda Yoga Anusandhana Samsthana https://onlinecourses.swayam2. ac.in/aic23_ge10/preview#:~:te xt=In%20this%20course%20we %20intend,meeting%20the%20 challenges%20of%20stress

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for M. Tech. in Civil Engineering with Specialization in Environmental Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	ISE	MSE	ESE	Total	
Semester- II										
1	MCVENEPCT 201	Industrial waste water and Treatment Management	3	--	--	20	20	60	100	3
2	MCVENEPCT 202	Solid and Hazardous waste Management	3	--	--	20	20	60	100	3
3	MCVENEPET 203	Program Elective-III	3	--	--	20	20	60	100	3
4	MCVENEPET 204	Program Elective-IV	3	--	--	20	20	60	100	3
5	MCVENEOET 205	Open Elective-V	3	--	--	20	20	60	100	3
6	MCVENEELP 206	PG Lab-II	--	--	4	25	--	25	50	2
7	MCVENEELP 207	Mini -Project	--	--	8	25	--	25	50	4
8	MCVENEHMP 208	Indian Knowledge System	3	--	--	20	20	60	100	3
		Total	**18**	**0**	**12**	**170**	**120**	**410**	**700**	**24**

Type of course:

Program Core: **PC**	Program Elective: **PE**
Open Elective: **OE** (Other than particular program)	Ability Enhancement Course: **AE**
Modern Indian Language: **MIL**	Humanities, Management, language and Commerce: **HM**
Experiential Learning Courses: **EL**	Multidisciplinary Minor Courses: **MD**
ABBRIVATIONS: **ISE**-INSEMESTER EVALUATION, **MSE**-MID SEMESTER EVLUATION, **ESE** -END SEMESTER EVALUATION	

SUBJECT CODE	Industrial waste water and Treatment Management			CREDITS			
MCVENEPCT 201				3			
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To understand the principle of various processes applicable to industrial wastewater treatment
CO2	To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.
CO3	To identify the best applicable technologies for wastewater treatment from the perspective of yield production.
CO4	To give an idea about waste treatment flow sheet for different industries
CO5	To learn various pollution prevention options.

Course Outcomes: Students will be able to	
CO1	Identify industrial wastewater pollution and implement pollution prevention.
CO2	Understand sources and types of industrial wastewater and their environmental impacts.
CO3	Apply knowledge and skills to design industrial wastewater treatment schemes.
CO4	Conduct research to develop effective management systems for industrial wastewater.
CO5	Choose the regulatory laws pertaining to environmental protection and learn waste minimization.

Course Contents

Module 1	**Introduction**	**Hrs. 8**
Industrial scenario in India– industrial activity and environment - uses of water by industry – sources and types of industrial wastewater – nature and origin of pollutants - industrial wastewater and environmental impacts – regulatory requirements for treatment of industrial wastewater – industrial waste survey – industrial wastewater monitoring and sampling - generation rates, characterization and variables – toxicity of industrial effluents and bioassay tests – major issues on water quality management.		
Module 2	**Industrial Pollution Prevention & Waste Minimisation**	**Hrs. 8**
Prevention vis a vis control of industrial pollution – benefits and barriers – waste management Hierarchy - source reduction techniques – periodic waste minimisation assessments – evaluation of pollution prevention options – cost benefit analysis – pay-back period – implementing & promoting pollution prevention programs in industries.		
Module 3	**Industrial Wastewater Treatment**	**Hrs. 6**
Flow and load equalisation – solids separation – removal of fats, oil & grease- neutralization removal of inorganic constituents – precipitation, heavy METAL removal, nitrogen & phosphorous removal, Ion exchange, adsorption, membrane filtration, electro dialysis & evaporation – removal of organic constituents – biological treatment processes,		

chemical oxidation processes, advanced oxidation processes – treatability studies.		
Module 4	**Wastewater Reuse And Residual Management**	**Hrs. 8**
Individual and common effluent treatment plants – Joint treatment of industrial and domestic wastewater - zero effluent discharge systems - quality requirements for wastewater reuse industrial reuse , present status and issues - disposal on water and land – residuals of industrial wastewater treatment – quantification and characteristics of sludge – thickening, digestion, conditioning, dewatering and disposal of sludge – management of RO rejects		
Module 5	**Case Studies**	**Hrs. 6**
Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for textiles – tanneries – pulp and paper – metal finishing – Oil refining–pharmaceuticals–sugar and distilleries		

Text Books:	
1	Jr. W. Eckenfelder (2007), "Industrial Waste Water Pollution Control", McGrawHill Exclusive (CBS).
2	Pichtel J., (2014), "Waste Management Practices: Municipal, Hazardous and Industrial", 2nd Edition, CRC Press.
3	Nemerow, N. L., (1978), "Industrial water pollution: Origin, characteristics and treatment", Addison-Wesley Educational Publishers Inc.
4	Frank Woodard, Industrial waste treatment Handbook, Butterworth Heinemann, 2nd Edition, New Delhi, 2006.
5	Arceivala, S.J., Wastewater Treatment for Pollution Control, 3rd Edition, McGraw-Hill, 2006

Reference Books:	
1	Rao, C.S., (2018), "Environmental Pollution Control Engineering", 3rd Edition, New Age International Publishers
2	M. N. Rao & Datta, Waste water treatment.
3	Hardam S. Azad, (ED), Industrial Wastewater Management Hand Book 1988.
4	Callegly, Forster and Stafferd, Treatment of Industrial Effluent, Hodder and Stonghton. 1988.
5	Indian standards: IS: 2490 (1963), IS: 3306 (1065).

SUBJECT CODE	Solid and Hazardous waste Management						CREDITS
MCVENEPCT 202							3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To provide a knowledge about generation, characteristics and composition of urban solid waste, hazardous waste and biomedical waste
CO2	To understand the nature of the various functional elements in regional waste management systems and the relationships among them
CO3	Have overview of MSW rules and Government initiatives.
CO4	To enumerate and describe different disposal and treatment methods for municipal solid waste, hazardous waste and biomedical waste
CO5	To discuss the various elements of integrated waste management system

Course Outcomes: Students will be able to	
CO1	Recognize fundamental elements of MSW and summarize practices for effective MSW management
CO2	Apply the fundamental elements of MSWM to analyze collection, transportation, and processing.
CO3	Evaluate processing and disposal method to make suitable plans for rehabilitation of existing SWM
CO4	Design of systems and processes to meet specified needs of waste minimization and recycling.
CO5	Apply the knowledge of science to characterize different types of solid and hazardous wastes.

Course Contents

Module 1	Introduction	Hrs. 6
Solid waste management: Objective, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, types, Composition, Quantities, Physical, chemical and Biological properties.		
Module 2	**Waste Generation and Recovery**	**Hrs. 8**
Solid Waste Generation Rate: Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems. Transfer station: Meaning, Necessity, Location and Economic analysis, Transportation of solid waste: Means and Methods, Routing of vehicles. **Sorting and Material Recovery**: Objectives, Stages of sorting, sorting operations, Guidelines for sorting for materials recovery, typical material recovery facility for a commingled solid waste.		
Module 3	**Disposal Methods**	**Hrs. 6**
Composting of solid waste: Principles, Methods, Factors affecting, Properties of compost, Vermicomposting. Energy recovery from solid waste: Parameters affecting, Biomethanation, Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options. Landfills: Definition, Essential components, Site selection, Land filling methods, Leachate and landfill gas management.		
Module 4	**Indian Scenario of Solid waste management**	**Hrs. 8**
Present scenario and measures to improve system for different functional elements of solid waste management system. Elements of financial management plan for solid waste system. Economy and financial aspects of solid waste management. Disposal options for Biomedical waste, Other Waste Types: Nuclear and Radio Active Wastes.		

Module 5	Hazardous waste management	Hrs. 8
Problems and issues of hazardous waste management, Need for hazardous waste management—Legislations on management and handling of HW, Toxicology and risk assessment, Hazardous Characteristics – TCLP tests – waste sampling- reduction of wastes at source – Recycling and reuse, labeling and handling of hazardous wastes, incineration – solidification and stabilization of hazardous wastes, Case studies.		

Text Books:	
1	Hilary Theisen and Samuel A, Vigil, George Tchobanoglous, Integrated Solid Waste Management, McGraw- Hill, New York, 1993
2	CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000
3	Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001.
4	Bio-medical Waste Management Rules 2016, CPCB.
5	CPHEEO, Manual on Municipal Solid Waste Management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2016.

Reference Books:	
1	Solid waste management –A. D. Bhide.
2	Gary C. Young, Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, Wiley, 2010
3	Rao M.N, Razia Sultana, Sri Harsha Kota, solid and hazardous waste management – Science and Engineering , Butterworth-Heinemann, 2016
4	George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015
5	WHO (2017) Manual on Solid Waste Management

SUBJECT CODE	(Program Elective-III)	CREDITS
MCVENEPET 203A	Agricultural Pollution Control	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To study the sources of soil contamination and its impact on geoenvironment.
CO2	To realize the significance of sampling techniques in geoenvironmental characterization.
CO3	To understand the state of the art methodologies for soil decontamination and containment.
CO4	To understand suitable soil pollution control method
CO5	To examine the methods and technologies involved in wastewater reuse in agriculture and assess their environmental benefits.

Course Outcomes: Students will be able to	
CO1	To identify the origin, nature, and extent of contamination in field.
CO2	To adopt suitable sampling techniques for geoenvironmental characterization.
CO3	To suggest the remediation techniques for decontamination
CO4	To apply corrective measures for soil improvement and sustainable irrigation practices.
CO5	To applying innovative pollution control technologies to minimize agricultural air pollution

Course Contents

Module 1	Environmental issues in agriculture	Hrs. 6
Types of farming systems, agro meteorology, water and nutrients requirement. Agricultural Activities and Environmental Impacts: Major Agricultural Practices, Irrigation Drainage Systems, Impact of Agricultural Activities on Environment, Crops, Diseases, Nutrients and its Control. Irrigation practices its negative impacts on Soil (land degradation)		
Module 2	**Fertilizers**	**Hrs. 8**
types of fertilizers, pesticides and other agrochemicals, soil and water conservation practices. Environmental Impacts of Fertilizers: Different types of Fertilizers Inorganic, Organic and Synthetic fertilizers. Effects on Environment due to use of fertilizers, Environmental Impacts of Pesticides Properties of Pesticides: Adsorption solubility in Water and Volatilization Soil Conservation; Vegetative practices And Mechanical Practices. Ground water Characterization and suitable remedial measures for avoiding its Contamination Pollution control monitoring strategies and plans.		
Module 3	**Water logging and salinity**	**Hrs. 6**
: Water logging: Its effects, Water logging control, Environmental effects due to water logging Remedial Measures Preventive and Curative Water logging measures. Soil Salinity: Classes of Saline and Alkali Soil, Improvement of Saline and Alkaline Soil Leaching and Reclaiming Saline soil.		
Module 4	**Wastewater reuse in agriculture**	**Hrs. 8**
Management and control of agricultural waste; recycling and reuse. Wastewater Reuse in Agriculture: Types of reuse, Reuse of urban waste water in Agriculture and horticulture from skewered area. Reuse considering techno economic aspect Preliminary Primary and secondary treatment and tertiary treatment to removed residual pollutants. Mechanized and Physicochemical Processes		
Module 5	**Agricultural air pollution control**	**Hrs. 8**
Odorous emissions related to storage and handling of animal wastes .Biotechnology in reduction of CO2 emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications. Novel methods of pollution control: Vermitechnology, Methane production, Root zone treatment, Membrane technology, Biodegradable plastics.		

Text Books:	
1	Microbial Biotechnology : A. N. Glazer and H. Nikaids
2	Molecular Biotechnology: Gleek and Pasternack.
3	T.V. Ramachandra, Soil & Ground Water Pollution from Agricultural activities, TERI.
4	Industrial Microbiology : Presscott and Dunn.
5	Roy, K.C., Sen R.K. and Tisdell, C.A., Environment and Sustainable Agricultural Development (Volumes I and II), New Age International Pvt. Ltd., New Delhi, 1996.

Reference Books:	
1	Biotechnology : A Text Book of Industrial Microbilogy, T. D. Brock,
2	Biotechnology : B. D. Singh , Kalyani Publishers
3	P. K. Agarwal, Agricultural Pollution: Causes, Effects and Control
4	R. S. Yadav, Waterlogging and Salinity: Causes and Control
5	J. K. Gupta, Environmental Science and Engineering

SUBJECT CODE	(Program Elective-III)	CREDITS
MCVENEPET 203B	Environmental Auditing	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	Appreciate the purpose and role of Environmental Audit in the decision-making process.
CO2	Understand strengths & limitations of environmental management.
CO3	To identify the prediction tools for the assessment of different environmental impacts
CO4	To provide knowledge of Environmental Ethics and Environmental Legislation
CO5	Learn the process and activities involved in planning and preparing for an environmental audit.

Course Outcomes: Students will be able to	
CO1	Explain ecological imbalance due to various types of pollution and perceive environmental ethics
CO2	Choose appropriate methodology for auditing and assess the impacts
CO3	Understand the different steps within environmental auditing.
CO4	Conduct on-site audits, evaluating audit results, and delivering comprehensive audit reports.
CO5	Ability to define and apply environmental audit processes in various industries.

Course Contents

Module 1	Environmental Audit	Hrs. 8
Definition of Environment Audit and its importance for industries. Environmental management system audits Types of audits, General audit methodology and basic structure of audit. Elements of an audit process and its importance. Concept of ISO14000		
Module 2	**Environmental protection Act**	**Hrs. 8**
Requirements of Rule 14 for Environmental Audit under Environmental protection Act 1986, Definitions of a. Signatory, b. Consumption Audit, c. Pollution audit, d. Hazardous audit, d. Solid waste audit, e. Disposal audit, f. Cost audit, g. Investment audit, h. Voluntary.		
Module 3	**Pre-audit Activities**	**Hrs. 6**
Pre-audit Activities for the Manager Selecting the audit team, planning the audit Pre-audit Activities for the Auditor Drawing up the audit specification, obtaining information before the audit, Checklists, Case studies of red category industries.		
Module 4	**Audit Report**	**Hrs. 8**
Conducting the Audit The opening meeting, Evaluation of the EMS, Interviewing, Site tour and observations Evaluating the Audit Results Evaluation of the audit results, the closing meeting, Recommendations, the audit report		
Module 5	**Environmental Reporting**	**Hrs. 6**
Environmental Reporting Purpose of producing an environmental report, writing the report, Environmental Statement, Independent validation, Brief introduction about Environment legislation		

Text Books:	
1	Larry W. Canter," Environment Impact Assessment ", McGraw-Hill Book Company, New York.
2	G.J. Rau and C.D. Weeten, "Environmental Impact Analysis Hand book, McGraw Hill, 1980.
3	Vijay Kulkarni and T V Ramchandra. “Environmental management” Capital Publishing Co.
4	Mhaskar A.K., “Environmental Audit" Enviro Media Publications.
5	Bishop P.L.: Pollution Prevention: Fundamentals and Practice, McGraw Hill International, 2004.

Reference Books:	
1	S.K. Dhameja, "Environmental Engineering and Management" S.K. Kalaria and Sons Publishers.
2	Lohani B.N and North A.M., (1984)., "Environmental Quality Management", South Asian Publishers, New Delhi.
3	Chanlett E.T., (1979), “Environmental Protection”, McGraw Hill Publication, New York.
4	Goetsch D.L.and Stanley D.: ISO 14000 Environmental Management, Prentice Hall, Upper Saddle River, NJ, 2001.

SUBJECT CODE	(Program Elective-III)	CREDITS
MCVENEPET 203C	Disaster Management and Risk Analysis	3

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO2	Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives
CO3	Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO4	Develop the strengths and weaknesses of disaster management approaches.
CO5	To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention, risk reduction.

Course Outcomes: Students will be able to	
CO1	Ability to summarize basics of disaster
CO2	Ability to illustrate disaster risk reduction and humanitarian response policy
CO3	Learn about disasters prone areas in India.
CO4	Ability to develop the strengths and weaknesses of disaster management approaches.
CO5	Ability to explain a critical understanding of key concepts in disaster risk reduction

Course Contents

Module 1	**Introduction**	**Hrs. 6**
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.		
Module 2	**Repercussions Of Disasters And Hazards**	**Hrs. 8**
Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.		
Module 3	**Disaster Prone Areas In India**	**Hrs. 6**
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics		
Module 4	**Disaster Preparedness And Management**	**Hrs. 8**
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.		

Module 5	Risk Assessment	Hrs. 8
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival		

Text Books:	
1	Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2	NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3	Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.
4	Kates, B.I & White, G.F The Environment as Hazards, oxford, New York, 1978.
5	R. B. Singh (Ed) Disaster Management, Rawat Publication, New Delhi, 2000. 5. H. K. Gupta (Ed) Disaster Management, Universiters Press, India, 2003.

Reference Books:	
1	R. B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 1994.
2	University of Tokyo, 1994. 7. Dr. Satender, Disaster Management in Hills, Concept Publishing Co., New Delhi, 2003.
3	R. K. Bhandani an overview on Natural & Man made Disaster & their Reduction, CSIR, New Delhi.
4	M. C. Gupta Manuals on Natural Disaster management in India, National Centre for Disaster Management, IIPA, New Delhi, 2001.
5	A. S. Arya Action Plan For Earthquake, Disaster, Mitigation in V.K. Sharma (Ed) Disaster Management IIPA Publication New Delhi, 1994.

SUBJECT CODE	(Program Elective-IV)	CREDITS
MCVENEPET 204A	Environmental Sanitation	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To understand the principles and practices of environmental sanitation and their role in public health.
CO2	To evaluate sanitation systems, including water, wastewater, and solid waste management in urban and rural settings.
CO3	To examine the role of environmental sanitation in controlling pollution and mitigating climate change.
CO4	To develop sustainable sanitation solutions for diverse environmental and socio-economic contexts.
CO5	To encourage research and development in innovative sanitation technologies and strategies for developing regions.

Course Outcomes: Students will be able to	
CO1	Identify and explain the fundamental concepts of environmental sanitation and their significance in
CO2	Analyze and assess different sanitation systems and their environmental impacts.
CO3	Design sustainable sanitation systems for communities, industries and municipalities.
CO4	Apply advanced methodologies for pollution control, waste treatment, and resource recovery.
CO5	Formulate innovative solutions for sanitation challenges in various socio-economic and environmental

Course Contents

Module 1	Introduction to Environmental Sanitation	Hrs. 8
Overview of environmental sanitation and public health, historical development of sanitation practices and policies, key principles of hygiene and sanitation, types of sanitation systems: on-site, off-site, community-based, policy frameworks and regulatory guidelines for sanitation (national and international)		
Module 2	**Water Supply and Quality for Sanitation**	**Hrs. 6**
Water quality requirements for drinking and sanitation, sources of contamination and health implications, drinking water standards and guidelines (WHO, BIS, etc.), sustainable water supply systems in urban and rural settings, Case studies of water-borne diseases and prevention		
Module 3	**Wastewater Management and Treatment**	**Hrs. 6**
Types and characteristics of wastewater (domestic, industrial, stormwater), advanced wastewater treatment technologies, on-site wastewater treatment (septic tanks, bio-digesters), off-site treatment: Municipal sewage treatment plants, resource recovery and reuse from wastewater (e.g., nutrients, water)		
Module 4	**Rural Sanitation**	**Hrs. 8**
Rural areas, Population habits and environmental conditions, problems of water supply and sanitation aspects, low cost excreta disposal systems. Rural sanitation improvement schemes. Case studies on sanitation. Emergency Sanitation practices during Natural calamity.		
Module 5	**Emerging Trends in Environmental Sanitation**	**Hrs. 8**
Innovations in sanitation technologies (e.g., eco-sanitation, composting toilets), decentralized sanitation systems for rural and urban slums, climate-resilient sanitation solutions, case studies on sustainable sanitation projects worldwide, role of community participation and behavior change in sanitation		

Text Books:	
1	Victor Ehalers & Earnest W Steel, Municipal and Rural sanitation.
2	Bhatia H. S., Environmental Pollution and Control, Galgotia Publication Pvt. Ltd., New Delhi.
3	Claude E. Boyd , "Water Quality: An Introduction", Publisher: Springer
4	A. K. Dikshit and M. Rajagopalan, "Environmental Sanitation and Waste Management", Publisher: Springer
5	Environmental Sanitation and Ecological Sanitation, CRC Press

Reference Books:	
1	Petra Bongartz, Naomi Vernon, John Fox, “Sustainable Sanitation for All: Experiences, Challenges, and Innovations”, Practical Action Publishing
2	Manual for “Sewerage and Sewage Treatment Systems” CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
3	Septage management in urban India, National Urban Sanitation policy, Ministry of Urban Development Government of India, 2013.
4	Arceivala S.J., and Asolekar S.R "Wastewater Treatment for Pollution Control and reuse "McGraw Hill , third Edition, New Delhi, 2007.
5	Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw-Hill Publication, New Delhi, 2003

SUBJECT CODE	(Program Elective-IV)						CREDITS
MCVENEPET 204B	Air Pollution Control						3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To impart knowledge on types and sources of air pollution,
CO2	To study the effects of air pollution on Human, animals, and environment
CO3	To minimize the various types of pollutants occurred in indoor as well as outdoor
CO4	To study various air pollution control equipment.
CO5	To study ambient monitoring and dispersion of air pollutants and their modeling.

Course Outcomes: Students will be able to	
CO1	Various types and sources of air pollution and its effects.
CO2	Methods of source and ambient monitoring and dispersion of pollutants and their modeling.
CO3	The principles and design of control of particulate pollutants
CO4	The principles and design of control of gaseous pollutant
CO5	Sources, effects and control of vehicular, indoor air and outdoor air

Course Contents

Module 1	Introduction	Hrs. 8
Definition, Sources and classification of Air Pollutants, Photochemical smog, Effects of air pollution on health, vegetation & materials, air quality, Global effects of air pollution. Automobile Pollution: Vehicular emissions, Motor fuel combustion, Automobile emission control. Odour pollution: Sources of Odour, Measurement of Odour, Odour control method. Indoor Air Pollution: Causes of air pollution, Sources and effects of indoor air pollutants, changes in indoor air quality, Control of indoor air pollutants, air cleaning systems, Cigarette smoke.		
Module 2	**Meteorology**	**Hrs. 8**

The atmosphere, zones of atmosphere, scales of meteorology, meteorological parameters, Heat, Wind, Pressure, Moisture and humidity, Rainfall and precipitation, Temperature lapse rate, Maximum mixing depth (MMD), Plume behavior, Effect of topography on pollutant dispersion, effect of air pollutant on meteorology, Air pollution modeling, Minimum stack height		
Module 3	**Modeling of Dispersion of Air Pollutants**	**Hrs. 6**
Dispersion of Air pollutants. Theories on modeling of Air pollutants. Gaussian model etc. Equations of the estimation of pollutant 22 concentrations. Plume Rise – Equations for estimation. Effective stack height and mixing depths.		
Module 4	**Pollution Control Methods**	**Hrs. 8**
Particulate Pollution Control Methods: Dilution, Source control, Control by using equipments such as Settling chambers, Cyclones, Fabric Filters, Electrostatic precipitators Wet Scrubbers/Wet Collectors, design and principle of these air pollution control units. Gaseous pollution control: Types of gaseous pollution control methods – absorption, adsorption and combustion processes. SOx Control Technology, Desulfurization of flue gas emissions, NOx Control Technology, Automobile pollution, sources of pollution, composition of auto exhausts, Control methods.		
Module 5	**Air pollution Monitoring and Management**	**Hrs. 6**
Environmental guidelines for sitting of Industries, Environment Management plan, stack emission standard, ambient air quality standards, stack emission monitoring, ambient air quality monitoring, ambient air quality survey		

Text Books:	
1	M. N. Rao et al. Air Pollution, Tata Mc-Graw Hill Publication
2	Richard W. Boubel et al., Fundamentals of Air Pollution, Academic Press, New York.
3	C.S. Rao., Environmental Pollution Control Engineering, Wiley Eastern Limited, New Delhi (1991).
4	Peavy and Rowe, Environmental Engineering, Mc-Graw Hill Publication
5	John H. Seinfeld, Air Pollution: Physical and Chemical Fundamental, Mc-Graw Hill book Co. 1988.

Reference Books:	
1	Paul N. Cheremisinoff, Richard A. Young, Air Pollution Control and Design Handbook, Part-I, Marcel Dekker Inc., New York 1977).
2	Paul N. Cheremisinoff (ed.), Encyclopedia of Environmental Control Technology, Vol. 2, Air Pollution Control, Guld Publishing Company. (1989).
3	Davis. Environmental Engineering, Mc-Graw Hill Publication.
4	KVSG Murali Krishna. Air pollution and control, Kaushal and Company, Jagannaickpur, Kakinada-2.
5	Noel de Nevers, Air Pollution control Engineering, Mc-Graw Hill Publication, New York.

SUBJECT CODE	(Program Elective-IV)	CREDITS
MCVENEPET 204C	Geo-environmental Engineering	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To have sufficient knowledge on fundamentals of Geo-environmental Engineering
CO2	To have better understanding on planning and design of slurry ponds -ash ponds and tailing ponds.
CO3	To have better understanding on subsurface contamination
CO4	To have understanding of geotechnical reuse of waste.
CO5	To introduce geosynthetic materials, their types, applications, and use in waste containment.

Course Outcomes: Students will be able to	
CO1	Understand fundamentals of Geo-environmental Engineering
CO2	Develop knowledge on planning and design of slurry ponds - ash ponds and tailing ponds.
CO3	Learn about subsurface contamination.
CO4	Understand reuse of geotechnical waste.
CO5	Learn about Slurry Waste Containment

Course Contents

Module 1	**Introduction to Geo-environmental Engineering**	**Hrs. 8**

Introduction, overview of pollution, control and remediation, Case histories on Geo-environmental Engineering, Soils- Soil as "Phased System", Soil classification, Various Soil Types with important engineering properties, their suitability for intended purpose, Clay Mineralogy.

Module 2	**Contaminant Transport in Soil**	**Hrs. 6**

Soil-water-contaminant interaction; Contaminant Transport, Geochemical Attenuation and attenuation capacity of soils. Zones of contaminant plume. Introduction to Detection of polluted zones and Monitoring designed system.

Module 3	**Introduction to Geo-synthetic Materials**	**Hrs. 6**

Various forms of Geo-synthetic material (GM, GT, GN, GG, GCL, GP, Geo-foam), Their general applications for various engineering functions. Various Geo-synthetic material properties. Use of Geo-synthetic material in waste containment. Concerns about use

Module 4	**Solid Waste Containment**	**Hrs. 8**

Site selection, Typical cross sections of landfills, merits and demerits. Area calculation of landfill site. EPA (MoEF and CPCB) Guidelines. CCL, GCL and composite liners. Compaction quality control for CC liners. Stability analysis of Landfills: Conventional Slope Stability analysis by method of slices, stability number concept. Stability against sliding of geo-membrane over clay (liner stability) and sliding of soil over geo-membrane (Cover stability).

Assessment of anchorage requirement of GM.		
Module 5	**Slurry Waste Containment**	**Hrs. 8**
Slurry Waste Containment: Slurry transported wastes, pond layouts, components of pond, embankment construction, staged raising of embankment, Design aspects, environmental impact and control. Vertical Barriers for Containment: Various types of Cutoff Walls, Requirements of good vertical barriers, Slurry trench walls using Bentonite and Cement-bentonite slurry, material and construction aspects. Geotechnical Reuse of Waste Material Waste reduction, use of waste in geotechnical construction, Waste characteristics for soil replacement, Transport considerations, and engineering properties of waste.		

Text Books:	
1	G L Sivakumar Babu, "Soil Reinforcement and Geosynthetics", Universities Press (India) Pvt. Ltd. Hyderabad, 2006.
2	Reddi L.N. and Inyang, H. I., "Geoenvironmental Engineering, Principles and Applications" Marcel Dekker Inc. New York, 2000.
3	Bagchi, A., "Design of landfills and integrated solid waste management" John Wiley & Sons, Inc., USA, 2004.
4	Rowe R.K., "Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
5	Yong, R. N., "Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation" CRC Press, New York, 2001.

Reference Books:	
1	Sharma H.D. and Reddy K.R., "Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
2	Sharma, H. D. and Reddy, K. R. (2004) Geoenvironmental Engineering: Site Remediation, Waste Containment and Emerging Waste Management Technologies, John Wiley and Sons Inc., Hoboken, New Jersey.
3	Fredlund D.G. and Rahardjo, H.,"Soil Mechanics for Unsaturated Soils" Wiley-Interscience, USA,
4	Hillel D.,"Introduction to Environmental Soil Physics" Academic Press, New York, 2003.
5	Mitchell, J.K.,"Fundamentals of Soil Behavior" Wiley, 2005.

SUBJECT CODE	(Open Elective-I)				CREDITS
MCVENEOET 205A	Research Methodology				3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To prepare students to undertake research, identify and formulate the research problems, state the hypothesis, design a research layout, set a research process and methodology.

CO2	To enable students to investigate the problem, interpret the results, propose theories, suggest possible/alternative solutions, solve and prove the solution adapted–logically and analytically, conclude the research findings.
CO3	To impart knowledge to review the literature and publish research in conference and journals
CO4	To educate students on patents, including application processes, patent rights, and licensing.
CO5	To provide an understanding of research design, including exploratory methods, observation studies, and experiments.

Course Outcomes: Students will be able to	
CO1	Analyze research and its significance in economic, social and legal aspects.
CO2	Evaluate research problem and its design for solution logically and critically
CO3	Produce research solution, publication, Dissertation, IPR and patent.
CO4	Skills in developing questionnaires, sampling techniques, and data preparation for analysis.
CO5	Ability to design and execute research projects using suitable qualitative and quantitative methods.

Course Contents

Module 1	**Research Design**	**Hrs. 6**
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys		
Module 2	**Data Collection And Sources**	**Hrs. 8**
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying		
Module 3	**Data Analysis And Reporting**	**Hrs. 6**
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.		
Module 4	**Intellectual Property Rights**	**Hrs. 8**
Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.		
Module 5	**Patents**	**Hrs. 8**
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.		

Text Books:	
1	Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).

2	Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007
3	David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
4	Research Methodology: Methods and Trends', by Dr. C. R. Kothari--- New Age International Publishers.
5	Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville

Reference Books:	
1	Research Methodology: concepts and cases—Deepak Chawla and Neena Sondhi,Vikas Publishing House Pvt.Ltd. (ISBN 978-81-259-5205-3)
2	Research Methods for Business—Sekaran—Wiley,India
3	Research Methods in Education---Louis Cohen,Manion,Morrison---Routledge(Taylor &Francis Group) / -- Cambridge University Press India Pvt. Ltd.-ISBN-978-0-415-58336-7
4	Research Methodology: A Step by Step Guide for Beginners', by Ranjit Kumar
5	Research in Education---John Best and James Kahn,Prentice Hall of India Pvt.Ltd.

SUBJECT CODE	(Open Elective-I)						CREDITS
MCVENEOET 205B	Nano Technology for Water and Wastewater Treatment						3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	Introduce the fundamentals and techniques of nanotechnology.
CO2	Familiarize students with nanomaterial characterization and responsible use in industry.
CO3	Explore nanotechnology applications in water and wastewater treatment.
CO4	Examine bio nanotechnology and nanoscale biological interactions.
CO5	Understand nonmanufacturing applications in environmental and biotechnological contexts.

Course Outcomes: Students will be able to	
CO1	Describe fundamental principles and techniques in nanotechnology.
CO2	Evaluate responsible usage and policies related to nanomaterials in industry.
CO3	Apply nanotechnology to design effective water purification systems.
CO4	Analyze nanoscale biological applications, including enzyme nonreactors.
CO5	Explain nonmanufacturing techniques for environmental and microbial nanoparticle production.

Course Contents

Module 1	**Introduction**	**Hrs. 8**

Background, what is nanotechnology, types of nanotechnology and nano-machines, top down and bottom up techniques, Molecular nanotechnology, atomic manipulation-nanodots, self-assembly, Dip pen nanolithography, Simple details of characterization tools- SEM, TEM, STM, AFM		
Module 2	**Characterization of Nano materials**	**Hrs. 6**
Nan particles and water, Responsible use of nano materials: an industry point of view, Policy aspects of innovation, Analytical techniques for characterization of nano materials.		
Module 3	**Effective, High-Performance Water and Wastewater Purification Systems**	**Hrs. 6**
Nano and micro engineered membrane technology, Applications of nanotechnology for drinking water, Biocatalysts for reductive treatment of water contaminated with priority pollutants, Video conferencing with Asian Institute of Technology nanotechnology laboratory.		
Module 4	**Bio nanotechnology**	**Hrs. 8**
Virus-based single-enzyme nanoreactors, Measurement of bacterial-particle interactions with atomic force microscopy		
Module 5	**Nonmanufacturing**	**Hrs. 8**
Bioremediation: from environmental processes to production of functional bionanomaterials, Microbial manufacture of silver nano particles for water disinfection, Microbial manufacture of chalcogen nanoparticles and quantum dots.		

Text Books:	
1	Nanotechnology-Basic Science and Emerging Technologies Mick Wilson, Kamali Kannangra Geoff Smith, Michelle Simons and Burkhard Raguse, Overseas Press.
2	Nanotechnology-AGentle Introduction to the Next Big Idea Mark Ratner and Daniel Ratner, Prentice Hall
3	Nanotechnology: RebeccaLJohnson, Lerner Publications.
4	Introduction to Nanotechnogy: Charles P. Poole Jr., Chapman and Hall/CR
5	Mick Wilson, Kamali Kannangara, Geoff smith, "Nanotechnology: Basic Science and Emerging Technologies", Overseas press, 2005.

Reference Books:	
1	Charles P.Poole Jr and. Frank J.Owens, "Introduction to Nanotechnology", Wiley Interscience, 2003.
2	Mark A.Ratner, Daniel Ratner,"Nanotechnology: A gentle introduction to the next Big idea", Pearson Education, 2003.
3	Hari Singh Nalwa, "Nanostructured materials and Nanotechnology", Academic press, 2001.
4	Alexei Nabok, "Organic and Inorganic Nanostructures", Artech House Publishers, 2005.

SUBJECT CODE	(Open Elective-I)	CREDITS

MCVENEOET 205C	Remote Sensing and GIS Application in Environmental Engineering						3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
CO1	To make the students conversant with basic of GIS and its general application in various fields.
CO2	To have adequate knowledge on Type of data and information handled in GIS.
CO3	To have adequate knowledge on various GIS analysis operations with vector data.
CO4	To understand Remote sensing and its basic along with its application in Environmental Engineering.
CO5	To have practical knowledge about handing geo-spatial data.

Course Outcomes: Students will be able to	
CO1	Students will be able to understand basics about GIS and RS
CO2	Students will be able to understand the practical application of GIS & RS in Environmental Engg.
CO3	Students will be able to analysis and visualize their own data sets in GIS domain.
CO4	Students will be able to download and process various data obtained from various RS platform.
CO5	Students will be able to use the knowledge to solve practical real-life problem and help in planning.

Course Contents

Module 1	**Fundamentals of GIS**	**Hrs. 6**
Introduction/Fundamental to GIS (History of GIS, Early developments in GIS, components of GIS, Applications of GIS)		
Module 2	**Spatial Data Modeling & Projection**	**Hrs. 8**
Spatial Data Modelling (Representation of spatial data, Raster & vector data model, TIN & DEM), Geo-referencing and Projection (Coordinate System, Map Projection, Transformation, Geo-referencing),Map and Map Scales (Introduction to Maps, Map Scales, Types of Maps, Map and Globe)		
Module 3	**Database Management in GIS**	**Hrs. 6**
Data Base Management system (Data Storage, Database Structure Models, GIS Data File Management), Spatial data (Primary data, Secondary data, Data pre-processing) Practical S -2		
Module 4	**Data Analysis & Interpolation**	**Hrs. 8**
Data Analysis (Vector operation & analysis, Raster operation & analysis, Network Analysis), Interpolation Technique (Global Methods of Interpolation, Local Methods of Interpolation) Practical S -3		
Module 5	**Cartography, GPS & Remote Sensing**	**Hrs. 8**
Cartographic Principles and Design (Introduction, Map layout, Toposheet, component of Map), GPS, Introduction to Remote sensing and its application		

Text Books:	
1	Burrough P A., (1986), "GIS for Land Resource Assessment", Oxford University Press, U.K.
2	Star J.L., and Estes J.E., (1990). "Geographic Information Systems; An Introduction". Prentice Hall Publications.
3	Laurini R. and Thompson D., (1992), "Fundamentals of Spatial Information Systems", 1 st Edition, Academic Press
4	Mishra H.C., (1997), "GIS Handbook", GIS India, ShanthiNivas, Hyderabad
5	Anji Reddy, (2012), "Textbook of Remote Sensing and GIS", 4th Edition, B.S. Publications, Hyderabad.

Reference Books:	
1	Floyd F. Sabins, (1996) "Remote Sensing - Principles and Interpretations", 3rd Edition, W.H. Freeman & Co.
2	Michael N. Demas. (2000), "Fundamentals of GIS", John Wiley & Sons, Inc.
3	GIS Applications for water, wastewater, and stormwater systems by U.M. Shamsi, CRC Press.
4	Introduction to Geographical Information Systems by Kang-tsung Chang, McGraw-Hill.
5	Geographical Information systems, A Management Perspective by Stan Aromoff, WDL Publications.

SUBJECT CODE	PG Lab-II- Environmental Pollution Monitoring Lab)						CREDITS
MCVENEELP 206							2
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	4	4	25	--	25	50

Course Objectives	
CO1	To study microbiological techniques, including staining, microscopy, and bacterial isolation.
CO2	To develop expertise in analyzing heavy metals in industrial wastewater through atomic absorption spectrophotometry.
CO3	To expose students to industrial processes and wastewater treatment methods across various industries.
CO4	To introduce students to air pollution control devices and soft computing techniques for water and wastewater treatment design.
CO5	To equip students with skills in water quality assessment using MPN and membrane filtration techniques.

Course Outcomes: Students will be able to	
CO1	Demonstrate proficiency in microbiological techniques and assess water samples for microbial
CO2	Analyze metal contaminants in wastewater using atomic absorption spectroscopy.
CO3	Develop comprehensive reports on industrial water usage, wastewater characteristics, and treatment
CO4	Evaluate air pollution control technologies used in large-scale industries.
CO5	Apply software tools for designing water, sewage, and effluent treatment systems..

Course Contents

Lab Practice will be based on completion of assignments / practicals / reports of site visits, confined to the courses in that semester. The term work will consist of --

- **Part A**: Microbiological techniques. 1 Microscopy, staining techniques. 2.Isolation and growth of bacteria. 3.Microbiological quality of water - MPN and membrane filtration technique and E coli test.
- **Part B**: Metal Analysis from Industrial wastewater using Atomic Adsorption Spectrophotometer (1) Arsenic (2) Nickel (3) Chromium
- **Part C**: Visits, Detailed Study, and report submission of any two of the following Industries with respect to Total water consumption, Sources of Wastewater generation its characteristics and Treatment methods----- Dairy, Fertilizer, Distillery, Sugar, Pulp & Paper, Iron & Steel, Metal Plating, Oil Refinery
- **Part D**: Visit to Air Polluting Industries like Thermal Power plant /Cement Manufacturing Industry etc. and Detailed Study with report submission on Air Pollution Control Devices with their design principles.
- **Part E**: Introduction to Soft Computing Techniques Study and application of software in –i) Design of Water Treatment plants ii) Sewage Treatment plant iii) Effluent treatment plant and iv) Sewarages Systems. It is mandatory to have such softwares in the laboratory.
- **Part F**: i) Report on atleast one patent with its details studied on any subject of the semester. ii) Technical review and critique of a research article/paper on any of the subjects studied in the semester from standard referred journal.

SUBJECT CODE	History of Environmental Engineering In India						CREDITS
MCVENEELP 208							3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	--	--	3	20	20	40	100

Course Objectives	
CO1	To explore the historical evolution of environmental engineering practices in India from ancient to modern times.
CO2	To examine traditional water, sanitation, and waste management systems used in historical Indian contexts.
CO3	To analyze the impact of colonialism and post-independence policy shifts on environmental engineering.
CO4	To understand the development of environmental policies, regulations, and the role of technology in shaping contemporary environmental practices.
CO5	To critically assess the successes, challenges, and future directions of environmental engineering in India.

Course Outcomes: Students will be able to

CO1	Explain traditional environmental practices and their engineering significance in ancient India.
CO2	Assess the colonial impact on India's environmental engineering and resource management.
CO3	Analyze post-independence policies and projects shaping India's environmental practices.
CO4	Identify contemporary environmental challenges and engineering solutions in India.
CO5	Evaluate future directions and innovative approaches in India's environmental engineering.

Course Contents

Module 1	**Traditional Environmental Engineering Practices in Ancient India**	**Hrs. 8**
Indigenous water management practices (stepwells, baolis, tanks), sanitation practices in ancient civilizations (Harappa, Mohenjo-Daro, etc.), waste management practices in early Indian societies, traditional ecological knowledge and its role in resource management		
Module 2	**Colonial Influence on Environmental Engineering**	**Hrs. 8**
Impact of British colonial rule on water and sanitation systems, Introduction of Western engineering practices and infrastructure (railways, canals, waterworks), colonial policies on forestry and land management, health and hygiene policies during the colonial period		
Module 3	**Environmental Engineering and Policy in Post-Independence India**	**Hrs. 6**
Development of water and sanitation infrastructure post-1947, key policies and programs (National Water Policy, Rural Sanitation Program, etc.), Establishment of regulatory bodies and environmental legislation, case studies of major projects (e.g., Bhakra Nangal Dam, Ganga Action Plan)		
Module 4	**Contemporary Challenges and Innovations in Environmental Engineering**	**Hrs. 8**
Urbanization, industrialization, and their environmental impact, pollution control measures (air, water, solid waste), sustainable technologies and green engineering solutions, role of government and non-governmental organizations in environmental innovation		
Module 5	**Future Directions for Environmental Engineering in India**	**Hrs. 8**
Emerging trends in environmental policy (sustainable development, climate action), decentralized water and sanitation solutions for rural India, integrating traditional knowledge with modern environmental engineering, prospects for research and development in environmental engineering		

Text Books:	
1	A. K. Biswas, "Water Management in India: Challenges and Strategies", Publisher: Oxford University Press
2	K. M. Hegde, " Ecological Traditions of India", Publisher: Foundation for Revitalization of Local Health Traditions
3	O.P. Dwivedi , " Environmental Policy in India", McGraw-Hill Education
4	N. H. Rao, "Environmental Engineering: History and Development in India", Tata McGraw-Hill
5	Vikas Ahuja, "India's Water Resources: Contemporary Issues on Irrigation", New Age Publishers

Teaching & Evaluation Scheme for M. Tech. in Civil Engineering with Specialization in Environmental Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	ISE	MSE	ESE	Total	
Semester-III										
1	MCVENEMDT 301	MOOC/SWAYAM/ NPTEL PLATFORM COURSES/Self Study.(It is desirable to choose one course from each of PE,OE &AE.)	3	--	--	20	20	60	100	03
2	MCVENEMDT 302		3	--	--	20	20	60	100	03
3	MCVENEHMT 303		3	--	--	20	20	60	100	03
4	MCVENEELP 304	Seminar-I	--	--	4	25	--	25	50	02
5	MCVENEELP 305	Dissertation Stage -I	--	--	20	50	--	50	100	10
		TOTAL	**9**	**--**	**24**	**135**	**60**	**255**	**450**	**21**

SUBJECT CODE				Multidisciplinary Minor Courses			CREDITS
MCVENEMDT 301 MCVENEMDT 302 MCVENEHMT 303							3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Contents

Sr.No.	Multidisciplinary Minor Courses
A	MOOC/SWAYAM/ NPTEL -Project Management and Intellectual Property Rights (Self Study) Student may select this course either from MOOC/SWAYAM/ NPTEL pool or any other approved reputed source. The submission of course completion certificate is mandatory. **MCVENEMDT301/302,MCVENEHMT 303 -** Institute has to take care of registration of subjects with detailed syllabus in first two weeks of beginning of the semester with exam department of DABATU.

SUBJECT CODE	Seminar I						CREDITS
MCVENEELP 304							2
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	4	2	25	--	25	50

Course Contents

Guidelines for Seminar
Seminar I shall be presented on one of the advanced topics chosen in consultation with the supervisor. Students must study latest literature. The concepts must be clearly understood and presented by the student. The student should use all modern methods of presentation. The student expects minimum 03 presentations within period of semester. A hard copy of the report should be submitted before delivering the seminar. A copy of the report in soft form must be submitted to the Supervisor along with other details, if any.

SUBJECT CODE	Dissertation Stage -I						CREDITS
MCVENEELP 305							12
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	24	24	50	--	50	100

Course Contents

Internship

Students can take Industry Internship along with Dissertation Stage –I. Students must maintain regular reporting with Dissertation supervisor regarding status of Dissertation

Students can take Industry Internship along with Dissertation Stage –I. Students must maintain regular reporting with Dissertation supervisor regarding status of Dissertation . Project-I is an integral part of the final project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation that may include mathematical model/block diagram/ PERT chart, and layout and design of the proposed system/work. As a part of the progress report of project-I work; the candidate shall deliver a presentation on progress of the work on the selected dissertation topic. It is desired to publish the paper on the state of the art on the chosen topic in international conference/ journal. The student shall submit the duly certified progress report of project -I standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.

Dissertation Stage I and Synopsis Approval Presentation:

It is a course requirement under the guidance of faculty Supervisor. PG student from second year is required to do innovative and research oriented applied work related to various theory and laboratory courses. Dissertation work may cover analytical formulation, experimentation or survey based project or combination of these. Student are encouraged to undertake an interdisciplinary type project.

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for M. Tech. in Civil Engineering with Specialization in Environmental Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	ISE	MSE	ESE	Total	
Semester-IV										
1	MCVENEELP 401	Dissertation Stage-II	--	--	40	100	--	100	200	20
		TOTAL	--	--	--	**100**	--	**100**	**200**	**20**

SUBJECT CODE	Dissertation Stage-II			CREDITS
MCVENEELP 401				20
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	30	15	100	--	100	200

Course Contents

Dissertation Stage-II

In Dissertation Stage-II , the student shall complete the remaining part of the project, which will consist of the simulation/ analysis/ synthesis/ implementation / fabrication of the proposed project work, work station, conducting experiments and taking results, analysis and validation of results and drawing conclusions.

It is mandatory to publish the paper on the state of the art on the chosen topic in international conference/ journal. The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.