NORTH MAHARASHTRA UNIVERSITY, JALGAON

॥अंतरी पेटवू ज्ञानज्योत॥

'A' Grade
NAAC Re-Accredited
(3rd Cycle)

SYLLABUS

for

Master of Technology (M. Tech.)
Environmental Science & Technology

DEPARTMENT OF ENVIRONMENTAL SCIENCE & TECHNOLOGY,
SCHOOL OF ENVIRONMENTAL AND EARTH SCIENCES
KAVAYITRI BAHINABAI CHAUDHARI
NORTH MAHARASHTRA UNIVERSITY,
JALGAON 425 001 (M.S.) INDIA

(2018 - 2019)

Summary of Distribution of Credits
for
M. Tech. (Environment Science & Technology)
at
School of Environmental and Earth Sciences
[at University Campus under Academic Flexibility *w.e.f.* 2018-19]

Regular

Sr. No	Type of course	Sem I	Sem II	Sem III	Sem IV
01	Core	09	09	05	--
02	Skill based	--	--	--	--
03	School Elective	03	03	--	--
04	Practical	03	03	10	15
Total Credits		**15**	**15**	**15**	**15**

Part-time

Sr. No	Type of course	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI
01	Core	03	06	03	06	05	--
02	Skill based	--	--	--	--	--	--
03	School Elective	03	--	03	--	--	--
04	Practical	--	03	--	03	10	15
Total Credits		**06**	**09**	**06**	**09**	**15**	**15**

Subject Type	Core	Skill based	School Elective	Practical	Total Credits
Credits	**23**	**--**	**06**	**31**	**60**

Total Credits = 88

SCHOOL OF ENVIRONMENTAL AND EARTH SCIENCES
NORTH MAHARASHTRA UNIVERSITY, JALGAON

Syllabus for M. Tech. (Environment Science & Technology)
with effect from 2018 -2019

Course credit scheme (Regular)

Semester	(A) Core Courses			(B) Skill Based / Elective Course			Total Credits (A+B)
	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (T+P)	Total Credits	
I	4	09 + 03	**12**	1	3 + 0	**3**	**15**
II	4	09 + 03	**12**	1	3 + 0	**3**	**15**
III	2	05 + 10	**15**	0	0 + 0	**0**	**15**
IV	1	00 + 15	**15**	0	0 + 0	**0**	**15**
Total Credits	**54**			**06**			**60**

(T, Theory; P, Practical)

Course credit scheme (Part-Time)

Semester	(A) Core Courses			(B) Skill Based / Elective Course			Total Credits (A+B)
	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (T+P)	Total Credits	
I	1	03 + 00	**03**	1	3 + 0	**3**	**06**
II	3	06 + 03	**09**	0	0 + 0	**0**	**09**
III	1	03 + 00	**03**	1	3 + 0	**3**	**06**
IV	3	06 + 03	**09**	0	0 + 0	**0**	**09**
V	2	05 + 10	**15**	0	0 + 0	**0**	**15**
VI	1	00 + 15	**15**	0	0 + 0	**0**	**15**
Total Credits	**54**			**06**			**60**

(T, Theory; P, Practical)

Structure of Curriculum (Regular)

		First Year				Second Year				Total Credit Value
		Semester I		Semester II		Semester III		Semester IV		
		Credit	Course	Credit	Course	Credit	Course	Credit	Course	
(A)	**Prerequisite and Core Courses**									
	Theory	9	3	9	3	5	1	--	--	**23**
	Practical	3	1	3	1	10	1	15	1	**31**
(B)	**Skill Based / Subject Elective Courses**									
1	Theory /Practical	3	2 (Any 1)	3	2 (Any 1)	--	--	--	--	**06**
	Total Credit Value	**15**	**5**	**15**	**5**	**15**	**2**	**15**	**1**	**60**

Structure of Curriculum (Part-Time)

		First Year				Second Year				Second Year				Total Credit Value
		Semester I		Semester II		Semester III		Semester IV		Semester V		Semester VI		
		Credit	Course	Credit	Course	Credit	Course	Credit	Course	Credit	Course	Credit	Course	
(A)	**Prerequisite and Core Courses**													
	Theory	3	1	6	2	3	1	6	2	5	1	--	--	**23**
	Practical	--	--	3	1	--	--	3	1	10	1	15	1	**31**
(B)	**Skill Based / Subject Elective Courses**													
1	Theory /Practical	3	2 (Any 1)	--	--	3	2 (Any 1)	--	--	--	--	--	--	**06**
	Total Credit Value	**6**	**2**	**9**	**3**	**6**	**2**	**9**	**3**	**15**	**2**	**15**	**1**	**60**

Course Structure M. Tech. (Environmental Sciences & Technology)

Semester I

Course Code	Course Type	Course Title	Teaching Scheme / Hrs. / Week	Exam Scheme	Marks		Total	Credit Point
					Internal	External		
*MTE - 101	Skill Based	Water & Wastewater Management	03	03	40	60	100	03
MTE - 102	Core	Environmental System Optimization & Modeling	03	03	40	60	100	03
MTE - 103	Elective (Select any Two)	Modern Tools in Environmental Technology	03	03	40	60	100	03
MTE - 104		Instrumental Techniques Environmental Analysis	03	03	40	60	100	03
MTE - 105		Biotechnological Applications for Environmental Protection	03	03	40	60	100	03
MTE - 106		Principals of Air & Noise Pollution Management	03	03	40	60	100	03
MTE – 107	Core	Practical Course	08	03	40	60	100	03
						Grand Total	**500**	**15**

Note: MTE: - 101, 102, & 107 are compulsory. Select any two papers out of MTE: - 103, 104, 105 &106

Semester II

Course Code	Course Type	Course Title	Teaching Scheme /Hrs. / Week	Exam Scheme	Marks		Total	Credit Point
					Internal	External		
*MTE - 201	Skill Based	Industrial Pollution Control	03	03	40	60	100	03
MTE - 202	Core	Environmental Impact Assessment & Audit	03	03	40	60	100	03
MTE - 203	Elective (Select any Two)	Industrial Safety, Environmental Health and Disaster Management	03	03	40	60	100	03
MTE - 204		Solid & Hazardous Waste Management	03	03	40	60	100	03
MTE - 205		Environmental Geo-technology	03	03	40	60	100	03
MTE - 206		Natural Resource Management	03	03	40	60	100	03
MTE – 207	Core	Practical Course	08	03	40	60	100	03
						Grand Total	**500**	**15**

Note: MTE: - 201, 202, & 207 are compulsory. Select any two papers out of MTE: - 203, 204, 205 &206

Semester III

Course Code	Course Type	Course Title	Teaching Scheme / Hrs. / Week	Exam Scheme		Total	Credit Point
				Internal	External		
MTE - 301	Core	Seminars & Industrial visits	--	100		100	05
MTE - 302	Core	Project	--	80	120	200	10
						Grand Total	**15**

Semester IV

Course Code	Course Type	Course Title	Teaching Scheme / Hrs. / Week	Exam Scheme		Total	Credit Point
				Internal	External		
MTE - 401	Core	Project	--	120	180	300	15
						Grand Total	**15**

*Employability and Skill Development Courses

COURSE STRUCTURE

M. Tech (Environment Science & Technology)

Sr. No.	Subject Code	Course structure
Semester I		
1	**MTE-101**	Water & Wastewater Management
2	***MTE-102**	Environmental System Optimization & Modeling
3	**MTE-103**	Modern Tools in Environmental Technology
4	**MTE-104**	Instrumental Techniques in Environmental Analysais
5	**MTE-105**	Biotechnological Applications for Environmental Protection
6	**MTE-106**	Principales of Air & Noise Pollution Management
7	**MTE-107**	Practical Course
Semester II		
8	***MTE-201**	Industrial Pollution Control
9	**MTE-202**	Environmental Impact Assessment & Audit
10	**MTE-203**	Industrial Safety, Environmental Health and Disaster Management
11	**MTE-204**	Solid & Hazardous Waste Management
12	**MTE-205**	Environmental Geo-technology
13	**MTE-206**	Natural Resource Management
14	**MTE-207**	Practical Course
Semester III		
15	**MTE-301**	Seminars & Industrial visits
16	**MTE-302**	Mid Term Project Presentation / Evaluation
Semester IV		
17	**MTE-401**	Dissertations & Project work

*Employability and Skill Development Courses

M. Tech (Environment Science & Technology)

Program Objectives for M. Tech. Program:

1. To impart students with strong knowledge base through theory courses and sessional that makes them suitable for industries, academics, research and consultancies.
2. To prepare the students for successful career in the industry; regulatory agencies, departments and boards; consulting firms; and academic and R&D institutions of international standard
3. To produce the graduates strong in Environmental Science and Technology fundamentals, and capable in addressing the diverse present and potential environmental problems
4. To produce the environmentalists who are sensitive to and well aware of the environmental concerns, issues and problems, and who can apply their specialized and modern environmental knowledge for the environmentally sound development.
5. To lay firm foundation for environmental managers who can work in multidisciplinary and interdisciplinary teams and who understand the language of both masses and the specialists from different disciplines.

Program Outcomes (PO) for M. Tech. Program:

Upon successful completion of the M. Tech. program, student will be able to:

PO Sr. No.	Program Outcomes	Cognitive level
PO1	Acquiring fundamental knowledge and **understanding** of environmental sciences	2
PO2	To **develop** basic environmental monitoring skills, including design and conduct of experiments and data analysis	3
PO3	Have fundamental knowledge of environmental technologies, and acquiring capabilities for the design, **diagnosis and analysis** of pollution control systems and devices, and of water supply and wastewater engineering.	4
PO4	To abilities and capabilities in the areas of development and implementation of environmental management systems, and environmental analysis, environmental aspects identification and environmental impacts assessment.	3
PO5	Obtain basic **understanding** on the aspects closely related with the environment, such as, energy, climate change, ISO 14001 based management systems and auditing, and project management	2

Program Specific Objectives for M. Tech. Program:

1. To impart students with strong knowledge base through theory courses and sessional that makes them suitable for industries, academics, research and consultancies.
2. Develop students analytical, computational and research skills through assignments, presentations and modelling software.
3. To train the students on developing practical, efficient and cost-effective solutions on environmental problems and challenges on environmental sciences and Technology
4. To inculcate among student's sensitivity towards social and corporate responsibilities.

Program Specific Outcomes (PO) for M. Tech. Program:

Upon successful completion of the M. Tech. program, student will be able to:

PO Sr. No.	Program Outcomes	Cognitive level
PSO1	Develop an ability to independently carry out research /investigation and development work to solve practical problems.	3
PSO2	Develop an ability to write and present a substantial technical report/document.	3
PSO3	Acquire in-depth knowledge about various environmental processes, analyze and design solutions for complex problems related to environmental and community health.	6
PSO4	Evaluate environmental sustainability and sensitize communities through effective communications and assess alternative solutions for or adequate decision making for overall environmental management.	5
PSO5	Acquire professional and intellectual integrity and ethics to produce socially responsible and competent environmental scientists and engineer	6

SEMESTER I

MTE – 101 WATER & WASTEWATER MANAGEMENT

Course Objectives (CObs):

1. Categories terminology and parameters frequently used in wastewater management.
2. Appraise different parameters involved in the design of wastewater treatment plants.
3. Interpret and illustrate the basics of wastewater treatment methods.
4. Design aerobic and anaerobic wastewater treatment plants.
5. Solve the routine problems in operations, control and management of wastewater treatment plants.

Unit I: Water Quality and Parameters:

Water Quality-Physical, chemical and biological parameters of water- Water Quality requirement - Potable water standards -Wastewater Effluent standards -Water quality indices. Water purification systems in natural systems-Physical processes-chemical processes and biological processes-Primary, Secondary and tertiary treatment-Unit operations-unit processes. Mixing, Clarification - Sedimentation; Types; Aeration and gas transfer – Coagulation and flocculation, coagulation processes - stability of colloids - destabilization of colloids-transport of colloidal particles, Clari – flocculation.

Unit II: Consequences of Water Pollution:

Biological uptake of pollutants and their effects on land, vegetation, animals and human health, bio-deterioration, bioaccumulation, bio-magnification and eutrophication, infectious microbial agents in water system and their consequences on human health.

Unit III: Sewage Treatment

Chemical precipitation, Principle of biological treatment-derivation of bacterial growth kinetics used in designing of wastewater treatment plant. Process design and operation of Activated sludge process and its modification. Bulking and rising sludge. Wastewater treatment for small communities – Oxidation ditch, extended aeration system, SBR; Process design and operation of mechanically aerated lagoon and Waste stabilization pond system. Sewage disposal in isolated unsewered areas–septic tank, cesspools and their effluent disposal methods.

Unit IV: Design and Operation

Sewage characteristics, Quantity & Quality, flow rate, treatment flow –sheets. Sewage treatment process, reactor type, hydraulic characteristics, C-diagram. Preliminary treatmentdesign and operation of screening and grit chamber. Sedimentation, design and operation PST; Design and operation of biological nitrification – de-nitrification system; luxurious phosphorus uptake. Aerobic attached growth process –Process design and operation of trickling filter, RBC, Bio- filter

Unit V: Process Selection and System Synthesis:

Waste waters, industrial wastewaters, interaction of system components, mixing waste waters and regional plants, Concept of common effluent treatment plant (CETP)system economics, water treatment systems, experimental studies. **Books and References**

1. Wastewater Engineering: Treatment, disposal, Reuse – Metcalf & Eddy Inc.4th ed. TMGHl, NewDelhi, 2003.
2. Environmental Engineering- Peavy, HS, Donald RR & G. Tchobanoglous, MGH Int. Ed. NewYork, 1985.
3. Wastewater Treatment for Pollution Control – Soli J Arceivala, Tata McGraw Hill, 2nd ed.1998
4. Wastewater Treatment Plants: Planning, Design and Operation- S.R..Qasim, Holt, Rinehart &Winston, NY, 1985
5. Industrial Water Pollution Control –WW Eckenfelder, Jr., McGraw –Hill , 2nd Edition, NY 1989.

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C101.1	Select or construct appropriate treatment schemes to remove certain pollutants present in water or wastewater.	3
C101.2	Design a water or wastewater treatment component.	6
C101.3	Balance chemical reactions and use balanced reactions to determine the distribution of species at equilibrium	3
C101.4	Learn how to determine characteristics ofwastewater, and the best available technology for physical, chemical and microbiological treatment of wastewater.	3

MTE 102 - ENVIRONMENTAL SYSTEM OPTIMIZATION AND MODELING

Course Objectives (CObs):

1. To understand the concept of environmental systems and their modeling; and to learn different techniques used in modeling.
2. The course aims to introduce fundamentals and need for optimization techniques in engineering problems. Various techniques such as Linear Programming, Geometric Programming, Dynamic Programming and Non-Linear Programming are taught to students to solve various environmental engineering problems for optimal solutions.
3. Understand the idea, methodology and basic tools of environmental modeling.
4. Understand the different modeling approaches, their scope and limitations.
5. Understand the fate and transport of pollutants.
6. Become aware of a wide range of applications of modelling in environmental management & decision making.

Unit I: Systems Approach Concept & Analysis

Model Classification, Terminology of Models, Model Building, Fundamental of Modeling, Transport Law, Chemical Equilibrium, Phase Equilibrium Rooth's Law, Relative Velocity and Chemical Kinetics.

Unit II: Process Modeling

Linear equilibrium system, Batch Reactor, pH system, Planning Models, Municipal solid waste management, Integrated Solid waste Management, Reuse and Recovery in paper, Palstic, glass andaluminum waste

Unit III: Water Modeling

Modeling of wastewater management systems. Modeling of pesticide management; Modeling of Modeling of municipal wastewater treatment, Model formulization and their solution, Numerical Techniques of Linear equations, Matrix inversion method, Gasses elimination and gas sidal method.

UNIT IV: Programming Model

Silent feature of optimizations, Linear programming problem, Simplex method, Prinicpales of problem in dual problem, Graphical Method, Principles related to graphical method – Optimum solution and their analysis (Minimization & Maximization) At least one problem of each method along with optimum solution.

Unit V: Air Dispersion & Equations of Continuity

Equations of continuity for rectangular, cylindrical, spherical. Derivation for rectangular coordinate. Numericals based on equation of continuity. Pollutant standard index criteria, toxic air pollutants, Motor vehicle emission, the point source Gaussian Plume models, Transportation Models.

Books and References

1. Handbook of Environmental and Ecological Modeling, Halling-Sorensen B., Nielsen S.N. andJorgensen S.E., Lewis Publishers Inc., 1995.
2. Fundamentals of Atmospheric Modeling, Jacobson Mark Z., Kluer Academic Press, 2002.
3. An Introduction to Water Quality Modeling, James A. (Ed), (2nd Ed.), 1992.
4. Techniques for Environmental System Analysis - R.H.Pantell Wiley, NY, 2001.
5. System Analysis and Design – RJ Aguilar, Prentice Hall, Englewood Cliffs, N.J., 1993.
6. Numerical Methods and Analysis- Dr. S. K. Rathore.
7. Transport Phenomenon – Bird.

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C102.1	Acquired knowledge to make use of the software packages and its application in civil engineering projects	3
C102.2	Understand the role and nature of modelling environmental systems	2
C102.3	Understand the basic principles of model building using both empirical and mechanistic modelling approaches	2
C102.4	To develop clear understanding of the challenges and decisions associated with model implementation and validation of model outputs	6

MTE - 103 MODERN TOOLS IN ENVIRONMENTAL TECHNOLOGY

Course Objectives (CObs):

1. Understanding of the fundamental concepts of Remote Sensing and Geographic Information System.
2. Understanding the wide application of Remote Sensing and GIS in Environmental System
3. Apply principles of Remote sensing and GIS to collect, map and retrieve spatial information.
4. Plan, assess and evaluate natural and manmade systems using geospatial models and methods.
5. PEO3 Use geospatial tools and techniques for hazard mitigation and resource planning.

UNIT I: Fundamentals of Remote Sensing

Introduction, Types, Application and Importance of Remote Sensing; Physics of Remote Sensing;The Electromagnetic spectrum; Spectral Reflectance Curves; Spectral Signatures; Resolution.

UNIT II: Satellite Remote Sensing

Remote Sensing Platforms: Gound, airborne and satellite based platforms; Some important Remote Sensing Satellites. Sensors: Passive and Active Sensors; Major Remote Sensing Sensors;Satellite band designations and principal applications; true Colour/False Colour, AerialPhotography/Aerial Photo Interpretation.

UNIT III: Digital Image Processing and Image Interpretation

Digital Image Processing: Pixels and Digital Number; Digital Image Structure; Format of Remote Sensing Data; Image Processing functions: Image Restoration, Image Enhancement, Image Transformation, Image Classification and Analysis; Image Interpretation strategies.

UNIT IV: Geographic Information Systems (GIS) & GPS

Geographic Information System; Introduction; Preparation of thematic map from remote sensing data; Co-ordinate systems; GIS components; Hardware, software and infrastructures; GIS data types: Data input and Data Processing; DEM/DT, generation. Integration of GIS and Remote Sensing Application of Remote Sensing and GIS Water resources Urban Analysis Watershed Management Resources Information Systems. Global Positioning System an introduction.

UNIT V: Computer Applications

Basic concepts of computer, hardware, operating systems Application software in Environmental sciences: word processing, spreadsheets, graphics and data base, Introduction to web browsing software and search engines with special reference to online environmental monitoring.

Books and References

1. Aerial photographic interpretation, Principles and applications - D. R. Leuder.
2. Photogeology - Miller, J.C.
3. Manual of colour aerial photography -Ed. Smith, J. T. Jr.
4. Manual of photogrammetry - Ed: Morrie M. Thompson.
5. Manual of Remote sensing - Ed: Robert G Reeves.
6. Theory of pattern recognition and modern forecasting - V. Karpin and Wright Pattern.
7. Remote sensing in Geology - Parry S. Siegal & Alan. R. Gillespie
8. Manual of photographic interpretation - Ed: Colwell, R.N.
9. Principles of Remote Sensing - Patel Singh; SP publication
10. Digital Remote Sensing - Pritivish Nag M Kudrat ; Concept publication

11. Principles of GIS for land and resources assessment, Burrough, P.A., 1986, Oxford.
12. Geographical information systems Vol.1 & 2 Edited by: Paul A. Longley, Michael F. Goodchild,David J. Maguire & David W. Rhind.
13. Geographical information systems and digital image processing – Muralikrishna1999. AlliedPublication**.**

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C103.1	To develop applications of environmental remote sensing and GIS which can directly enhance service delivery on land use management, ground water management/prospects, agriculture, forestry, food and water security, disaster management, etc.	2
C103.2	Identify specific data and methodologies for effective mapping and evaluation of natural resources	2
C103.3	Develop and Devise geospatial models and tools to address the social and engineering problems	6
C103.4	Apply geospatial technologies for hazard mitigation and management	3

MTE – 104 INSTRUMENTAL TECHNIQUES IN ENVIRONMENTAL ENGINEERING

Course Objectives (CObs):

1. The aim of the course is to deepen the students' knowledge of and acquire practical experience in instrumental methods of chemical analysis and to acquaint students with practical work on actual complex problems and with the equipment that is essential for determining the state of the environment and in contemporary research of environmental phenomena.
2. The goal of environmental engineering is to ensure that societal development and the use of water, land and air resources are sustainable. This goal is achieved by managing these resources so that environmental pollution and degradation is minimized.
3. To provide information regarding different elements of industrial water pollution and methods of treatment.
4. Also to expose students to the various industrial processes and the origin, characteristics.

Unit I: Treatment of Data in Quantitative Analysis

Accuracy, Precision, Standard deviation, Types of errors, Minimization of errors. Significant figures, Criteria for rejection of data, Principles of instrumentation.

Unit II: Spectrophotometric Methods

Principles, applications, advantages & limitations of the following Spectrophotometric methods: Colorimetry & Spectrophotometry, FTIR, NMR, Atomic absorption spectrophotometry, Flame photometry, Fluorimetry, Nephelometry and Turbidimetry, Inductively coupled plasma spectroscopy & Mass spectroscopy.

Unit III: Electrochemical Methods

Principles, applications, advantages & limitations of following electrochemical methods: Polarography, Pulse polarography, Ion-selective electrode oscilloscopic polarography, cyclic voltametry & anode stripping voltametry.

Unit IV: Chromatography

Principles, applications, advantages & limitations of following chromatographic methods: Adsorption, Partition, Column chromatography, Paper chromatography, thin layer chromatography, Gas chromatography, High Performance Liquid Chromatography (HPLC), Ionchromatography & size exclusion chromatography.

Unit V: Physical and Biological Methods

Analytical methods in Biotechnology & bio-process control, Electrophoresis, X-ray crystallography, Bio-informatics tools, Bio-assay of pharmaceutical products, online & off line measurement systems, micro processor based control systems.

BOOKS & REFERENCES:

1. Instrumental Methods of analysis, Willard H H& Dean LL, John Willey, 1976.
2. Modern Methods of chemical analysis Recsok RL, & Shields LD, John Willey & sons, Inc 1990.
3. Instrumental Methods of chemical analysis, Ewing GW, McGrw Hill Book Company, Inc. 1975.
4. Fundamental of molecules spectroscophy. Banwell CN, McGraw Hill, NY, 1990.
5. Vogels textbook of Quantitative chemical analysis, Third Ed.

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C104.1	Students will be develop skills to use adequate equipment and determine the state of pollution in the environment, they will be able to correctly perform sampling and prepare the samples, as well as to adequately use instrumental methods of chemical analysis and interpret the results.	6
C104.2	Able to assess various treatment methods and preventive aspects of pollution of chemical process industries which release emissions, wastewater, solid residue and effluent, leading to degradation of the environment.	5
C104.3	Examine Indiscriminate and unregulated exploitations of both renewable and nonrenewable resources can be avoided.	3
C104.4	Develop awareness regarding imperative need for proper treatment Systems to control.	6

MTE-105 BIOTECHNOLOGICAL APPLICATIONS FOR ENVIRONMENTAL PROTECTION

Course Objectives (CObs):

1. Knowledge on scope of biotechnology in environmental applications
2. Knowledge of microbiology and biochemistry
3. Ability to perform various molecular biological applications, and knowledge of equipment used in molecular biological techniques
4. Ability to apply molecular biological techniques in pollution management and industrial applications
5. Knowledge of advanced biotechnological applications, and biosafety in analytical procedures

Unit I: Environmental Biotechnology: Basic Concept

Principles and concepts of environmental biotechnology – usefulness to mankind.

Unit II: Biotechnology in Pollution Control

Types of pollution, Methods for measurement of pollution, Methodology of environmental management, air pollution and its control through biotechnology. Water as a scare natural resource,need for water management, measurement of water pollution, waste water collection, waste water treatment – Physical, chemical and biological treatment processes. Solid waste management (composting, wormiculture and methane production)

Unit III: Microbial Technology for Waste Management

Degradation of high concentrated toxic pollutants, non-halogenated, halogenated petroleum hydrocarbons-metals. Mechanisms of detoxification-oxidation reactions, de-halogenation biotransformation of metals. Microbial cell/enzyme technology – adapted microorganisms – biological removal of nutrients microalgal biotechnology and applications in agriculture- role of extra cellular polymers.

Biotechnological remedies for environmental damages – decontamination of ground water systems subsurface environment – reclamation concepts – bioremediation. Production of proteins – biofertilizers. Biodegradation of solid wastes – physical, chemical and microbiological factors of composting – health risk – pathogens – odour management – technologies of commercial importance advances in biogas technology – case study.

Unit IV: Fermentation Biotechnology

Anaerobic digestion, anaerobic filters, Up-flow un-anaerobic sludge blanket reactors, treatment schemes for waste water of daiy, distillery, tannery, sugar, antibiotic industries.

Aerobic process, activated sludge, oxidation ditches, trickling filters, towers, rotating biological contractors, oxidation ponds.

Unit V: Biotechnology and Global Environmental Problems

Ozone depletion UV-B, green house effect and acid rain, their impact and biotechnology approaches for management.

Books and References

1. Wainwright, M, "An Introduction to Environmental Biotechnology ", 1999.
2. Martin, A.M., "Biological Degradation of Wastes ", Elsevier Appl. Science, New York, 1991.
3. Sayler, Gray S. Robert Fox and James W. " Blackburn Environmental Biotechnology for WasteTreatment ", Plenum Press, New York 1991.
4. Bruce E. Rittmann, Eric Seagren, Brian A.Wrenn and Albert J. Valocchi, Chittaranjan Ray,Lutgarde Raskin, Insitu Bioremediation (2nd Ed.) Nayes Publ. U.S.A.

1994.

5. Old, R.W., and. Primrose, S.B., "Principles of Gene Manipulation (3rd Ed.) ", Blackwell Sci.Publ., Cambridge, 1985.

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C105.1	Understand key concepts from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.	2
C105.2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.	5
C105.3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.	5
C105.4	Express critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.	6

MTE – 106 PRINCIPALES OF AIR & NOISE POLLUTION MANAGEMENT

Course Objectives (CObs):

1. This course provides a comprehensive overview of air and noise quality and the science and technology associated with the monitoring and control.
2. Understand the factors that must be satisfied for potable water, land and air for the removal and treatment of pollutants.
3. Provide a strong link between the Pollution Damage, Public Authority Control Systems and Technical Control Systems
4. Know the relationship between social, legislative and biological constraints in a modern developed society

UNIT I: Sources of Air Pollution

Stationary and mobile, fugitive emissions, secondary pollutants; Effects of air pollution in regional and global scale, air pollution episodes; Emission factors inventory and predictive equations.

UNIT II: Atmospheric Meteorology

Wind profiles, turbulent diffusion, topographic effects, separated flows, temperature profiles in atmosphere, stability, inversions, and plume behavior.

UNIT III: Air Quality Monitoring

Objectives, time and space variability in air quality; air sampling design, analysis and interpretation of air pollution data, guidelines of network design in urban and rural areas.Stack monitoring. Air pollution standards and indices. Dispersion of air pollutants and modeling, Basic concepts, inversion layer and mixing height, atmospheric stability classes, theory and applicationof acoustic sounding (SODAR) technique. Boxmodel, The Gaussian dispersion model point, area and line sources. Prediction of effective stack height physics of plume rise, Holland's equation, Briggs equation, etc. modifications of Gaussian dispersion models; indoor air quality models. Airpollution control devices.

UNIT IV: Effects of Air Pollution and Air Monitoring Instruments

Human health, plants, animals and microbes, archeological monuments and aesthetics, Orsat apparatus, Respirable dust sampler and source monitors.

UNIT V: Noise Pollution

Basics of acoustics and specification of sound; sound power, sound intensity and sound pressurelevels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psycho-acoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infra-sound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices.

Books and References

1. Environmental Engineering – Arcadio P. Sincero and Gregoria A. Sincero, Prentice Hall of India,1999.
2. Environmental Pollution Control Engineering- CS Rao, Wiley Eastern Ltd., New Delhi, 1996.
3. Environmental Noise Pollution – PE Cunniff, McGraw Hill, New York, 1987.
4. Handbook of Noise Measurement – APG Peterson & EE Gross PH, Englewood cliffs NewJersey, latest edition.
5. Air Pollution Control Equipment – H. Brauer and Y. B. G. Verma, Berlin Heidelberg, New York,latest edition.

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C106.1	Identify the sources of air and noise pollution	2
C106.2	Develop knowledge to monitor the ambient air quality	6
C106.3	Understand the concepts involved in control technologies	2
C106.4	Use and devise advanced methods for monitoring and modeling spatial and temporal patterns of pollution.	6

MTE-107 PRACTICAL COURSE

Course Objectives (CObs):

1. To impart training for monitoring of basic water and soil quality parameters.
2. To familiarize the student with the general instrumentation used for environmental monitoring.

1. Calibration and Standardization Techniques in the water and waste water quality analysis.
    a. Study of Various components of Effluent Treatment Plant in accordance with effluentcharacteristics and parameters.
    b. Skimming tanks : Oil and Grease,
    c. Equalization and neutralization tanks: pH & Electrical Conductivity etc.
    d. Primary Settling tank: Total Solids and its various forms.
    e. Activated Sludge Processes (Aeration, Trickling filter, RBCs etc. (Dissolved Oxygen,Chemical Oxygen Demand and Biochemical Oxygen Demand)
2. Drinking Water Treatment :
    a. Alkalinity, Hardness Ca & Mg
    b. Chloride, Residual chloride, Chlorine Demand
    c. Sulfate, Nitrate and Phosphate
3. Soil Study :
    a. Soil sampling, description of the soil horizon, determination of soil pH, conductivity andsalinity from soil samples
    b. Organic carbon and Organic Matter from soil samples (Walky- Black Method)
    c. Sodium and Potassium; CEC from soil samples 5. Remote Sensing and GIS Techniques
    a. Study of traditional maps
    b. Visual interpretation of earth's features from aerial photographs and satellite images c. Stereo-photo interpretation
    d. Photogrametric computation
    e. Preparation of thematic maps in GIS
    f. Operation of GPS
    g. Drawing flow charts for the computer programs required in solving environmentalproblems.

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C107.1	On completion of this course, the student will be able to monitor and analyse the basic parameters of soil and water	4
C107.2	Will able to handle the common instruments available in environmental laboratory to evaluate environmental quality	4

SEMESTER II

MTE-201 INDUSTRIAL POLLUTION CONTROL

Course Objectives (CObs):

1. To understand the important issues and their abatement principles of industrial pollution.
2. The course introduces various concepts of water efficiency and waste minimization in industrial sectors.
3. Characterization and classification of different types of wastes are discussed along with existing norms for waste disposal.
4. Treatment methods of specific pollutant arising out of industrial process are explained.

Unit I: Introduction

Industrial scenario – requirement of water for industries – Sources and types of industrial wastewater – Industrial wastewater disposal and environmental impacts – Reasons for treatment of industrial wastewater – Regulatory requirements – Industrial waste survey – Industrial wastewater generation rates, characterization and variables – Population equivalent – Toxicity of industrial effluents and Bioassay tests – Preventing and minimizing wastes at the source – Individual and Common Effluent Treatment Plants.

Unit II: Industrial Water Pollution Control and Treatment

Characteristics of different industrial wastewaters and their effects on environment. Standards related to industrial wastewater. Waste volume reduction, waste strength reduction, neutralization, equalization and proportioning. Industry specific wastewater treatment for chloro- alkali, electroplating, distillery, tannery, pulp and paper, fertilizer, etc. Treatment technology of coal washery and coke oven effluents. Acid mine drainage: occurrence, effects and treatment technologies. Equalization – Neutralization – Oil separation – Flotation – Precipitation – Heavy metal Removal – Refractory organics separation by adsorption – Aerobic and anaerobic biological treatments. Chemical oxidation – Ozonization – Photocatalysis – Wet Air Oxidation – Evaporation
– Ion Exchange.

Unit III: Air Pollution Control System Design

Review of general principles of industrial air pollution control. Design and operation of gravity settling chambers. Design and operation of cyclones. Design and operation of wet dust scrubbers

– column scrubbers, jet scrubbers, vortex scrubbers, rotating disc scrubbers, and venturi scrubbers. Design and operation of fabric filters. Design and operation of electrostatic precipitators design and operation of mist separators- baffled mist separators, pressure separators. Dust control and abatement measures in mines; role of green belts. Control devices for gaseous pollutants with special emphasis on adsorption, absorption, mass transfer, condensation, and combustion.

Unit IV: Noise Control Engineering

Noise pollution and management in Mines, Washeries, Power plants, Fertilizer plants, Cement plants, etc. health effects and control measures. Noise measurement techniques and analysis: Industrial Worksite, Noise prediction and modelling, noise impact assessment: Scultz Fractional Impact method; Value function curves. Noise abatement measures in industries - Sound absorption, Acoustic barrier, Vibration Isolation, Vibration damping, Muffling, Personal protector.

Unit V: Case Studies

Industrial manufacturing process description, wastewater characteristics and waste treatment flow sheet for – Textiles, Tanneries, Pulp and paper, Metal finishing (plating anodizing), Petroleum Refining, Sugar and Distilleries, Dairy, Iron and steel, Fertilizers.

Books and References

1. Eckenfelder, W.W., (1999) “Industrial Water Pollution Control”, Mc-Graw Hill.
2. Arceivala, S.J., (1998) “Wastewater Treatment for Poll. Control”, Tata McGraw Hill.
3. World Bank Group (1998)”Pollution Prevention and Abatement Handbook – Towards
4. Cleaner Production “, World Bank and UNEP, Washington D.C.

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO’s Sr. No.	Course Outcomes	Cognitive level
C201.1	Analyze industrial activity and identify the environmental problems.	4
C201.2	Plan strategies to control and reduce pollution	6
C201.3	Select the most appropriate technique to control and treat industrial pollution	5
C201.4	Apply environmental management systems (EMS) to an industrial activity	3

MTE-202 ENVIRONMENTAL IMPACT ASSESSMENT, POLICIES AND AUDIT

Course Objectives (CObs):

1. To introduce the subject of environmental auditing and management.
2. To provide an awareness of the concepts on which environmental auditing is based.
3. Appreciate the purpose and role of EIA in the decision-making process.
4. Understand strengths & limitations of environmental management.
5. Interpret options for evaluating environmental and social impacts.
6. Know formats of EIA Report (Environmental Impact Statement, or Environmental Statement)

Unit I: Introduction

Environmental Impact Assessment (EIA) – Environmental Impact Statement (EIS) – Environmental Risk Assessment (ERA) – Legal and Regulatory aspects in India – Types and limitations of EIA – Terms of Reference in EIA- Issues in EIA – national – cross sectoral – socialand cultural.

Unit II: Components and Methods of EIA

Components – screening – setting – analysis – prediction of impacts – mitigation. Matrices – Networks – Checklists. Importance assessment techniques – cost benefit analysis – analysis of alternatives – methods for Prediction and assessment of impacts – air – water – soil – noise – biological – cultural – social – economic environments. Standards and guidelines for evaluation.Public Participation in environmental decision making.

Unit III: Policies and Quality Control

Environmental Policies- National and International; International treaties, Carbon managementKyoto Protocol and Clean Development Mechanism (CDM), Carbon Neutrality.Environmental Legislations-Acts, Rules, Regulations and Notifications.Environmental standards,Criteria for standard setting.

Unit IV: Audit, Documentation and Monitoring

Environmental audit, objectives, types, features, planning of audits; Organisation of AuditionProgramme, pre-visit data collection. Audit Protocol; Onsite Audit; Data Sampling-Inspections-Evaluation and presentation; Exit interview; Audit Report- Action Plant- Managementof Audits;Waste Management Contractor Audits. Life Cycle Approach.

Unit V: Case Studies

Case studies of EIA of developmental projects (Express highway, Petroleum Industry, Dam, etc.)

Books and References

1. Canter, L.W., " Environmental Impact Assessment ", McGraw Hill, New York, 1996.
2. Petts, J., " Handbook of Environmental Impact Assessment Vol. I and II ", BlackwellScience,London, 1999.
3. The World Bank Group., " Environmental Assessment Sourcebook Vol. I, II and III ", TheWorld Bank, Washington, 1991.
4. Strategic Environmental Assessment – RikiTherirvel, E.Wilson, S.Thompson, .Heaney, D.Pritchard. Earthscan,London, 1992.
5. Environmental Impact Assessment-Cutting edge for the 21st century – Alan Gilpin, CUP,London, 1994.

6. Environmental Impact Assessment-Theory & Practice – Peter Wathern, UnwinHynman,Syndeny, 1988.
7. A Practical Guide to Environmental Impact Assessment – Paul, A Erickson, Academic Press,1994.

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

5.

CO's Sr. No.	Course Outcomes	Cognitive level
C202.1	Recognize and relate between organizations and the environment	2
C202.2	Explain what environmental auditing is and how it originated	2
C202.3	Describe the benefits of environmental auditing and how it fits with the wider environmental management responsibilities of an organization	2
C202.4	Assess critically the benefits of environmental auditing	5

MTE-203 INDUSTRIAL SAFETY, ENVIRONMENTAL HEALTH AND DISASTER MANAGEMENT

Course Objectives (CObs):

1. An ability to select and apply the knowledge, techniques and modern tools of the discipline to fields broadly-defined as fire protection, health, environment and safety engineering and technology
2. Demonstrate a mastery of Health safety and environment knowledge and safety management skills, to reach higher levels in their profession
3. Effectively communicate on Health safety and environment, facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering environment
4. Demonstrate professional expertise to the industrial and societal needs at national and global level subject to legal requirements

Unit I: Disaster Management

Disasters: Natural- Earthquake, flood, volcanic eruption, cyclones. Manmade- Failure of dams, leakage, explosion, oil-spills and fire of hazardous chemicals. Leakage in atomic reactor plants. Mining disaster. Monitoring of critical parameters. Risk-analysis, HAZOP, Consequence Analysis. Fault Tree analysis and Event Tree analysis. Emergency Management: Indian and foreign legislations. Case studies.

Unit II: Industrial Safety

Organizing for Safety: Definition, need, nature and principles. Directing for Safety: Direction, definition, process, principles and techniques, Leadership: Monitoring for Safety, Health & Environment: Occupational Safety, Health and Environment Management System, Bureau of Indian Standards on Safety and Health: 14489-1998 and 15001- 2000, ILO and EPA Standards.

Unit III: Environmental & Occupational Health

Definition: As per WHO. Common occupational diseases, Occupations involving risk of contracting diseases, Mode of causation of the diseases and its effects, Diagnostic methods used for detecting occupational diseases. Biological monitoring. Evaluation of injuries, Hierarchy of control measures for occupational health risks, Occupational health management services at the work place. Lung function test on Medspirator, Ear testing on Audiometer. Physical health hazards, Chemical health hazards, Industrial dermatosis, Control methods and reduction strategies for air pollutants, noise and radiations. Prevention and control of occupational diseases. Environmental monitoring and occupational exposure limits.

UNIT IV: Personal Protective Equipments

Role of personal protective equipment, Selection criteria for personal protective equipment,Respiratory and non-respiratory type personal protective equipments

UNIT V: Case Study on Safety Aspects in Industries

- Safety in chemical industry
- Safety in textile industry
- Safety in pharmaceutical industry
- Safety in food industry
- Safety in mine industry

Books & References:

1. Industrial Safety and pollution control handbook: National Safety Council and Associatepublishers Pvt. Ltd, Hyderabad (1993).
2. Handbook of Environmental Health and Safety: Herman Koren and Michel Bisesi, JaicoPublishing House, Delhi (1999).
3. Environmental Toxicology and Chemistry: Donald G. Crosby, Oxford University Press, USA(1998).
4. Handbook of Environmental Risk Assessment and Management: Peter Calow, BlackwellScience Ltd., USA (1998).
5. Principals of Environmental Toxicology: Ian C. Shaw and John Chadwick, Taylor and Francis,USA (1998).
6. The Factories Act-1948, Government Printing Press, Civil lines, Delhi (1994).
7. Risk Assessment and Environmental Management: D. Kofi Asvite-Dualy, John Willey & Sons,West Sussex, England (1998).
8. Introduction to Environmental Engineering & Science: Gilbert M. M., Pearson Education,Singapore (2004).

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C203.1	Apply knowledge of Engineering fundamentals for hazard identification, risk assessment and control of occupational hazards.	3
C203.2	Design, Establish, Implement maintain and continually improve an occupation health and management system to improve safety.	6
C203.3	Conduct investigations on unwanted incidents using root cause analysis and generate corrective and preventive action to prevent recurrence and occurrence of such incidents.	4
C203.4	Design man-machine systems using human factors engineering tools so as to achieve better work Environment to improve efficiency and reduce Human error at the workplace.	6

MTE-204 SOLID AND HAZARDOUS WASTE MANAGEMENT

Course Objectives (CObs):

1. Understanding of problems of municipal waste, biomedical waste, hazardous waste, ewaste, industrial waste etc.
2. Knowledge of legal, institutional and financial aspects of management of solid wastes.
3. Become aware of Environment and health impacts solid waste mismanagement.
4. Understand engineering, financial and technical options for waste management.

Unit I: Nature of Solid Wastes

Definition of solid waste, Industrial mining, Agricultural and domestic (urban) waste, Waste generation in Technological societies, Major legislations, Monitoring responsibilities, Sources & types of solid wastes, Sampling & characterization, Composition of MSW, Storage, Handling & future changes in waste composition

Unit II: Collection & Transport of Solid Waste

Collection of solid wastes, Types of solid wastes collection systems, Analysis of collection systems, Alternative Techniques for collection systems, Collection & Transformation of solid wastes, Unit operations used in separating and processing material recovery facility, Need fortransfer operations, Transport means and methods, Transfer stations types & design.

Unit III: Solid Waste Disposal

Sanitary landfill- planning, Site selection, Design and operation, Aerobic landfill stabilization, Biological oxidation, Composting, Vermicomposting, Pyrolysis, Incineration & Energy Recovery, Bioremedial Waste categorization, Land reclamation – pre & post project land use planning, Physical, Chemical & Biological reclamations.

Unit IV: Hazardous Waste Management

Definition & identification of Hazardous Wastes, Sources & Characteristics of hazardous wastes, Hazardous waste in municipal waste, Hazardous waste regulations & legislations, Minimization of Hazardous wastes, Handling & storage of Hazardous wastes, Landmark episodes.

Unit V: Hazardous Waste Treatment

Hazardous Waste Treatment technologies, Physical, chemical & thermal methods of stabilizations, Solidification, Chemical Fixation & encapsulation, Incineration of Hazardous waste landfills, Reclamation of Hazardous waste landfill sites.

Books & References

1. Solid wastes : Engineering Principles & Management Issues, Tchobanglous G, Thesien GH,Eliassen R, Mc Graw Hill Int. ED, Singapore, 1977
2. Solid waste management, Montell CL, John Willey, NY, 1975
3. Environmental engineering, Peavy HS, Rowe D R
4. Technobanglus G, Thesien GH, Mc Graw Hill Int. ED, Singapore, 1985
5. Hazardous waste management, Lagrega MD, Buckingham PL, Evans JV, McGraw Hill Int. Ed.NY, 2001
6. Biremediation Principles, Eweie JB, Ergas SJ, Chang DYP & Schroder ED, McGraw Hill Int.Ed. Singapore, 1988

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C204.1	Learn and describe basic concepts of solid waste management, beginning from source generation to waste disposal in a system of municipality organizational structure.	1
C204.2	Develop understanding on various technological applications for processing of waste and their disposals in various ways.	3
C204.3	Acquire knowledge on waste to energy productions in the perspectives of sustainable development.	3
C204.4	Apply basic concepts in hazardous waste management and integrated waste management for urban areas.	3

MTE – 205 ENVIRONMENTAL GEO-TECHNOLOGY

Course Objectives (CObs):

1. Explain the effects of pollutants in soil properties.
2. Awareness about the adverse effects of soil and ground water contaminants
3. Analyze and apply the various techniques for remediation of the contaminants.

Unit I: Introduction

Introduction to Environmental Geotechniques-Environmental cycles and their interaction-Soil water environment interaction relating to geotechnical problems-Effect of pollution on soil water behavior-Sources, production and classification of wastes-Environmental regulations in IndiaCase studies of foundation failures by ground contamination.

Unit II: Site Selection and Method of Disposals

Criteria for selection of sites for waste disposal facilities-parameters controlling the selection of wastes disposal sites-current practices for waste disposal, subsurface disposal techniques-Passive contaminant systems-leachate contamination-applications of geomembrane and other techniques in solid and liquid waste disposal-rigid or flexible membrane liners.

Unit III: Hydrology of Contaminants

Transport phenomena in saturated and partially saturated porous media-contaminant migration and contaminant hydrology-Hydrological design for ground water pollution control-Ground water pollution downstream for landfills Bearing capacity of compacted fills-foundation for waste fill ground-pollution of aquifers by mining and liquid wastes-protection of aquifers

Unit IV: Hazardous Waste Disposal

Hazardous waste control and storage system-Stabilization /Solidification of wastes-Processes and Functions- Monitoring and performance of contaminant facilities-Environmentally safe disposal ofsolid and liquid waste

Unit V: Remedial Measures

Ground modification techniques in waste fill, Remedial measures for contaminated groundsRemediation technology-Bio-remediation

Books and References

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

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
MTE-205.1	Analyze the soil contamination concentration and type	4
MTE-205.3	Monitor and analyses quality of ground water	4
MTE-205.3	Formulate and express the steps to remediation of soil and groundwater	6
MTE-205.4	Design the landfill site	6

MTE – 206 NATURAL RESOURCE MANAGEMENT

Course Objectives (CObs):

1. To understand general principles of natural resource management
2. To apply soil and water conservation principles and practices on natural resource management
3. To assess the challenges between agricultural productivity and environmental protection.

Unit I: Mineral Resources Evaluation and its Role In National Economy

Methods of evaluation of minerals, rocks, water, soil and fossil fuels. Collection of data, sampling technique and instrumentation, preservation of samples, preparation of thematic and resource maps for rocks, ores and minerals. Quality and feasibility assessment of rocks and minerals for building, decorative, ornamental, and jewellery purposes. Evaluation of medicinal values of minerals. Principles of mineral economics, significance of mineral resources in national economy, Production, demand, supply and substitution of natural resources in global context. Commercial grade Classification of ore reserves. Ore reserve estimation. Economic evaluation of ore deposit. Preparation of technical report.

Unit II : Marine Resources Management

Introduction to marine resources, Factors controlling abiotic resources and their distribution - polymetallic manganese nodules, phosphorites, hydrocarbons, beach placers evaporates, rare metals, corals, pearls and shells. Prospecting and mining of the ocean floor, Management of marine resources, demand, supply and production of marine resources. Policies and acts relating to ocean and land.

Unit III : Land Resource Management

Land as a natural resource, biotic and abiotic and their importance in sustainable developments. Classification of lands - techniques of terrain evaluation. Land use and land cover classification, Study of soils, their uses, components and profiles. Physical chemical and engineering properties of soils and classification of soils. Soil erosion and preventive measures.

Unit IV: Water Resource Management

Importance of water management, Concept of planning and design of percolation tanks, dry land farming and water management, watershed management and watershed programmes. Methods of rainwater harvesting and techniques, necessity of planned water supplies. Planning and execution of modern water supply schemes, India's water budget, demand and supply, state and central policies, acts and taxation system, water dispute and case studies.

Unit V: Forest and Agriculture Studies

Crop type classification, area estimates, and spectral response of different crops. Crops diseases and Assessment, Crop and Water management and monitoring. Advances in Crop monitoring by RS, SoilSurvey and mapping, soil conservation and watershed management Landuse/Landcover mapping andplanning, Geomorphology in soil survey and mapping soil erosion, case studies.

BOOKS & REFERENCES

1. Introduction to oceanography. H.V. Thurman
2. Hand book of subsurface geology - C.A.Moore
3. Principles of Geomorphology - Thornburry
4. Petroleum stratigraphy - R.L.Breuner
5. World oil energy economics - H.A,.Kerklelin 6. Geology of petroleum - A.I.Levorsen.
7. Landform - Shall (1991).
8. Mining methods - R.N.P. Arogyaswamy

9. Introduction to India's economic minerals - Sharma, N.L. & Ram . K.S.
10. Non Fuel mineral deposits of India 1999: Mukerjee., Allied Publ.
11. Ground water hydrology - DK Todd
12. Hand Book of applied Hydrology - Ventechow
13. Hydrology - Davis and Dewiest

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C206.1	Analyze critically and reflect on natural resource management issues and strategies in Australian and international contexts	4
C206.2	Integrate, interpret and transmit information and construct logical, consistent and synthesized arguments about natural resource management issues and their wider environmental context	6
C206.3	Collect, analyses, interpret, synthesize and present natural resource data and theory at a range of scales, and apply knowledge and skills in management and policy contexts	4
C206.4	Communicate the principles of managing natural resources with specialist and non-specialist audiences including practitioners and stakeholders such as land holders, extension officers, consultants and policy makers	6

MTE - 207 PRACTICAL COURSE

Course Objectives (CObs):

1. To impart training on collection of air samples and monitoring of air pollutants.
2. To impart training on collection and analysis of physicochemical parameters of water samples.
3. To impart training on estimation of microbiological parameters of water and wastewater samples.

Air pollution analysis

1. Demonstration of air pollution monitoring instruments; Calibration of HVS by orifice method;
2. Study, Estimation and report preparation of suspended particulate matter (SPM) and PM_{10}
3. Estimation of Oxides of sulfur and nitrogen from the ambient air. 4. Study of wind-rose diagram and air pollution metrology

Water & Waste water analysis

5. Determination of chlorine demand, break-point chlorination and free residual chlorine
6. Estimation of Na and K in sewage sample, wastewater and natural water
7. Determination of Nitrate-nitrogen of nitrate nitrogen from the given wastewater samples.
8. Determination of iron from raw sewage, wastewater, natural surface water and compare the results
9. MLSS and MLVSS. Sludge Volume Index (SVI) and development of sludge settling characteristics curve and design of PST based on settling curve.
10. Determination of the Biochemical Oxygen Demand (BOD) for a given sample of wastewater
11. Determination of the Chemical Oxygen Demand (COD) for a given sample of wastewater
12. Determination of the Optimum Alum Dose for a given sample of water through Jar Test.

Bacteriological analysis of water and soil

13. Estimation of fecal coliform (total coliform) from the swage and drinking water samples.
14. Microbiology of Air: by exposure plate method.
15. Microbiology of soil- Heterotopic bacterial counts by colony counter

Soil pollution analysis

16. Field identification of different types of soil as per Indian standards and determination of pH, and moisture content of soil by oven drying method.
17. Study and determination of compaction characteristics of soil.
18. Determination of grain size by sieve analysis method and bulk density of the given soil sample.

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C207.1	On completion of this course, the student will be able to undertake air sample collection its analysis and comparing it with permissible standards and develop analysis report writing skill.	4
C207.2	On completion of this course, the student will be able to collect water and wastewater samples and analyse them for physicochemical and microbiological parameters and comparing it with permissible standards and develop analysis report writing skill.	3

SEMESTER III

MTE 301: SEMINARS AND INDUSTRIAL VISITS

Course Objectives (CObs):

1. To provide students an insight regarding internal working of industries.
2. To provide an exposure to students about practical working environment

- Seminars on recent topics in environment management.
- Industrial visits to study the process and sources of waste generation and waste management.

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C301.1	Theoretical knowledge but it is not enough for making a good professional career, so with aim to go beyond academics, industrial visit provides student a practical perspective. This will get good opportunity to develop full awareness about industrial practices	3

MTE 302: MID TERM PROJECT PRESENTATION / EVALUATION

Course Objectives (CObs):

1. To develop the data presentation skill in students.
2. Students will be provided with guidance and support by teaching staff as a dissertation supervisor.

- The project pertaining to pollution control / safety audit / EIA / environmental audit / resource management can be undertaken by the student.

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C302.1	Data presentation skill will develop in the students.	3

SEMESTER IV

MTE – 401 DISSERTATIONS & PROJECT WORK

Course Objectives (CObs):

1. To prepare students for carrying out independent research on a topic of their choice within the field of environmental science and presenting an account of the research in the form of a dissertation.
2. To demonstrate skills and knowledge acquired throughout the taught component of the M.Tech. programme.
3. Projects can take several forms, including a quantitative analysis of environmental data.

- On the completion of project work each student has to submit for examination, a dissertation embodying the results of the research work carried out by him / her. The viva – voce examination will be conducted by the Board of Examiners to be constituted by N.M.U.

Course Outcomes (COts):

Upon successful completion of the course, student will be able to:

CO's Sr. No.	Course Outcomes	Cognitive level
C401.1	Identify key research questions within the field of environmental science on which they will carry out independent research.	2
C401.2	Manage their time effectively while working on their independent research. Demonstrate and understanding appropriate referencing and develop skills in other aspects of dissertation writing.	2
C401.3	To learn or describe the process of carrying out independent research in written format and report your results and conclusions with reference to existing literature and research findings	2

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